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AN EXPLORATION OF LEADERSHIP CHALLENGES IN GOVERNMENT HOSPITALS IN INDIA DURING HEALTH CRISES

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ABSTRACT

INTRODUCTION

Leadership in Indian government hospitals faces serious challenges during health crises like the COVID-19 pandemic, including bureaucratic delays, resource constraints, and ethical dilemmas in resource usage. These issues are further worsened by federal-state tension, inadequate adaptive competency, and systemic inequities, usually resulting in suboptimal crisis response and burnout. This paper includes a systematic literature review (SLR) for exploring these challenges and dynamics to inform practice and policy. By critically reviewing existing literature, the study focuses on bridging the gap in understanding crisis-specific stressors and general healthcare management problems, highlighting the need for a transformative approach in resource-deficient settings.

METHOD

The SLR method follows PRISMA guidelines, searching databases such as Scopus, PubMed, and Google Scholar. 17 articles were finally selected to be included in the study following the inclusion and exclusion criteria specified. Major themes were identified from the extensive review of the selected articles.

RESULTS

Three interconnected themes emerged: systemic operational challenges covering sub-themes of resource scarcity and governance delays; leadership styles and competencies, including adaptive deficits and mental health gaps; and policy reforms, which covered decentralisation and training as sub-themes. Sub-themes revealed crisis-specific aggravated challenges, such as rural inequities and burnout, with regional successes like Kerala's (Indian State) adaptive strategies contrasting national hierarchical failures.

CONCLUSION

The review reveals the importance and need for an evolutionary leadership shift to develop resilience in Indian hospitals. Recommendations include adaptive training, decentralisation, mental health support, global partnerships, and post-crisis evaluations.

KEYWORDS

Leadership challenges, government hospitals, health crises, adaptive leadership, resource scarcity, and policy reforms.

INTRODUCTION

Leadership in government healthcare organisations in India is the foundation of public health resilience. Specifically, during health crises like the COVID-19 pandemic, leaders have to adapt responses amid high patient loads, bureaucratic challenges, and resource constraints. [1] Healthcare organisations cater to the needs of a diverse population, often in urban or under-resourced settings, making efficient leadership mandatory for mitigating the impacts of crises like the COVID-19 pandemic. Challenges, including staff burnout, ethical decision-making in limited resource conditions, and adapting to rapidly changing policies, might result in systemic failures if not addressed in a timely manner. [2, 3] The pandemic revealed that frontline leaders in Indian hospitals faced challenges attributed to mental health strain and supply shortages, compounding the pre-existing struggles in the decentralised healthcare system. [4] This paper uses a systematic literature review (SLR) for qualitative exploration of these dynamics, drawing evidence from 17 peer-reviewed articles published between 2019 to 2025. The study aims to gather qualitative insights by focusing on themes like the adaptive approach and policy gaps in the Indian settings. Through this, the paper further focuses on presenting informed strategies for improving leadership effectiveness.

The SLR responds to three primary research questions:
RQ1: What are the primary challenges faced by leaders in Indian government hospitals, particularly during a health crisis?
RQ2: How do leadership competency and style influence crisis response effectiveness in such situations?
RQ3: What structural reforms and policies are recommended to enhance leadership resilience for future health crises?

These RQs facilitate a thematic synthesis, contributing to a deeper understanding of leadership in resource-constrained environments.

LITERATURE REVIEW

The Systematic Literature Review (SLR) drew qualitative evidence (conceptual knowledge, existing issues, theoretical aspects, etc.) from 17 studies, the findings of which reveal consistent patterns of adaptive deficiency, operational disruption, and reform imperative, linked to the unique federal state health dynamics of India. [6]

SYSTEMIC BARRIERS

Key findings highlight systemic barriers compounded by crises. For instance, healthcare providers in India reported resource shortages and serious mental health impacts during the pandemic, with leaders facing ethical dilemmas in staff management and triage. [2] Exploratory studies in Eastern India revealed managerial ineffectiveness because of occupational stress and inconsistent guidelines, resulting in a decline in service quality. [15] Frontline managers faced hurdles in policy implementation, like innovative but unsustainable workloads and human resource gaps, specifically in rural areas. [7] The vulnerability in the healthcare system was evident during the second wave of COVID-19; governance weaknesses delayed responses, and federal-state tensions amplified fragility. [8] A systematic review of the distribution of services revealed leadership failure in the supply chain, largely affecting the vulnerable portion of government hospitals. [10]

LEADERSHIP COMPETENCY AND STYLE

On leadership styles, the adaptive approach was reported to be crucial, yet it was underdeveloped. A conceptual framework on adaptive leadership in crisis revealed the need for evolutionary transformation, including the promotion of collaboration and distress regulation during uncertainty. [17] A qualitative descriptive study focused on the Kerala region revealed successful strategies like community engagement and swift adaptation in the initial phase of the pandemic, suggesting a flexible leadership style. [11] Theories on healthcare leadership revealed challenges in pragmatic decision-making and emotional labour, suggesting significant competency gaps. [16] Global reviews showed a buffering effect of sense of coherence for the mitigation of mental health stress on leaders [14], though it is underutilised in the Indian setting. Evidence from Indonesia shows the role of the transformational leadership style in improving hospital performance, offering a parallel for the Indian setting, where hierarchical models usually weaken. [3]

POLICY AND STRUCTURAL REFORMS

Post-COVID-19 pandemic analysis promoted adaptive governance beyond just coverage, focusing on multidimensional reforms for building resilience. [12] Evaluation of public health policy identified failure in India's counter-response, forecasting needs for training and decentralised incentives. [5] During the pandemic, hospital response strategies, drawing on qualitative evidence, recommended preparedness simulation and intersectoral coordination to overcome challenges like communication failure. [9] Insights from Bangladesh showed similar issues to the Indian context, highlighting policy gaps and professional burnout. [13], presenting cross-regional learning. Resilient hospital building learnings from the Eastern Mediterranean Region, focused on context-specific adaptation [6], are transferable to resource-limited Indian settings. Innovative strategies were linked to evolutionary transformation during COVID-19, stressing the shift from a reactive to a proactive leadership approach. [1] Table 1 summarises the 17 sources, including authors, year, focus, methods, main findings, geographic focus, and a structured quality assessment based on CASP (Critical Appraisal Skills Programme) (High to Low).

TABLE 1: SUMMARY OF RESEARCH PUPLICATION USED IN STUDY

Authors and Year	Study Focus	Methodology	Key Findings	Geographic Focus	Quality/Rigor (Indicative) [CASP]
Nimavat N et al., 2022 [10]	Pandemic effects on healthcare service distribution	Systematic review with qualitative synthesis	Leadership failures in supply chains are affecting equitable access	India	High
Schäfer SK et al., 2020 [14]	COVID-19 impact on public mental health	Qualitative buffering effect analysis	Sense of coherence buffers mental health strains in crises	Germany	High
Singh PK et al., 2024 [16]	Navigating healthcare leadership theories	Thematic qualitative study	Theories, challenges, and insights for future leadership practices	Global (general, with Indian relevance)	High
Sott MK et al., 2025 [17]	Role of adaptive leadership in crises	Systematic review and conceptual framework	Framework for adaptive competencies in times of crisis	Global	High
Fahlevi M et al., 2022 [22]	Leadership style and hospital performance	Empirical qualitative evidence	Transformational leadership enhances crisis outcomes and performance	Indonesia	Moderate-High
Gauttam P et al., 2021 [5]	Public health policy and COVID-19 response in India	Empirical policy analysis	Critiques policy failures and recommends reforms for better crisis combating.	India	Moderate-High
Khalil M et al., 2022 [6]	Building resilient hospitals during COVID-19	Lessons from qualitative analysis	Context-specific strategies for resilience in	Eastern Mediterranean Region	Moderate-High

			resource-limited settings		
Kundapur R et al., 2023 [7]	Frontline managers' challenges in COVID-19 policy implementation	Qualitative analysis	Human resource gaps and innovative responses in multi-state settings	India	Moderate-High
Razu SR et al., 2021 [13]	Challenges for healthcare professionals in COVID-19	Qualitative inquiry	Burnout, policy gaps, and professional strains during the pandemic	Bangladesh	Moderate-High
Mohammadinia L et al., 2023 [9]	Hospital response challenges and strategies in COVID-19	Qualitative study with interviews	Coordination gaps and preparedness needs for effective crisis management	Iran	Moderate-High
Prajitha KC et al., 2021 [11]	Strategies and challenges in Kerala's COVID-19 response	Qualitative descriptive study	Effective adaptations in the initial phase, with community engagement key	India (Kerala)	Moderate-High
Rao NV et al., 2021 [12]	Adaptive governance for post-COVID reforms	Qualitative reform analysis	Multidimensional resilience beyond coverage, emphasising shared accountability	India	Moderate-High
Crain MA et al., 2021 [1]	Healthcare leadership preparation and transformation during COVID-19	Qualitative narrative analysis	Emphasises innovative preparation leading to evolutionary changes in leadership roles for crisis resilience	Global (general)	Moderate
Filip R et al., 2022 [4]	Global public health challenges during COVID-19	Qualitative review of measures and problems	Systemic strains, policy gaps, and the need for buffering strategies in pandemics.	Global	Moderate
Sengupta M et al., 2021 [15]	Challenges for providers in COVID-19 times	Exploratory qualitative study	Managerial stress and inefficiencies	India (Eastern)	Moderate

			from guidelines and shortages		
Malik MA, 2022 [8]	Health system fragility in pandemics	Qualitative data analysis	Governance weaknesses and lessons from India's second COVID-19 wave	India	Moderate
Debbarma S, 2023 [2]	Challenges for healthcare professionals in India during COVID-19	Exploratory (Editorial)	Resource shortages and mental health strains as major barriers in Indian hospitals	India	Low

CASP Legend (indicative):
•High = systematic/structured analysis or strong theoretical rigor
•Moderate-High = solid analytic work with some scope limits
•Moderate = narrative/descriptive with peer review but limited structure
•Low = editorial/opinion, no primary data used

GAPS IDENTIFIED IN THE LITERATURE

The SLR revealed notable gaps in research on leadership challenges in Indian government hospitals during a health crisis, particularly COVID-19. Various sources focused on systemic issues like bureaucratic delay and resource scarcity, but there is limited comparative study across different regions of the country, like district-tertiary or rural-urban divides, with some isolated examples like Kerala. Accountability mechanisms and clinical managerial conflicts are some of the underexplored areas, though briefly mentioned in the literature, but not analysed extensively. Mental health support strategies for leaders are discussed globally, but their implementation in an Indian-specific context is sparse, usually overlooking the long-term burnout impact on vulnerable populations. Furthermore, the adaptive leadership framework is conceptualised, but studies lack long-term tracking of post-crisis reforms, like the evolution of federal-state tension or training efficacy. Global comparisons are limited, with missed opportunities of contrasting India's challenges with successful strategies from regions like Indonesia and the Eastern Mediterranean. The gaps present the need for rigorous and mixed-method research, including quality assessment and a global perspective, to improve leadership resilience in future uncertainties.

METHODOLOGY

This SLR methodology complies with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. [18] As an SLR approach, narrative themes are synthesised from peer-reviewed sources.

CASP, a well-established tool used to systematically assess the quality, trustworthiness, and relevance of research evidence. A structured critical appraisal using CASP tools is performed on the study using an appropriate CASP checklist per study type (qualitative/systematic review/cohort-adapted for analytic quantitative paper) based on the information provided in the selected articles. CASP criteria are condensed into five domains: 1) aims & method fit, 2) design & recruitment, 3) data collection & ethics, 4) analysis rigor & reflexivity, and 5) findings clarity & value and summarised into the CASP summary table (see Appendix 1).

INCLUSION AND EXCLUSION CRITERIA

The inclusion criteria followed for the selection of articles are:

- Peer-reviewed articles from 2019 to 2025
- Articles focused on leadership in an Indian government hospital (or comparable) during COVID-19
- English, open-access articles

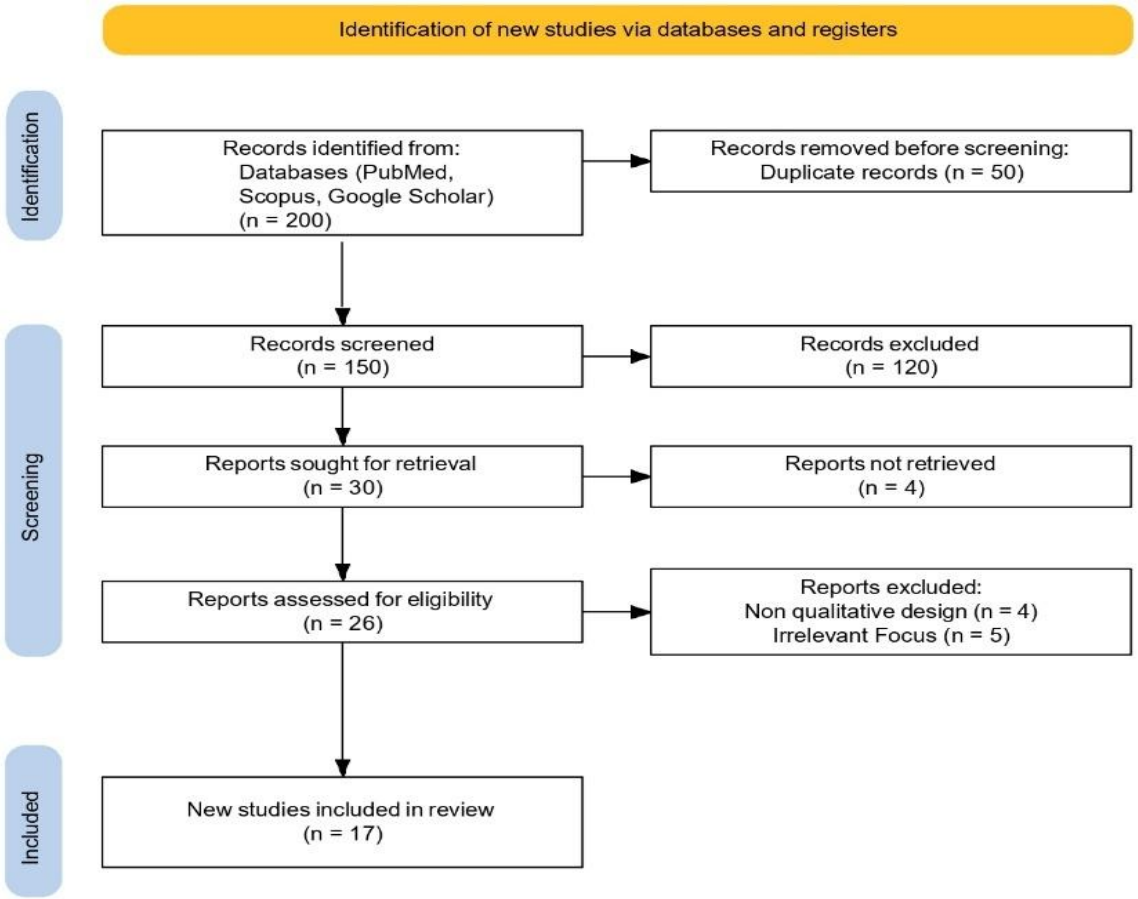
The exclusion criteria were based on:

- Reports or non-peer-reviewed articles
- Non-crisis context
- Irrelevant research focus, for example, studies conducted in private hospitals

SEARCH STRATEGY

An initial search was conducted on three major databases, PubMed, Scopus, and Google Scholar, using the Boolean strings "leadership challenges" AND "government hospitals" AND India. AND COVID-19; "adaptive leadership" AND "public health"; "adaptive leadership" AND pandemic and other combinations for the 2019 to 2025 period. The initial result showed 200 records, and PRISMA was followed on this, as shown in Figure 1. On screening, 50 duplicates were removed, and on title/abstract screening, 120 were excluded. The remaining 30 articles were searched for full text, of which 4 were not accessible; lastly, 17 articles were included in the SLR.

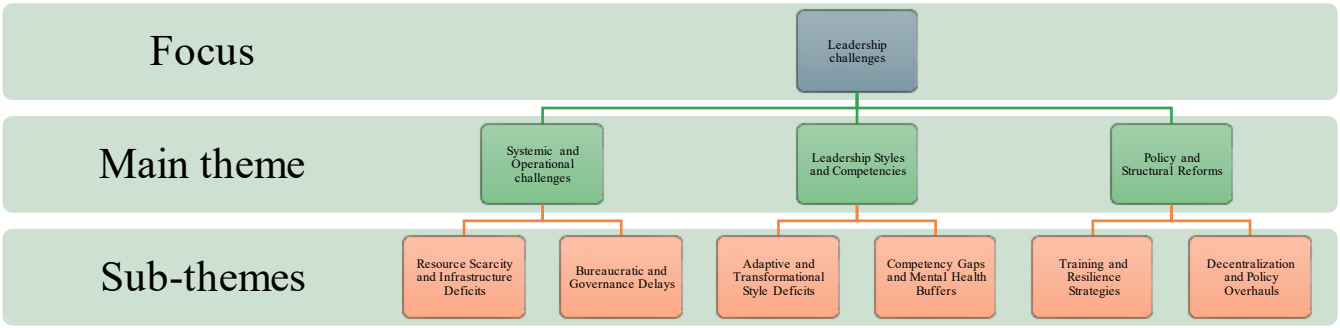
FIGURE 1: PRISMA FLOWCHART



FINDINGS

The review revealed three interconnected themes that capture the complexities of leadership challenges in Indian government hospitals during a health crisis, specifically the COVID-19 pandemic, as shown in Figure 2. The themes show the dynamic relationship between operational barriers, leadership, and reform needs, suggesting how systemic pressures cascade into demand for long-term structural changes and enhanced competencies. The interplay maps to research questions; systemic issues under RQ1 create the need for adaptive competencies in RQ2, eventually pointing toward policy reforms in RQ3.

FIGURE 2: IDENTIFIED THEMES IN SLR



THEME 1: SYSTEMIC AND OPERATIONAL CHALLENGES (ADDRESSING RQ1)

This dominant theme focuses on the foundational hurdles that compound leadership difficulties in the public health system in India during crises, differentiating crisis-specific stressors from usual operational challenges. It explicitly links the issues to pandemic-induced pressures like supply disruptions and overwhelming patient load, rather than treating them as perennial issues in complicated health institutions. This theme demonstrates the way operational barriers affect leadership efficacy, necessitating a focus on adaptive approaches. The sub-themes under this highlight how resource constraints and governance inefficiency create a vicious cycle of ethical strain and inefficiency.

Sub-theme 1.1: Resource Scarcity and Infrastructure Deficits

The subtheme of resource scarcity and infrastructure deficit emerges dominantly; leaders in government hospitals struggled with shortages of medical staff, basic facilities, and essential supplies, usually resulting in profound ethical dilemmas in care allocation and patient triage. [2,15] During the pandemic, healthcare professionals reported disruption in service distribution; rural areas suffered disproportionately because of logistical failures and inadequate infrastructure. [10] This constraint strained regular operations and heightened mental health impacts on staff and leaders, fostering reduced morale and burnout in a high-pressure workplace. [14] Studies further revealed that these constraints, although present in non-crisis times, were magnified by demands during the pandemic, like sudden spikes for PPE and ventilators, forcing leaders to improvise without sufficient backup. [4, 13] Global overviews frame resource issues as manageable by leveraging innovation, but in the Indian context, the inequity is highlighted, and vulnerable populations in remote locations bear the consequences, showing a gap in equitable response. [5, 8]

Sub-theme 1.2: Bureaucratic and Governance Delays

This subtheme illustrates hurdles in policy implementation, including federal-state tensions and obstructed timely crisis response. [7, 8] Frontline managers chalked out innovative but unsustainable strategies for navigating through delayed approvals and inconsistent guidelines, hindering leadership effectiveness and amplifying systemic fragilities. [7] The second COVID-19 wave in India witnessed deeper governance loopholes, like poor coordination between state and central authorities, resulting in operational disruptions that could have been overcome with agile structures. [8] This subtheme differentiates pandemic-specific delays, like procurement bottlenecks, from usual administrative issues.

THEME 2: LEADERSHIP STYLES AND COMPETENCIES (ADDRESSING RQ2)

This theme dives into how deficiencies in transformational and adaptive leadership approaches undermine crisis management effectiveness, highlighting a critical gap in current strategies. It maps challenges to theoretical frameworks like the transformational and contingency models. This theme illustrates the way leadership style and competency deficits amplify systemic issues (RQ1), paving the way for specific reforms.

Sub-theme 2.1: Adaptive and Transformational Style Deficits

The sub-theme shows that leaders usually opt for hierarchical models, which are ineffective in dynamic crises, resulting in suboptimal responses and missed opportunities for improvement. [1, 3, 17] For example, in Kerala, adaptive strategies focusing on rapid decision-making and community collaboration were successful in the initial phase of the pandemic, contrasting with failures in rigid systems in other parts of the country. [11] Comparative details from Indonesia show that

transformational leadership style fosters flexibility and motivation, significantly enhancing hospital performance, and provides valuable lessons for the Indian setting. [3] Innovative preparation, resulting in evolutionary transformation, emerges as a mandatory aspect, with research stressing a shift from a reactive hierarchical model to a proactive team-oriented approach to better manage crises. [1, 16, 17] This sub-theme focuses on the impact of leadership style on outcomes, like better resource utilisation and enhanced staff resilience, while chalking out lack of flexibility in Indian government hospitals.

Sub-theme 2.2: Competency Gaps and Mental Health Buffers

The focus of this sub-theme is on unaddressed skills like emotional intelligence and distress regulation, contributing to widespread leadership burnout during prolonged uncertainty. [14, 16] Buffering methods like the sense of coherence reported mitigation of mental health impacts in a global setting, but were not explored in the Indian setting because the theoretical insights usually fail to translate into a practical setting in India's rigid system. [4, 13] Research highlights the requirement of competency development to bridge the gaps, revealing that inadequate skills reduce crisis readiness and exacerbate ethical stress. [16]

THEME 3: POLICY AND STRUCTURAL REFORMS (ADDRESSING RQ3)

The forward-looking theme is based on resilience building via systemic changes, including global lessons to inform India-specific strategies and presenting actionable insights to address underexplored issues.

Sub-theme 3.1: Decentralisation and Policy Overhauls

Decentralisation and policy overhauls require granting local autonomy to overcome bureaucratic delays, with post-COVID analysis stressing multidimensional governance, including shared accountability for resolving federal stress. [5,12] Policy forecast in the Indian setting reveals the need for a tailored response for the vulnerable population, moving ahead of cost-focused metrics to a more equitable framework. Global studies reinforce this by critiquing one-size-fits-all practice and presenting a decentralised model to improve responsiveness. [4]

Sub-theme 3.2: Training and Resilience

This focuses on innovative preparation as a major parameter for leadership evolution, drawing from global examples like the resilience hospital building in the Eastern Mediterranean, suggesting intersectoral coordination. [6, 9, 17] A study focusing on Bangladesh provides a parallel for incentive-based training, focusing on preparedness to bridge operational gaps and mitigate mental health stress. [13] This sub-theme is linked to RQ2, proposing the integration of an adaptive framework into policy for sustainable resilience.

RECOMMENDATIONS

Various actionable recommendations have emerged to address the leadership challenges in Indian government hospitals during a health crisis, like the COVID-19 pandemic. These recommendations aim to bridge systemic gaps, improve adaptive competency, and promote resilient reforms, directly addressing the research questions by mitigating operational barriers (RQ1), enhancing leadership styles (RQ2), and promoting policy changes (RQ3). Through the recommended changes, administrators and policymakers can evolve crisis response from reactive to proactive, improve outcomes, and reduce inequities.

RECOMMENDATION 1: IMPLEMENT ADAPTIVE TRAINING PROGRAMS

Incorporate an adaptive training program to build competencies among leaders. [17] For example, the conceptual model emphasises the development of evolutionary leadership, incorporating scenario-based and simulation exercises to develop skills like flexible decision-making and distress regulation. [1,17] This could be achieved through workshops tailored to the Indian setting, drawing on global insights to bridge gaps identified in qualitative studies, eventually reducing burnout and improving crisis readiness. [16] The training would directly address hierarchical deficits found in frontline managers, promote transformational styles to improve ethical handling of resources, and enhance team motivation.

RECOMMENDATION 2: DECENTRALISED AUTHORITY

Decentralise authority to reduce bureaucratic delays and empower local leaders, since centralised structures often aggravate federal-state strain during a crisis. [5,12] Policy suggests shifts in decision-making power to the hospital level, allowing timely responses in case of demand surges, like procurement of supplies without wasting time on national approvals. [5, 8] This reform would promote agility, as seen in regional models like community-driven adaptation in Kerala, and align with the requirement of multidimensional governance to provide equitable services.

RECOMMENDATION 3: IMPROVE MENTAL HEALTH SUPPORT

Improve mental health support for leaders in government hospital settings through dedicated strategies and programs, including buffering mechanisms to overcome emotional strain and burnout. [2] Studies revealed a significant psychological impact from resource constraints, suggesting interventions like coherence building and unselling strategies for maintaining leadership efficacy. [14] This is important for sustainable morale in a high-pressure workplace, as evidence from reviews suggests that mental health prioritisation improves outcomes. [4]

RECOMMENDATION 4: FOSTER GLOBAL PARTNERSHIPS

Foster global partnership to support resilience, using lessons on cross-cultural strategies from regions like Bangladesh and the Eastern Mediterranean. [6, 13] Collaborative initiatives could include knowledge-sharing on resilient hospital models and intersectoral coordination, adapting successful practices to India's context to address underexplored issues like clinical-managerial conflicts. [9]

RECOMMENDATION 5: EVALUATE REFORMS QUALITATIVELY POST-CRISIS

Qualitatively evaluate reforms post-crisis through feedback loops and thematic assessment to understand effectiveness and refine accordingly. Hospital response strategies advocate for this practice to keep track of long-term impacts, ensuring reforms evolve simultaneously based on empirical findings (based on empirical studies in SLR). [9] Collectively, these recommendations provide a roadmap for transforming leadership and promoting sustainability and equity in India's public health system.

CONCLUSIONS

The review has highlighted the multifaceted leadership challenges in Indian government hospitals during a health crisis, specifically COVID-19, through an analysis of 17 peer-reviewed articles from 2019 to 2025. Systemic barriers, adaptive leadership style deficits, and the imperative for policy reforms were the three identified themes, addressing research questions and suggesting that crisis-specific stressors compound longstanding inequities. Findings reveal the requirement for a shift from the traditional hierarchical leadership model to a flexible, resilient model, supported by regional success stories like Kerala's. These results give policymakers a road map for improving crisis preparedness and equity by promoting international collaborations and mental health assistance. In order to assess the effects of reform, future research should use longitudinal mixed-methods studies. This will help to fortify India's public health system against new challenges and ensure ethical, long-lasting leadership for people who are at risk.

References

1. Crain MA, Bush AL, Hayanga H, Boyle A, Unger M, Ellison M, Ellison P. Healthcare leadership in the COVID-19 pandemic: from innovative preparation to evolutionary transformation. Journal of Healthcare Leadership. 2021 Sep 7:199-207.
2. Debbarma, S. COVID-19 pandemic and challenges faced by healthcare professionals in India. Cureus. 2023 Apr 29;15(4).
3. Fahlevi M, Aljuaid M, Saniuk S. Leadership style and hospital performance: empirical evidence from Indonesia. Frontiers in Psychology. 2022 May 26;13:911640.
4. Filip R, Gheorghita Puscaselu R, Anchidin-Norocel L, Dimian M, Savage WK. Global challenges to public health care systems during the COVID-19 pandemic: a review of pandemic measures and problems. Journal of personalised medicine. 2022 Aug 7;12(8):1295.

5. Gauttam P, Patel N, Singh B, Kaur J, Chattu VK, Jakovljevic M. Public health policy of India and COVID-19: Diagnosis and prognosis of the combating response. Sustainability. 2021 Mar 19;13(6):3415.
6. Khalil M, Mataria A, Ravaghi H. Building resilient hospitals in the Eastern Mediterranean Region: lessons from the COVID-19 pandemic. BMJ global health. 2022 Jun 1;7(Suppl 3):e008754.
7. Kundapur R, Aggarwal S, Gaitonde R, Rashmi A, George LS, Pandey A, Bavaskar Y. Challenges faced by frontline health managers during the implementation of COVID-19 related policies in India: A qualitative analysis. Indian Journal of Medical Research. 2023 Jul 1;158(1):21-7.
8. Malik MA. Fragility and challenges of health systems in pandemic: lessons from India's second wave of coronavirus disease 2019 (COVID-19). Global Health Journal. 2022 Mar 1;6(1):44-9.
9. Mohammadinia L, Saadatmand V, Khaledi Sardashti H, Darabi S, Esfandiary Bayat F, Rejeh N, Vaismoradi M. Hospital response challenges and strategies during COVID-19 pandemic: a qualitative study. Frontiers in public health. 2023 Jun 30;11:1167411.
10. Nimavat N, Hasan MM, Charmode S, Mandala G, Parmar GR, Bhangu R, Khan I, Singh S, Agrawal A, Shah A, Sachdeva V. COVID-19 pandemic effects on the distribution of healthcare services in India: A systematic review. World Journal of Virology. 2022 Jul 25;11(4):186.
11. Prajitha KC, Rahul A, Chintha S, Soumya G, Suresh MM, Nair AN, Valamparampil MJ, Reghukumar A, Venkitaraman S, Anish TS. Strategies and challenges in Kerala's response to the initial phase of COVID-19 pandemic: a qualitative descriptive study. BMJ open. 2021 Jul 1;11(7):e051410.
12. Rao NV, Prashanth NS, Hebbar PB. Beyond numbers, coverage and cost: adaptive governance for post-COVID-19 reforms in India. BMJ Global Health. 2021 Feb 1;6(2):e004392.
13. Razu SR, Yasmin T, Arif TB, Islam MS, Islam SM, Gesesew HA, Ward P. Challenges faced by healthcare professionals during the COVID-19 pandemic: a qualitative inquiry from Bangladesh. Frontiers in public health. 2021 Aug 10;9:647315.
14. Schäfer SK, Sopp MR, Schanz CG, Staginnus M, Göritz AS, Michael T. Impact of COVID-19 on public mental health and the buffering effect of a sense of coherence. Psychotherapy and psychosomatics. 2020 Aug 18;89(6):386-92.
15. Sengupta M, Roy A, Ganguly A, Baishya K, Chakrabarti S, Mukhopadhyay I. Challenges encountered by healthcare providers in COVID-19 times: an exploratory study. Journal of Health Management. 2021 Jun;23(2):339-56.
16. Singh PK, Singh S, Kumari V, Tiwari M. Navigating healthcare leadership: Theories, challenges, and practical insights for the future. Journal of Postgraduate Medicine. 2024 Oct 1;70(4):232-41.
17. Sott MK, Bender MS. The role of adaptive leadership in times of crisis: A systematic review and conceptual framework. Merits. 2025 Jan 22;5(1):2.
18. 18. Sofian A, Ismail S. A Systematic Literature Review on the Contributing Factors of Safety Culture in Mining Industry. Journal of Business and Social Development. 2024;12:69-87.

APPENDIX 1: CASP SUMMARY TABLE

Authors and Year	CASP tool used	Overall Appraisal
Nimavat N et al., 2022 [10]	Systematic-Review	High
Schäfer SK et al., 2020 [14]	Cohort (CASP-adapted to cross-sectional analytics)	High
Singh PK et al., 2024 [16]	Qualitative (thematic/conceptual)	High
Sott MK et al., 2025 [17]	Systematic-Review	High
Fahlevi M et al., 2022 [22]	Qualitative	Moderate-High
Gauttam P et al., 2021 [5]	Qualitative (policy analysis)	Moderate-High
Khalil M et al., 2022 [6]	Qualitative (multi-setting lessons)	Moderate-High
Kundapur R et al., 2023 [7]	Qualitative	Moderate-High
Razu SR et al., 2021 [13]	Qualitative	Moderate-High
Mohammadinia L et al., 2023 [9]	Qualitative	Moderate-High
Prajitha KC et al., 2021 [11]	Qualitative	Moderate-High
Rao NV et al., 2021 [12]	Qualitative (policy analysis)	Moderate-High
Crain MA et al., 2021 [1]	Qualitative	Moderate
Filip R et al., 2022 [4]	Systematic-Review	Moderate
Sengupta M et al., 2021 [15]	Qualitative (exploratory)	Moderate
Malik MA, 2022 [8]	Qualitative (descriptive)	Moderate
Debbarma S, 2023 [2]	Qualitative (applied to editorial)	Low

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IMPACT OF WORK-LIFE BALANCE (WLB) ON EMPLOYEE RETENTION AND ORGANISATIONAL PERFORMANCE ACROSS PAN-ASIAN COUNTRIES

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ABSTRACT

The interplay between professional commitments and personal life has become an important point to ponder over, particularly within the diverse socio-economic landscape of Pan-Asian countries. Work-life balance (WLB) is a growing aspect that is getting recognised as a keystone for both individual employee well-being and organisational sustainability. This study investigates the impact of WLB on employee retention and organisational performance across Pan-Asian countries, employing a comprehensive, systematic review with a qualitative comparative approach drawing from empirical studies, systematic reviews, and data-driven analysis published between 2014 and 2025. Utilising person-organisation fit and social exchange theories as conceptual frameworks, the study synthesises evidence from diverse sectors, including IT, healthcare, public administration, and hospitality.

Thematic analysis reveals that well-implemented WLB initiatives, such as flexible scheduling, supervisor support, and family-friendly policies, consistently reduce turnover intentions and enhance productivity, motivation, and overall job satisfaction, particularly when aligned with cultural norms and organisational contexts. Comparative findings highlight regional differences, such as Malaysia, Indonesia, and India showing particularly strong retention and performance gains, while challenges such as resource scarcity in SMEs, ingrained overwork cultures, and uneven policy enforcement persist across Asia. Despite these advances, significant research gaps remain. Studies are predominantly cross-sectional and sector-focused, limiting understanding of the long-term WLB impact and neglecting underexplored sectors like manufacturing and agriculture.

The manuscript concludes with actionable best practices and recommendations, calling for more longitudinal and intersectional research, integrating technology-driven work models, and greater support for resource-limited organisations. This review establishes WLB as a foundational lever for organisational resilience in Asia, underlining the need for context-sensitive, evidence-based approaches to policy, practice, and future research.

KEYWORDS

Work-life balance, Employee Retention, Organisational Performance, person-organisation fit, social exchange theory, Comparative Analysis

INTRODUCTION

Work-life balance (WLB) has become a prominent central focus in current employment, specifically focusing on Asia's rapidly changing and culturally diverse economies. The various Pan-Asian organisations are showing the transition from traditional and rigid work structures to more adaptable and flexible models. With this transition, the need for harmony between professional and personal life has gained critical importance for both employees and employers. Numerous studies highlight a strong connectivity between well-regulated and implemented WLB practices and beneficial outcomes, including higher employee retention rates, increased job satisfaction, reduced burnout, and improved overall organisational performance [1] [2] [3]. However, in Asian settings, these outcomes are shaped and formulated by unique cultural norms, economic developments, and industry-specific challenges, and altogether demand customised approaches that reflect regional complexities [4].

At the same time, qualitative case studies reveal that flexible scheduling, supportive leadership, and organisational policies focused on employee well-being not only reduce turnover intentions but also boost motivation and job performance [3]. The importance of WLB varies across Asian countries and is highly influenced by cultural ethos, family structure, and regulatory frameworks, which can be considered dynamic, highlighted by cross-country comparisons in East Asia and SMEs throughout the region [4].

With WLB neglected in work culture, employees report higher stress, lower engagement, and intentions to leave. This, in turn, results in increased costs for organisations due to the loss of talent and reduced productivity [2] [5]. Therefore, understanding and fostering WLB in the Asian context is necessary not just for employee well-being but also as a lever for competitive and sustainable organisational performance [6] [7].

Despite broad understanding and recognition of these dynamics, there is still a lack of qualitative and comparative research covering the breadth of Pan-Asian experiences. This study addresses that gap by synthesising insights from open-access peer-reviewed literature, focusing on qualitative approaches and cross-country comparative perspectives to illuminate key drivers, barriers, and best practices for WLB, employee retention and organisational performance in Asia [1] [4] [5].

The primary objective of this study is to analyse the impact of WLB on employee retention and organisational performance across Asian countries. Based on the objective, the authors have formulated four research questions. They are—

RQ1. How does WLB influence employee retention among organisations across Pan-Asian countries?
RQ2. What is the relationship between WLB and organisational performance across Pan-Asian Countries?
RQ3. What are the key drivers and barriers to effective WLB implementation in diverse Asian settings?
RQ4. How do comparative perspectives reveal unique regional patterns and best practices for optimising WLB?

METHODOLOGY

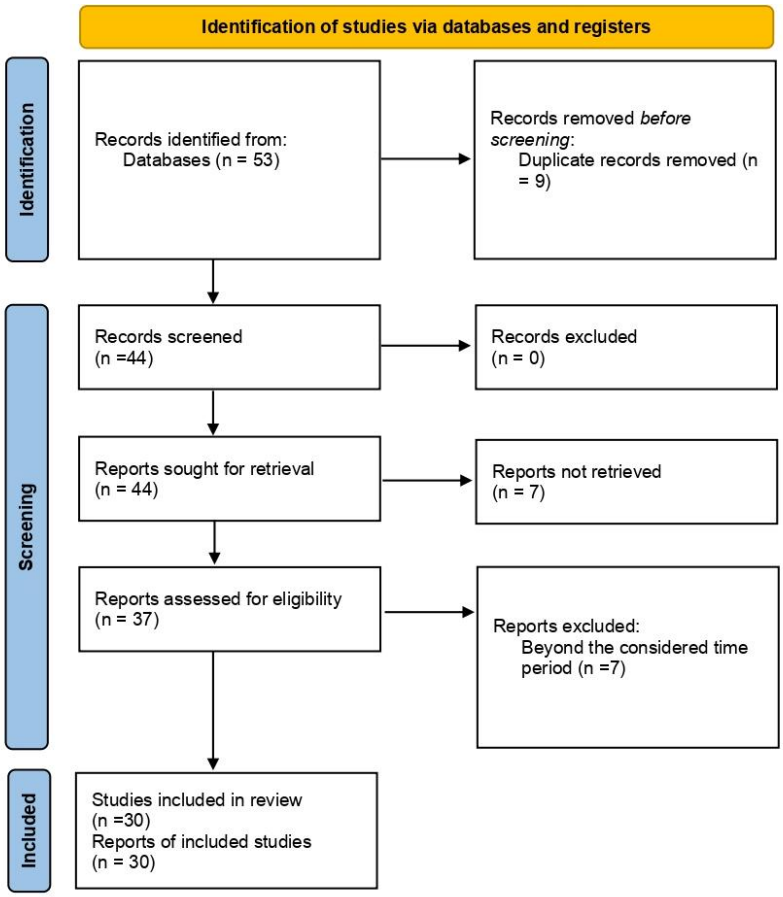
This study is a comprehensive literature review designed to explore and synthesise the impact of WLB on employee retention and organisational performance across Pan-Asian countries. The research utilises open-access peer-reviewed articles with an emphasis on thematic discussion about the impact of WLB on employee retention and organisational performance. It also aims to identify the context-specific differences in WLB implementation and outcomes. One of the prominent tools, PRISMA, was used to maximise transparency by screening research articles accordingly.

LITERATURE IDENTIFICATION AND SELECTION

A systematic search was conducted in accordance with PRISMA. The open-access databases, such as Google Scholar, PubMed Central, Scopus, and Frontiers, were selected for peer-reviewed articles. Selected articles are in English and published between 2014 and 2025. Further, the Boolean search method was applied using combinations of the keywords

such as ("work-life balance" AND "employee retention" OR "public sector"), ("work-life balance" AND "employee retention" AND "organisation performance"), ("WLB" AND "employee retention" OR "organisational performance"), ("WLB" AND "employee retention" AND "SME"), ("employee retention" AND "public sector" OR "India"). After this, the further process was guided by inclusion and exclusion criteria for screening. A PRISMA flow diagram documents the study selection process, which includes 4 steps, viz., identification (53 articles), screening (44 articles), eligibility (37 articles), and inclusion (30 articles), to maintain transparency as shown in Figure 1.

FIGURE 1. PRISMA FLOW CHART OF STUDIES INCLUDED



INCLUSION CRITERIA

- Studies addressing WLB in relation to employee retention or organisational performance in Asian contexts.
- Open-access, peer-reviewed articles published between 2014 and 2025.

EXCLUSION CRITERIA

- Non-open-access articles
- Studies focused solely on non-Asian contexts
- Non-peer-reviewed reports, editorials
- Studies before 2014
- Research without sufficient relevance to retention or organisational outcomes.

This methodology is structured following the conceptual framework of Person-Organisation Fit Theory and Social Exchange Theory [10] [4]. These theories are appropriate for the study because they accommodate sectoral, cultural, and organisational heterogeneity and directly interpret how alignment and reciprocal investment drive the success of WLB interventions in employee retention and organisational performance across Asia. These frameworks also helped to design our inclusion and exclusion criteria and the comparative analysis of findings. Studies were examined and synthesised according to how they conceptualised and measured the fit between employee expectations and organisational practices and the quality of exchange relationships affecting retention and performance.

LITERATURE REVIEW

A critical review of recent research studies (Table 1) highlights the multifaceted impact of WLB practices on employee turnover and organisational performance across the Pan Asian region. The literature highlights that while the underlying value of WLB is widely recognised, its implementation and outcomes are deeply determined by sectoral realities, manager cadre commitment, and most crucially, cultural context. The effectiveness of WLB in reducing turnover and enhancing employee well-being is often based on the degree of alignment between individual needs and organisational culture. This supports the core idea of Person Organisation Fit theory [10]. Also, studies show that supervisor support and management engagement in WLB build an environment of mutual benefits, as highlighted in Social Exchange Theory [4][5]. These theoretical lenses recur throughout the literature and help explain why WLB policies yield variable success across both large organisations and SMEs [5] [10] [13] [26].

TABLE 1. STUDIES INVOLVED IN THE SYSTEMATIC LITERATURE REVIEW

Author(s) & Year	Country / Region	Work Focus	Conceptual Framework
Mohanty K, Mohanty S (2014) [37]	India	Employee perception of WLB in the hotel industry in Odisha, India	Employee Perception Model
Sumanarathna B, Samarakoon SMAK (2019) [20]	Sri Lanka	WLB policies and retention intention of executive women in IT in Sri Lanka	Gender and WLB Theory
Ratnesh M, Ali A, Sinha AR (2019) [24]	Asia	Determinants of WLB: Cross-cultural Asian review	Cultural theory and WLB
Al KE (2019) [31]	Malaysia	WLB practices and turnover intention mediated by person-organisation fit	Person-Organisation Fit Theory
Pandey DK (2019) [35]	India	WLB and organisational performance	Organisational Performance Framework
Chaudhuri S, Arora R, Roy P (2020) [13]	India	Review of WLB policies and organisational outcomes in the Indian context	Systematic literature review
Le H, Newman A, et al. (2020) [23]	Asia	Systematic review of WLB in Asia	Systematic literature review
Ayar D, Karaman MA, Karaman R (2021) [18]	Turkey	WLB and mental health needs of health professionals during COVID-19 in Turkey	Crisis Response and Psychological Stress Model
Panda A, Sahoo CK (2021) [26]	India	WLB, retention and psychological empowerment	Psychological Empowerment Theory
Susanto P, Setiawan N (2022) [4]	Indonesia	WLB, job satisfaction, and performance among SME employees	Social Exchange Theory
Zainal NSB, Wider W, et al. (2022) [8]	Malaysia	Employee retention in the Malaysian service industry	Social Exchange Theory
Pan Y, Sun G (2022) [14]	China	Qualitative study on WLB among professional women in mainland China	Gender and Work-Life Integration Framework

Andrianto MA, Palupi M (2023) [10]	Indonesia	Effect of WLB and person-organisation fit on organisational citizenship behaviour in Indonesia.	Person-Organisation Fit Theory
Suhartini E, Nurnadjamuddin M, et al. (2023) [11]	Indonesia	WLB and stress for working women in the Indonesian banking sector	Stress-coping and work-family conflict models
Chen X, Al Mamun A, et al. (2023) [16]	China	Work design, employee well-being, and retention in China	Job Characteristics Theory
Lamichhane BD, Bhaumik A, Gnawali A (2023) [21]	Nepal	WLB and job performance in Nepalese microfinance institutions	Job Demands-Resources Model
Murugan GB, Dharshini MP (2023) [25]	India	Impact of WLB on job retention in the ITES sector	Job Retention Model
Lumbao E, Ferraren S Jr. (2023) [36]	Philippines	WLB quality dynamics in the Philippine national government	Human Resource Development Framework
Thilagavathy S, Geetha SN (2023) [29]	Asia	Systematic review on WLB	Systematic literature review
Lee Z (2024) [3]	East Asia (General)	Analysis of WLB initiatives and cultural/policy frameworks in East Asia	Policy and cultural context framework
Mu H, Deng Y, Li Y, et al. (2024) [15]	China	Burnout, work overload and imbalance among medical personnel in Liaoning, China	Job Demands-Resources Model
Fadilla ZN, Yuniawan A (2024) [12]	Indonesia	Gen Y employee retention interplay with WLB, supervisor support, and engagement in Semarang	Social Exchange Theory
Herawaty MT, Asmadi I, et al. (2024) [27]	Indonesia	Impact of WLB, job satisfaction on retention in banking	Job Satisfaction and Stress Theory
Rizqulloh ADB, Kuncoro WA, et al. (2024) [28]	Indonesia	Improving performance through training and WLB	Human Capital Theory
Dede DS, Farhan A (2024) [30]	Indonesia	Effect of WLB on employee performance	Work-Performance Linkage Model
EŞici H, Şehitoğlu Y, et al. (2024) [19]	Turkey	WLB of white-collar remote workers in Turkey	Remote Work and Work-Life Integration Framework
Ngath S, Siek D, et al. (2024) [32]	Cambodia	Employee satisfaction with working environments in Cambodia	Work Environment Satisfaction Model
Hashim NA, Fakhruddin FM (2025) [9]	Malaysia	Impact of WLB in the workplace, Company, Selangor, Malaysia	Organisational Support Theory
Chabbra A, Bohara S (2025) [33]	India	WLB initiatives and employee retention: Data-driven analysis	Data-driven HR Model
Roy I (2025) [34]	India	Linking WLB practices, satisfaction, and job satisfaction via org. identification	Organisational Identification Theory

In Malaysia, the link between WLB and retention is thoroughly affirmed and approved, especially in the service and SME sectors. This is due to the fact that it follows flexible scheduling, and managerial support drives engagement and minimises the attrition. However, persistent high demands of work and traditional norms around the present scenario often counteract policy gains, suggesting that cultural inertia can dilute or delay the measurable impact of WLB reforms [8] [9]. Indonesian studies, particularly among Gen Y workers and banking professionals, underscore the amplifying effects of supervisor support, which is a factor that can help to mediate WLB's effectiveness on organisational membership and commitment. Yet the literature showcases the persistent challenges for SMEs, where resource strains regularly hinder comprehensive policy adoption and sustainment [10] [11] [12].

Indian and Chinese settings focus on both the promise and limitations of WLB. In IT, banking, and healthcare, WLB practices such as empowerment and flexibility correlate strongly with reduced burnout and improved retention. A few of the crucial mediators are psychological empowerment and job satisfaction. Although the sectoral stress and ingrained overwork culture hinder the practical gains, it mainly affects early-career professionals [13] [14] [15] [16].

Comparative reviews covering East Asia, Turkey, and South Asia provide broader context. In Turkey, the nature of adaptive responses to crises, for example, the most notable COVID-19 pandemic, resulted in accelerated acceptance of remote and flexible work. It, in turn, yields retention and well-being gains in health and knowledge sectors. However, these results are often situational because of the organisational cultural rigidity, which is still considered a frequent stumbling block [3] [17] [18] [19]. Across South Asia, WLB initiatives have generated measurable progress in job satisfaction and retention, particularly for women and managers in competitive industries. Nevertheless, familial expectations and organisational inflexibility continue to undermine WLB's potential [20] [21].

While meta-analyses and policy-focused studies across the region overwhelmingly affirm the business case for WLB, persistent gaps remain in longitudinal measurement and intersectional analysis (taking into account gender, sector, and region), and the study of WLB under digital and hybrid models [22] [23] [24]. The literature supports nuanced and context-specific interventions. It also points out against the idea of one-size-fits-all approaches.

COMPARATIVE SYNTHESIS

The findings synthesised from across Malaysia, Indonesia, India, China, Turkey, Nepal, and other Pan-Asian countries clarify that WLB's influence on retention and performance is deeply context-dependent. Table 2 shows the comparative synthesis of the impact of WLB on employee retention and organisational performance, along with key drivers and enablers. This table also uses a colour grading code where green is for high, yellow is for medium and blue is for low impact.

TABLE 2. COMPARATIVE SYNTHESIS OF WLB'S IMPACT ON EMPLOYEE RETENTION AND ORGANISATIONAL PERFORMANCE ACROSS ASIAN COUNTRIES

Country/Region	Predominant Sectors	WLB Impact on Retention	WLB Impact on Performance	Key Drivers & Enablers	Barriers & Challenges
Malaysia	Service, SMEs	High: Flexitime, supervisor support	High: Motivation, engagement	HR integration, person-org fit	Workload, traditional norms
Indonesia	SMEs, Banking, Gen Y	High: Supervisor/cultural fit	High: Commitment, OCB	Supervisor engagement, SME adaptation	SME resources, uneven adoption

India	IT, Hospitality, Services	High: Empowerment, org. identification	High: Performance, loyalty	Flexibility, psychological empowerment	Overwork culture, sector stress
China	Healthcare, Professionals	Moderate: Policy/culture mix	High: Satisfaction, well-being	Family-friendly policies, cultural adaptation	Overload, speciality stress
Turkey	Health, Tech/Knowledge	High: Remote/flexible work	High: Well-being, productivity	Crisis leadership, WLB reviews	Policy adaptation, transient reforms
Nepal	Microfinance, SMEs	High: Supervisor culture	High: Job performance	Leadership, empowerment	Resource scarcity
Sri Lanka	IT, Women Executive	Moderate: Women-focused policies	Moderate: Job satisfaction	Senior women champions, tailored intervention	Family/social norms
Cambodia, Philippines	Public/Govt. Services	High: WLB satisfaction, workplace environment.	Moderate: Retention, HR outcomes	HR reforms, employee feedback	Traditionalist expectations
East Asia (Regional)	Multiple	Policy-driven improvements	High: Policy leadership	Regulation, cross-sector learning	Inconsistent enforcement

The comparative analysis highlights that successful WLB interventions almost always require both top-down support and grassroots adaptation. Organisations that fail to align policies with employees' needs and cultural realities risk superficial policy adoption and limited practical benefits. The literature's strongest critique is reserved for shallow, performative WLB initiatives that lack institutional buy-in or fail to address deep-seated sectoral and social barriers.

ANALYSIS AND DISCUSSION

This section synthesises findings by themes and directly addresses the research questions that guide this study. The thematic analysis was conducted manually in accordance with established qualitative research practices. After a systematic review and extraction of findings from the included studies, recurring concepts and patterns related to WLB, retention, and organisational performance were identified through a process of careful reading, annotation, and comparison across sources. These codes were then grouped to form the themes that are discussed in this section. This manual approach to theme generation is well established in qualitative synthesis literature and allows for close, context-sensitive engagement with the source material.

THEME 1. RQ1. WLB AND EMPLOYEE RETENTION

The literature consistently demonstrates that effective WLB policies play a significant role in reducing turnover intentions and improving staff retention across diverse Pan-Asian contexts [8] [9] [10]. In Malaysia, for example, flexible scheduling and supervisor or manager support in SMEs and service sectors correlate with higher organisational loyalty [8] [9] [25]. While similar trends are observed in Indonesia, where manager engagement in WLB amplifies employee commitment and trust [10] [11] [12]. However, even as these positive effects are documented, resource constraints in SMEs and cultural

norms requiring long work hours persistently limit the uniform adoption of robust WLB frameworks [11] [12]. Studies focusing on Nepal and Sri Lanka support these findings, primarily illustrating that policies tailored to women and professionals, especially in microfinance and IT, help in better retention, but they still face vulnerability in terms of broader social and familial expectations [20] [21].

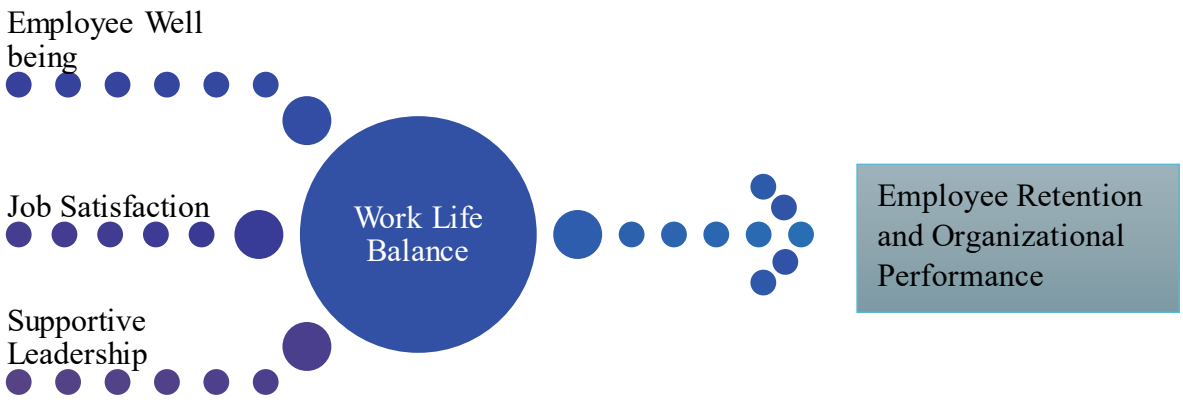
THEME 2. RQ2. WLB AND ORGANISATIONAL PERFORMANCE

A strong link between WLB and organisational performance is shown across the countries, particularly in sectors that involve high work pressure, such as IT, healthcare, and banking [13] [14] [26] [16]. Flexible work arrangements and initiatives related to empowerment and psychological support help in reducing burnout and frequent absences, as shown by the studies from India and China [13] [14] [16]. Turkish and East Asian findings during the pandemic further demonstrate that remote and hybrid working models can safeguard performance and employee well-being when under organisational strain [27] [28] [19] [22]. However, these performance gains are often contingent on managerial buy-in and can be determined by traditional expectations and operational stress [8] [23].

THEME 3 RQ3. DRIVERS AND BARRIERS TO WLB

Leadership commitment emerges as the most consistent driver of WLB implementation and success. Organisations with supportive cultures, engaged supervisors, and adaptive policies demonstrate greater improvements in retention and performance, as shown in Figure 2 [1] [13] [22].

FIGURE 2. KEY DRIVERS OF WLB RESULTING IN EMPLOYEE RETENTION AND ORGANISATIONAL PERFORMANCE



Conversely, barriers such as limited resources in SMEs, sectoral stress, deep-rooted overtime norms, and lack of enforcement of WLB policies remain persistent obstacles [15] [21] [23] [24]. For women and professionals in South Asia, social and Familial structures often further restrict the practice benefits of formal WLB initiatives [20] [21].

THEME 4: RQ4. REGIONAL COMPARISONS AND BEST PRACTICES

Cross-country comparisons reveal that Malaysia and Indonesia excel in leveraging WLB for SMEs. India and China report the largest effects in knowledge-intensive sectors. Also, the sustainability and depth of WLB outcomes depend on policy adaptation and organisational contexts [13] [16] [25]. Turkey and East Asia illustrate how external factors such as the COVID-19 pandemic can accelerate beneficial change, though without systematic follow-through, such reforms may be short-lived [3] [22] [23] [27].

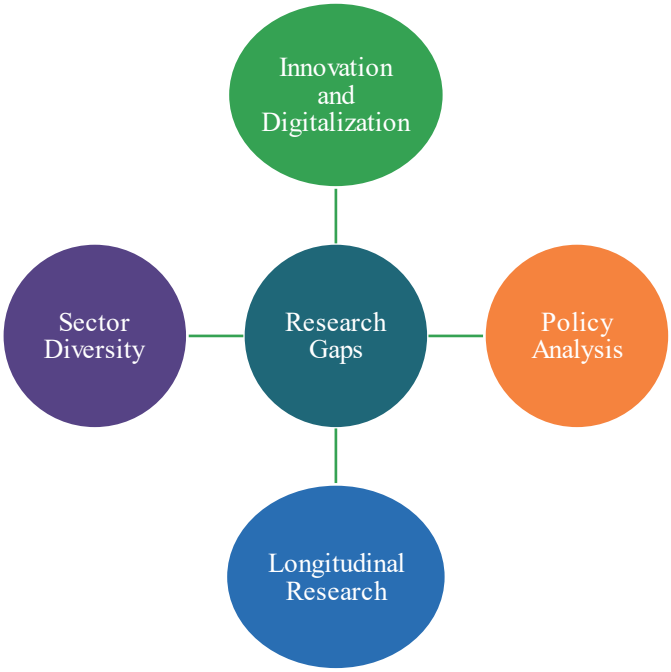
Findings from this review affirm that WLB applications generate the most significant improvements in employee retention and organisational performance when there is a strong fit between employee values and the organisation's WLB practices, highlighting Person Organisation Fit theory [10]. Also, the review supports that investments in WLB in the form of

leadership commitment or flexible scheduling result in positive employee outcomes, enhanced trust in accordance with Social Exchange Theory [4][5].

RESEARCH GAPS

Despite a growth in the implementation of WLB in various organisations, several notable gaps persist, as shown in Figure 3.

FIGURE 3. KEY RESEARCH GAPS IDENTIFIED THROUGH SLR



1. Innovation and Digitalisation

While digital platforms and hybrid work models rapidly reshape organisational boundaries, only a handful of studies examine how technology-mediated flexibility influences WLB outcomes, especially outside major metropolitan or "white-collar" contexts [30] [32].

2. Policy Analysis

There is limited in-depth examination of national labour policy, legal framework, and regulatory enforcement, particularly in developing economies or regions with fragmented governance [29] [32] [36]. Also, several studies touch on mediators like organisational identification or person-organisation fit; the mechanisms explaining how WLB policies result in improved retention or performance remain less explored and shallow [31] [34]. This constrains efforts to design more effective, context-sensitive implementations and to explain inconsistent program outcomes.

3. Longitudinal Research

Most existing studies rely on cross-sectional designs, making it difficult to draw causal inference or assess the long-term sustainability of WLB interventions [29] [33] [35]. This lack of longitudinal or follow-up studies means it remains unclear whether positive outcomes for retention and performance are maintained over time or diminish as workplace environments evolve. There is also insufficient research into how WLB intersects with social variables such as gender, age, career stage, demography, and other factors [32].

4. Sector Diversity

The major part of research is concentrated on high-profile sectors such as IT, banking, hospitality, and healthcare, while sectors like manufacturing, agriculture, public administration, and governance are less explored. As a result, the external validity and generalisability of WLB findings remain limited, and sector-specific challenges or opportunities may be overlooked [29] [36] [37].

RECOMMENDATIONS

Based on the research findings and gaps identified, the authors suggest the following recommendations.

1. **Institutionalise Leadership Commitment to WLB**

Organisations should prioritise extensive and specific management training that emphasises the connection between WLB, employee well-being, and organisational success. The seniors and line managers must practice the models that show healthy work-life boundaries, such as respecting after-hours communication norms and openly using WLB policies themselves. This will help to set expectations for lower ordinates. The ability to commit signals the value of these initiatives, increasing employee trust and policy adoption. Leadership buy-in also strengthens the enforcement and continuous improvement of WLB practices, making such efforts resilient to staff turnover or policy drift. This cultural acceptance of WLB is repeatedly shown to drive retention and performance benefits [1] [8] [10] [25].

2. **Expand Flexible Work Arrangements Tailored to Local Context**

Employers should offer flexible options such as remote work and compressed schedules as per the industry needs, culture, and workforce demographics. Clear and specific policies, along with regular employee feedback, should guide implementation to ensure fairness and relevance. Periodic evaluations can address gaps and enhance motivation, productivity and retention [13] [19] [22] [23].

3. **Provide Specialised Support for SMEs to Implement WLB**

SMEs need targeted support such as government incentives, policy templates, and manager training to implement WLB strategies like job sharing or staggered shifts. Sector-based collaborations and external monitoring can boost adoption and demonstrable business value [10] [12] [21].

4. **Integrate WLB Mandates and Guidelines into National Labour Policy**

Governments should enforce flexible work standards and overtime limits, keeping familial needs in consideration. Incentives and penalties can promote compliance, while transparency and reporting improve accountability and normalise new work norms [3] [22] [23].

5. **Develop Dynamic WLB Monitoring, Evaluation, and Feedback Systems**

Organisations should track WLB effectiveness through employee surveys, real-time feedback, and transparent reporting. Systems must also identify challenges and disparities and promote continuous improvement [1] [8] [10] [22] [23]. Also, there is a need to invest in longitudinal studies on WLB impacts across sectors and demographics, including marginalised groups. Research should explore digitalisation and hybrid work effects, translating insights into practice with organisational partnerships [4] [13].

These recommendations, based upon reviewed literature, provide a multi-level roadmap for advancing WLB in Asia. These recommendations enable immediate improvements and sustainable change through institutional, policy, and research innovation.

CONCLUSIONS

WLB stands out as a critical yet contextually dependent point for improving employee retention and organisational performance across Pan-Asian economies. Leadership at the manager level, flexible policy, and supportive work cultures consistently help in delivering substantial benefits, particularly in high-stress and knowledge-based sectors. However, the effectiveness of WLB reforms is often tempered by traditional labour expectations, uneven resource distribution, and limited SME sectoral representation in research. Bridging these gaps will require a dual approach where evidence-based policy reform and grassroots-level management commitment are going to be aligned with ongoing, intersectional research. Only with context-sensitive adaptation and long-term evaluation can WLB policies achieve their full potential in Asia's diverse and dynamic labour markets.

References

1. Gragnano A, Simbula S, Miglioretti M. Work–Life Balance: Weighing the Importance of Work–Life Balance for Professional Fulfilment and Wellbeing. Int J Environ Res Public Health. 2020;17(9):3257.
2. Boamah SA, et al. Striking a Balance between Work and Play: The Effects of Work-Life Interference and Burnout on Faculty Turnover Intentions and Career Satisfaction. Int J Environ Res Public Health. 2022;19(2):955.
3. Lee Z. Cultural Contexts and Policy Frameworks: Examining Work-life Balance Initiatives in East Asia. Int J Econ Bus Manag Res. 2024;8(9):76-93.
4. Susanto P, Setiawan N. Work-Life Balance, Job Satisfaction, and Job Performance among SMEs Employees. Front Psychol. 2022;13:906876.
5. Zaitouni M, et al. Work-life balance: A landscape mapping of two decades of scholarly research. Behav Sci (Basel). 2024;14(7):431.
6. Rodríguez-Sánchez JL, et al. Investing Time and Resources for Work–Life Balance: The Effect on Talent Retention. Int J Environ Res Public Health. 2020;17(6):1920.
7. Wong K, Chan AHS, Teh PL. How Is Work–Life Balance Arrangement Associated with Organisational Performance? A Meta-Analysis. Int J Environ Res Public Health. 2020;17(12):4446.
8. Zainal NSB, Wider W, Lajuma S, Khadri MWABA, Taib NM, Joseph A. Employee retention in the service industry in Malaysia. Frontiers in Sociology [Internet]. 2022 Jul 8;7. Available from: https://doi.org/10.3389/fsoc.2022.928951
9. Hashim NA, Fakhruddin FM. Work-Life balance in the workplace: A case of S company in Beranang, Selangor, Malaysia. International Journal of Research and Innovation in Social Science [Internet]. 2025 Jan 1;IX(II):4012–26. Available from: https://doi.org/10.47772/ijriss.2025.9020313
10. Andrianto MA, Palupi M. Effect of Work-Life Balance and Person-Organisation Fit on Organizational Citizenship Behavior through Organizational Commitment on Employees of PT. Baba Rafi Indonesia. TIJAB (the International Journal of Applied Business) [Internet]. 2023 Mar 28;7(1):12–30. Available from: https://doi.org/10.20473/tijab.v7.i1.2023.39076
11. Suhartini E, Nurnadjamuddin M, Mapparenta, Suriyanti. Investigations of work-life balance and stress for working women in the Indonesian banking sector. Glob Bus Financ Rev. 2023;28(6):159–169. doi:10.17549/gbfr.2023.28.6.159
12. Fadilla ZN, Yuniawan A. Gen Y Employee Retention: the interplay of Work-Life balance, supervisor support, and engagement in Semarang. Jurnal Ilmiah Manajemen Dan Bisnis [Internet]. 2024 Dec 25;9(2):203–13. Available from: https://doi.org/10.38043/jimb.v9i2.5991
13. Chaudhuri S, Arora R, Roy P. Work–life balance policies and organisational outcomes – a review of literature from the Indian context. Ind Commer Train. 2020;52(6):343–366. doi:10.1108/ICT-01-2019-0003.
14. Pan Y, Sun G. Exploring work-life balance among professional women in mainland China: A qualitative study. Frontiers in Psychology [Internet]. 2022 Nov 9;13. Available from: https://doi.org/10.3389/fpsyg.2022.938664
15. Mu H, Deng Y, Li Y, Xie Q, Na J, Mao C, et al. Cross-sectional study of the association between burnout and work overload, and work-life imbalance among medical personnel in Liaoning, China: role of speciality. BMJ Open [Internet]. 2024 Jun 1;14(6):e079304. Available from: https://doi.org/10.1136/bmjopen-2023-079304
16. Chen X, Al Mamun A, Hoque ME, Hussain WM, Yang Q. Work design, employee well-being, and retention intention: a case study of China's young workforce. Heliyon. 2023 May 1;9(5).
17. Zagaria A. The impact of work-life balance on employee well-being and organisational productivity. Int J Emerg Ment Health Hum Resilience. 2024;26(6):164–165. doi:10.4172/1522-4821.1000672.
18. Ayar D, Karaman MA, Karaman R. Work-Life balance and mental health needs of health professionals during COVID-19 pandemic in Turkey. International Journal of Mental Health and Addiction [Internet]. 2021 Nov 24;20(1):639–55. Available from: https://doi.org/10.1007/s11469-021-00717-6
19. Eşici H, Şehitoğlu Y, Ayaz A, Karaman MA. Work-life balance of white-collar remote workers in a technopark in Turkey. Population and Economics [Internet]. 2024 Oct 1;8(3):1–16. Available from: https://doi.org/10.3897/popecon.8.e114269
20. Sumanarathna B, Samarakoon SM a. K. The effect of work-life balance policies on the retention intention of executive women employee in the information technology (IT) industry in Sri Lanka. Kelaniya Journal of Human Resource Management [Internet]. 2019 Jun 30;14(1):1. Available from: https://doi.org/10.4038/kjhrm.v14i1.63

21. Lamichhane BD, Bhaumik A, Gnawali A. Striving for excellence: The role of Work-Life Balance in optimising job performance among employees in Nepalese microfinance institutions. International Journal of Professional Business Review [Internet]. 2023 Aug 29;8(8):e03338. Available from: https://doi.org/10.26668/businessreview/2023.v8i8.3338
22. Montaño WJN. Examining the Influence of work-life balance initiatives on employee retention: A Comprehensive literature review. Journal of Economics Management and Trade [Internet]. 2025 Apr 16;31(4):51–62. Available from: https://doi.org/10.9734/jemt/2025/v31i41283
23. Le H, Newman A, Menzies J, Zheng C, Fermelis J. Work–life balance in Asia: A systematic review. Human Resource Management Review. 2020 Dec 1;30(4):100766.
24. Ratnesh M, Ali A, Sinha AR. Determinants of work-life balance: A cross-cultural review of selected Asian countries. Space and Culture, India. 2019;7(1):223-39.
25. Murugan GB, Dharshini MP. Analysis on the impact of work-life balance towards job retention in ITES sector (IT enabled service sector). International Journal of Engineering And Management Research. 2023;13(3):47-59.
26. Panda A, Sahoo CK. Work–life balance, retention of professionals and psychological empowerment: an empirical validation. European Journal of Management Studies [Internet]. 2021 Nov 6;26(2/3):103–23. Available from: https://doi.org/10.1108/ejms-12-2020-0003
27. Herawaty MT, Asmadi I, Rahayu EIH, Zahra Z. Impact of Work-Life balance, job satisfaction, and stress levels on employee retention in banking sector companies. International Journal of Business Law and Education [Internet]. 2024 Oct 1;5(2):2405–17. Available from: https://doi.org/10.56442/ijble.v5i2.875
28. Rizqulloh ADB, Kuncoro WA, Hidayati R, Lataruva E. Improving employee performance quality through training and work life balance: Literature review. Res Horiz. 2024;4(6):317–326.
29. Thilagavathy S, Geetha SN. Work-life balance – a systematic review. VILAKSHAN XIMB J Manag. 2023;20(2):258–276. doi:10.1108/XJM-10-2020-0186.
30. Dede DS, Farhan A. The Effect of Work-Life Balance on Employee Performance. Journal of E-business and Management Science. 2024 Jun 30;2(1):249-55.
31. Al KE. Work-life balance practices and turnover intention: The mediating role of person-organization fit. International Journal of ADVANCED AND APPLIED SCIENCES [Internet]. 2019 Jul 23;6(9):76–84. Available from: https://doi.org/10.21833/ijaas.2019.09.012
32. Ngath S, Siek D, Kork K, Vong C, Ry M, Chhean C. Assessing Employee Satisfaction with Working Environments in Battambang Province, Cambodia: Identifying Key Factors and Organizational Implications. International Journal of Research Publication and Reviews [Internet]. 2024 Jul 1;5(7):1789–801. Available from: https://doi.org/10.55248/gengpi.5.0724.1749
33. Chabbra A, Bohara S. The Impact of Work-Life Balance Initiatives on Employee Retention: A Data-Driven Analysis of Workforce Sustainability. International Journal of Research Publication and Reviews [Internet]. 2025 Mar 1;6(3):3666–74. Available from: https://doi.org/10.55248/gengpi.6.0325.11147
34. Roy I. Linking Work-Life Balance Practices with Work-Life Balance Satisfaction and Job Satisfaction: The Mediating Role of Organisational Identification. Journal of Human Resource and Sustainability Studies [Internet]. 2025 Jan 1;13(02):277–301. Available from: https://doi.org/10.4236/jhrss.2025.132016
35. Pandey DK. Work-life balance and organizational performance. J Emerg Technol Innov Res (JETIR). 2019;6(5):191–194.
36. Lumbao E, Ferraren S Jr. Work-Life quality dynamics of employees in a selected Philippine national government entity: Basis for human resource development strategies. Journal of Law and Sustainable Development [Internet]. 2023 Dec 26;11(12):e2682. Available from: https://doi.org/10.55908/sdgs.v11i12.2682
37. Mohanty K, Mohanty S. An Empirical Study on the Employee Perception on Work-Life Balance in Hotel Industry with Special Reference to Odisha. Journal of Tourism and Hospitality Management [Internet]. 2014 Jan 1;2(2). Available from: https://doi.org/10.15640/jthm.v2n2a5

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ARTIFICIAL INTELLIGENCE IN HOSPITAL PROCUREMENT: ADVANCING SUPPLY CHAIN RESILIENCE AND EFFICIENCY IN SINGAPORE

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ABSTRACT

The COVID-19 pandemic exposed critical vulnerabilities in hospital supply chains across the Asia-Pacific region, emphasizing the need for more resilient and agile procurement systems. This study examines how artificial intelligence (AI) is being leveraged to optimize hospital procurement processes in Singapore, a country known for its advanced digital infrastructure and strong public health governance. Using a qualitative research approach based on secondary data, literature analysis, and relevant case studies, the paper explores the application of AI technologies such as predictive analytics, demand forecasting, and supplier risk assessment in Singapore's healthcare procurement ecosystem. The findings reveal that AI integration has improved procurement responsiveness, minimized supply chain disruptions, and enhanced crisis preparedness. A conceptual model is proposed to illustrate how AI supports both operational efficiency and supply chain resilience within resource-optimized yet high-demand health systems. The study also identifies regulatory, workforce, and organizational challenges that influence the pace of AI adoption. The insights from this research offer practical guidance for policymakers, hospital administrators, and supply chain professionals seeking to strengthen procurement systems through AI-driven strategies in digitally mature healthcare environments.

KEYWORDS

Artificial Intelligence; Hospital Procurement; Healthcare Supply Chain Resilience; Digital Health System; Asia-Pacific.

INTRODUCTION

The COVID-19 pandemic, by nearly every measure, exposed deep cracks in the global healthcare supply chain, leading to critical shortages of essential medical supplies and disruptions in logistics [1]Singapore, despite its advanced healthcare infrastructure, was not immune to these challenges. The initial surge in COVID-19 cases, particularly among migrant worker dormitories in early 2020, stressed the healthcare supply system and prompted urgent responses to enhance supply chain resilience [2]

Global healthcare has, of course, rushed toward digital upgrades since 2020, yet the pace-and depth-of AI adoption still looks very different from one country to another. In some places a full-stack AI platform sits at the heart of purchasing, while elsewhere teams are still estimating stock levels on whiteboard walls. The mismatch keeps showing up in frontline resilience: hospitals that leaned into tech early generally bounced back faster when fresh shocks rolled in. The COVID-19 pandemic highlighted key elements of emergency preparedness. These include having national or regional strategic reserves of personal protective equipment, intensive care unit (ICU) devices, consumables and pharmaceuticals, as well as effective supply chains and efficient utilization protocols [3]

In response to these pandemic pressures, Singapore accelerated efforts to pilot and implement AI-driven tools aimed at demand forecasting, inventory management, and procurement optimization within hospital supply chains. These initiatives, beginning around mid-2020, were intended to mitigate supply disruptions and improve operational agility during crises. Singapore's government procurement framework, coupled with emergency procurement procedures, enabled rapid acquisition and distribution of essential goods, helping to prevent shortages despite global disruption
Singapore stands out in the Asia-Pacific conversation about AI-powered hospital purchasing. Its digital maturity is backed by signature push projects, most notably the Smart Nation initiative and the National AI Strategy. Centralized organs like MOH Holdings, together with hospital families such as SingHealth and the National University Health System, have already piloted machine-learning tools that streamline ordering processes, a practice that proved invaluable during the recent pandemic surge.

This research asks how those experiments have strengthened the resilience and speed of procurement workflows. The goal is to catalogue the specific AI solutions in play, inventory the benefits they delivered, and catalogue the hurdles caregivers faced. A qualitative approach, drawing solely secondary sources, literature surveys, and publicly recorded case studies, forms the backbone of the analysis.

This study unfolds in several stages. Section 2 surveys the procurement hurdles faced by hospitals and catalogs how artificial intelligence has been employed across health-system supply chains. Moving to Section 3, a conceptual framework is sketched that ties AI-fueled purchasing decisions to measurable gains in organizational resilience and operational efficiency. Section 4 then shifts to the Singaporean context, documenting local hospitals that have already woven AI tools into their sourcing routines. A short set of policy and practice recommendations appears in Section 5, aimed squarely at healthcare administrators and government decision-makers. The paper closes with Section 6, which restates the central findings and points toward avenues for further inquiry.

LITERATURE REVIEW

HOSPITAL PROCUREMENT AND SUPPLY CHAIN CHALLENGES

As digital health technologies such as telemedicine and e-health become more embedded in healthcare systems, especially through data-driven innovation [4]. Hospital procurement systems are similarly being shaped by the broader wave of digital transformation. Hospital purchasing and inventory networks form a complex web quietly behind every successful patient encounter. Pharmacies, surgical suites, and even the bedside drawer all depend on a choreography that blends centralized buying, commodity forecasting, customs clearance, and on-the-floor readiness. Shortages or transport delays can inflate operational costs and push clinical teams past the breaking point, so profitability and safety travel a shared route. Health economists have traced much of the ledger swell to cutting-edge devices and software; one recent calculation put the technology share of OECD gross domestic product on a curve nobody in finance was comfortable estimating for 2030 [5].

ARTIFICIAL INTELLIGENCE IN PROCUREMENT

Across contemporary commerce, artificial intelligence is moving at speed and reshaping countless routines; purchasing management is already feeling the squeeze [6]. Smart algorithms promise a total overhaul: sourcing supplies, brokering agreements, overseeing vendors, and steering big-picture choices may soon obey rather different logics [7]. By mining

huge data troves, swallowing repetitive chores, and spitting out tactical recommendations, the new tech could hand cost relief, sharpen workflow, and shore up compliance-the trifecta every buyer dreams about [8].

AI IN HEALTHCARE AND HOSPITAL SUPPLY CHAINS

Disruptive technologies such as artificial intelligence, blockchain, and Internet of Things are not only reshaping procurement but also environmental health monitoring, showcasing their cross-functional utility in health systems [9]. Artificial intelligence offers clinicians an unprecedented ability to spot diseases and forecast recovery, thereby sharpening the quality of day-to-day decision-making in hospital [10]. By sifting through mountains of historical charts, lab results, and treatment logs, these algorithms learn to match a patient's telltale sign with what happened afterward [11]. The insight that emerges often equips doctors and nurses to act with fresh confidence, so direct gains in patient welfare usually follow [11]. Beyond the bedside, AI engineers are quietly redesigning the supply chains that feed medicines, gloves, and scanning time to frontline workers, making sure nothing sits on a shelf too long. In Singapore-a Smart Nation already stitched together by fiber-optic cables and 5G radios-local authorities see the technology as ready to graduate from pilot ward to province-wide rollout [12]. Hospitals that embrace the shift report shorter queues, longer lifespan gains, and, perhaps surprisingly, smaller bills for the stretched health budget [10]

THEORETICAL FRAMING: SUPPLY CHAIN RESILIENCE AND DIGITAL TRANSFORMATION

Recent scholarship suggests that merging insight from resilience theory with the principles of digital transformation can illuminate contemporary supply-chain management under growing global strain [13]. At its core, supply-chain resilience is the capacity to absorb shocks and return to full function, a quality that firms now cite as vital to preserving both workflow and market edge [14]. Digital transformation-the widespread adoption of connected tools and data platforms-is credited with offering new levers for that toughness, even if its rollout often brings technical headaches alongside opportunity [15]. Given the labyrinthine structure of today's sourcing networks and the dizzying parade of disruptions-wildfires, container port blockages, trade embargoes-managers are left asking how specific digital fixes can shore up strength when the next blow arrives [16].

METHODOLOGY

This study adopts a systematic review methodology based exclusively on secondary data sources to investigate the incorporation of artificial intelligence within the healthcare supply chains in Singapore. The review is from 2020 to 2025, thereby capturing developments that occurred during and after the COVID-19 pandemic.

Inclusion criteria centered on peer-reviewed articles, governmental reports, internal hospital publications, and industry-oriented case studies that specifically discussed AI technologies, innovative applications, and procurement streamlining within Singapore's healthcare environment.

The review examined key databases and information repositories, specifically PubMed, Scopus, Web of Science, the Singapore Ministry of Health's publication archive, and libraries of healthcare technology vendors. The search strategy employed a combined keyword approach featuring terms such as "Singapore," "healthcare supply chain," "artificial intelligence," "procurement," "COVID-19," and "demand forecasting."

Data extraction and synthesis were executed following a thematic content analysis protocol, which aimed to unearth implementation results, functional performance indicators, encountered challenges, and accrued insights. Particular emphasis was placed on hospital-level case studies, most notably Singapore General Hospital, to assess the assimilation of AI-enabled Enterprise Resource Planning (ERP) platforms, with operational metrics and barriers to integration as focal points.

Constraints of the methodology derive primarily from the absence of original data collection techniques, such as semi-structured interviews or direct observational studies, thereby restricting empirical corroboration and diminishing the depth

of understanding regarding front-line user experiences and intra-organizational dynamics. This lacuna is explicitly recognized and earmarked as warranting further investigative effort.

CONCEPTUAL FRAMEWORK

The conceptual framework advanced herein is anchored in the Technology Organization Environment (TOE) model, which elucidates the dynamics of technological adoption in institutional settings. By leveraging this model, the analysis elucidates how artificial intelligence instruments, institutional preparedness, and contextual exigencies interact to influence procurement performance in the healthcare sector.

- The technological facet encompasses innovations such as predictive analytics for demand signal forecasting, natural language processing (NLP) for contract review automation, and dashboard-centric inventory oversight. Each of these components is designed to foster anticipatory, evidence-based decision-making across the hospital supply chain.

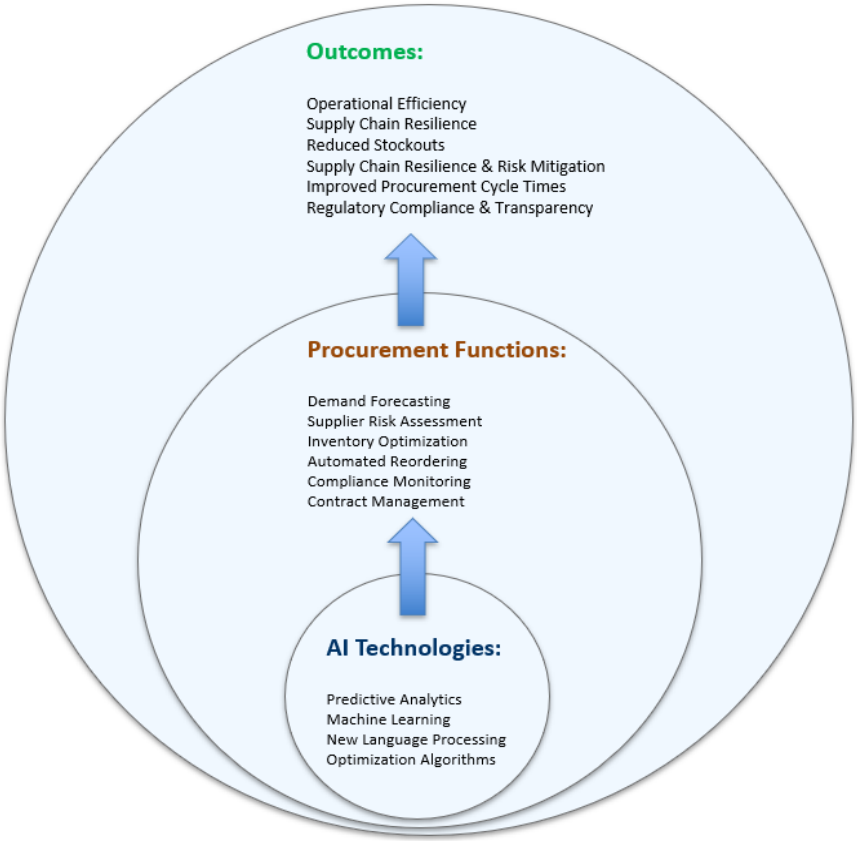
- The organizational layer examines intra-institutional assets and capabilities, including digital backbone architecture, procurement process configuration, and workforce proficiency. Singapore's public hospital cluster, which benefits from the stewardship of MOH Holdings and a centralized enterprise resource planning (ERP) backbone, possesses a cohesive foundation for the systematic diffusion of AI capabilities across constituent institutions.

- The environmental layer integrates regulatory endorsement, the overarching national digital health roadmap, and disruptive exogenous events such as pandemics. The COVID-19 crisis, for example, revealed systemic vulnerabilities in global sourcing and supply, thereby accelerating efforts to construct predictive, automated, and resilient hospital logistics networks [1]

In Singapore's hospitals, the practical integration of AI into procurement illustrates the interaction of the TOE framework. Procurement executives now access AI-driven dashboards that issue real-time alerts, initiating automatic reorders the moment inventory crosses predefined thresholds, or projecting future demand by analyzing developing patterns. Similarly, the experience of Indian environmental health systems illustrates how the synergistic application of AI and the Internet of Things, acting on shared databases, creates early warning systems, optimizes the dispatch of critical supplies, and enables ongoing surveillance capabilities that directly advance procurement objectives such as rigorous supplier assessment and precise stock management [9]

This study reconceptualises procurement as a dynamic, AI-augmented business function, which in turn allows for systematic evaluation of whether digital instruments substantively fortify resilience and streamline operations. The framework deliberately omits clinical AI applications, such as algorithms for diagnostic imaging or patient outcome forecasting, to avert confusion between fundamentally different domains. Both categories reside within the wider digital health architecture, yet procurement AI demands distinct deployment strategies, regulatory compliance pathways, and evaluative criteria tailored to its specific operating environment.

FIGURE. 1. A CONCEPTUAL FRAMEWORK ILLUSTRATING THE INTEGRATION OF AI TECHNOLOGIES, PROCUREMENT FUNCTIONS AND OUTCOMES IN HOSPITAL PROCUREMENT.



AI ADOPTION IN SINGAPORE'S HOSPITAL PROCUREMENT SYSTEM

Singapore has consistently led the region adopting advanced technologies, and its healthcare sector is no exception. AI is now embedded in procurement operations, enabling hospitals to predict supply requirements with heightened accuracy. During crisis such as COVID-19 pandemic, facilities tapped machine-learning algorithms to scrutinize historical usage data and project future demand, a move that curtailed both stockouts and surplus waste. Artificial Intelligence often improves weather prediction and the forecast of severe weather incidents [9] the same principle applies when those models are re-oriented to anticipate material flows.

REAL-WORLD APPLICATION OF AI IN PROCUREMENT

Singaporean hospitals have begun letting Artificial Intelligence take the lead in procurement, a move that is already underscoring sharper cost control and streamlined purchasing across the entire health network.

Singapore General Hospital (SGH) has implemented customized Enterprise Resource Planning (ERP) systems, including SAP R3 integrated with hospital-specific modules (Hospital 2000 system), to streamline procurement workflows and inventory management. This integration has reengineered traditional procurement and supply chain processes, improved real-time data access and reduced delays in medicine ordering and distribution [17]. Other public clusters such as the National Health System (NUHS) and the National Healthcare Group (NHG) have aligned with MOHH's digital roadmap, adopting similar AI-enhanced procurement strategies within their hospitals.

Artificial intelligence can mirror human decision-making in ways that once seemed fanciful, and its effects have begun to arrive on the shop floor. In finance, trading fvloors already lean on machine-driven models for real-time portfolio tweaks and for sorting out shady transactions in the blink of an eye [18]. Modern hospitals now use AI to analyze past invoices and inventory; this generates timely recommendations on purchases. During flu spikes stock levels for consumables are automatically adjusted. Supplier quotes are analyzed based on cost, quality and delivery.[11]. Because grading is

automated, the system ensures fairness and eliminates favoritism. It prioritizes patients care with early warnings that prevent shortages [19].

Modern artificial-intelligence algorithms can sift through mountains of data-including old purchase logs, up-to-the-minute pricing signals, and scenario-driven forecasts-in search of the most advantageous buying paths [20]. By accurately projecting future needs for consumables, drugs, and high-tech gear, hospitals keep shelves stocked without tipping into expensive surplus. A second promise lies in AI's power to read supplier offers at electronic speed, assigning weights to cost, craftsmanship, on-time arrivals, and the fine print of legal compliance. That kind of machinery lifts busy administrators out of paperwork ruts and grounds every choice in hard evidence rather than gut feeling, a point underscored by [21].

Generative AIs even churns out faux patient records, a trick that researchers and trainees can use without risking real people's privacy [22]. In Singapore's razor-thin procurement world, systems examine vendor trustworthiness, market mood swings, and far-flung political tremors to flag supply hiccups before they become crises. Plugging such smart tools into hospital purchasing fits neatly with the Smart Nation goal of marrying cutting-edge tech to everyday life and keeping the city-state a step ahead on the global stage.

OVERCOMING IMPLEMENTATION CHALLENGES AND REGULATORY CONSIDERATIONS

The appeal of AI in hospital procurement is tempered by real-world challenges. Data security remains paramount, requiring encryption, monitoring, and compliance with regulations like the Personal Data Protection Act. Ethical concerns follow: Are algorithms fair? Who is accountable for errors? As Jiang noted in 2017, regulations often lag innovation. Staff must also be trained to interpret AI output, not just read dashboards. [23]emphasized that legal, ethical, and regulatory safeguards ranging from audits to post-implementation reviews are baseline requirements to ensure patient safety and fair market practices. Systems that never rest, probing for vulnerabilities around the clock, form the bedrock of secure AI deployment; so, too, do routines that refresh predictive models with the latest incoming data [21]. Grappling steadily with these tasks will clear a pathway for Singaporean hospitals to adopt artificial intelligence in purchasing without sacrificing oversight or integrity.

Singapore's centralized procurement structure does enable the swift rollout of artificial intelligence solutions; however, the scarcity of public records on instances where solutions underperformed or pilot initiatives fell short hampers the cultivation of a resilient capability development culture. The absence of such documentation inhibits the identification of latent operational vulnerabilities and the refinement of adaptive strategies.

A pressing risk is the temptation to delegate critical procurement activities such as vendor suitability assessments and the calibration of emergency consignment triggers entirely to algorithmic systems. [24] observe that errors, however statistically infrequent, can escalate in high-stakes settings if the model's predictive confidence is not balanced by systematic human verification and parallel system stress testing.

IMPLICATIONS AND RECOMMENDATIONS

Singapore's hospitals have begun to weave Artificial Intelligence into their procurement processes with encouraging results, and that experience now provides a useful roadmap for health executives, regulators, and tech designers who want to upgrade supply chains in other busy healthcare systems. Though the initiative has already produced clear benefits, faster ordering cycles, better supplier accountability, and stronger buffers against disruption, maintaining and expanding those advantages will demand coordinated effort in three interlocking areas: the hospital sector itself, the framework of public policy that supports it, and the evolving landscape of digital tools and platforms.

FOR HOSPITAL ADMINISTRATORS AND PROCUREMENT LEADERS

Hospital administrators must prioritize artificial intelligence literacy and reskilling procurement teams so that decision-makers can both grasp and have confidence in the insights produced by AI. Also investing in modular, interoperable procurement platforms that can easily integrate seamlessly with other hospital data systems already in operation. In

addition, institutions should implement ongoing evaluation frameworks that quantitatively assess the return on investment for AI technologies, measuring their impact on supply chain efficiency, patient outcomes, and overall cost-effectiveness.

FOR POLICYMAKERS AND REGULATORS

For artificial intelligence to deliver its full potential, those in charge of policy need to lay the foundation by standardizing the way procurement data is formatted, supporting open-data infrastructure, and using central measures like grants or co-funding to encourage collaboration between different sectors. In addition, governance frameworks must tackle issues of algorithm transparency, ethics and accountability if the public is to trust the technology and if automated decisions are to be genuinely fair.

FOR TECHNOLOGY PROVIDERS AND DEVELOPERS

AI developers should collaborate directly with hospitals when designing their solutions, ensuring that new tools genuinely address everyday operational challenges and comply with local purchasing rules. A clear focus on explainable AI is essential; when procurement decisions can be easily understood and audited, stakeholders feel more confident, particularly during major spending projects.

CONCLUSION

This research investigated the role of artificial intelligence in streamlining hospital purchasing processes and strengthening overall resilience in Singapore. Healthcare systems worldwide have felt mounting strain since the COVID-19 outbreak, and Singapore's planners now view AI as a powerful driver of agile, evidence-based procurement. Centralized purchasing managed by MOH Holdings, together with a robust national digital backbone, has created fertile ground for blending AI capabilities such as predictive models, supplier risk dashboards, and live inventory trackers.

The conceptual model articulated in the study traced direct connections between specific AI functions and traditional procurement activities, revealing that when the two are harmonized, operations improve while the supply chain grows sturdier. Data gathered from Singapore's network of public hospitals showed clear gains, including shorter delivery times, smarter stock allocations, more reliable suppliers, and a sharper ability to respond in emergencies.

The report also pointed out hurdles like fragmented data repositories, skill shortages among staff, pressing ethical questions, and inconsistent technology deployment from one site to the next. Overcoming these obstacles will demand close collaboration among hospital leaders, government officials, and solution developers.

Singapore's journey in digitizing its healthcare supply chain provides useful insights for nations pursuing similar reforms. IT has succeeded because of governance frameworks, institutional capabilities, and emerging technologies. As artificial intelligence matures, scholars and practitioners should investigate its lasting effects on cost efficiency, the standard of patient care, and the way human and machine expertise can best complement one another during procurement choices.

In the end, constructing robust and streamlined hospital purchasing systems with the help of AI is more than a straightforward tech enhancement; it is a core strategic necessity for healthcare systems that intend to remain responsive in the years ahead.

References

1. P. Chowdhury, S. K. Paul, S. Kaisar, and M. A. Moktadir, "COVID-19 pandemic related supply chain studies: A systematic review," Transp Res E Logist Transp Rev, vol. 148, Apr. 2021, doi: 10.1016/j.tre.2021.102271.
2. A. Q. Chua et al., "Health system resilience in managing the COVID-19 pandemic: lessons from Singapore," BMJ Glob Health, vol. 5, no. 9, Sep. 2020, doi: 10.1136/BMJGH-2020-003317.

3. Y. M. Arabi et al., "How the COVID-19 pandemic will change the future of critical care," Mar. 01, 2021, Springer Science and Business Media Deutschland GmbH. doi: 10.1007/s00134-021-06352-y.
4. A. Kumar, S. K. Sandhu, G. Madaan, N. Gupta, and S. Ahmed, "REVIEW OF TELEMEDICINE AND E-HEALTH: A BIBLIOMETRIC ANALYSIS," in Asia Pacific Journal of Health Management, Australasian College of Health Service Management, 2023. doi: 10.24083/apjhm.v18i2.2399.
5. E. Hollnagel and J. Leonhardt, "From Safety-I to Safety-II: A White Paper," Jun. 2014.
6. S. Ronchi, M. Guida, F. Caniato and A. Moretto, "The role of artificial intelligence in the procurement process: State of the art and research agenda," Journal of Purchasing and Supply Management, vol. 29, no. 2, p. 100823, Jun. 2023, doi: 10.1016/j.pursup.2023.100823.
7. O. A. Cherif, V. Simon-Moya, A. C. C. Ballester, "Intelligent purchasing: How artificial intelligence can redefine the purchasing function," J Bus Res, vol. 124, pp. 69–76, Apr. 2020, doi: 10.1016/j.jbusres.2020.11.050.
8. Y. Riahi, T. Saikouk, and I. Badraoui, "Artificial intelligence applications in supply chain: A descriptive bibliometric analysis and future research directions," Expert Syst Appl, vol. 173, p. 114702, Apr. 2021, doi: 10.1016/j.eswa.2021.114702.
9. A. Kumar, G. Madaan, P. Sharma, and A. Kumar, "Application of Disruptive Technologies on Environmental Health: An Overview of Artificial Intelligence, Blockchain and Internet of Things," Asia Pacific Journal of Health Management, vol. 16, no. 4, Dec. 2021, doi: 10.24083/apjhm.v16i4.1297.
10. P. L. Frana, "Assessing Smart Nation Singapore as an International Model for AI Responsibility," International Journal on Responsibility, vol. 7, no. 1, Jun. 2024, doi: 10.62365/2576-0955.1109.
11. F. Jiang, "Overview Of the Medical Artificial intelligence (Ai) research," Jun. 2017.
12. A. Y. Z. Tung and L. W. Dong, "Malaysian Medical Students' Attitudes and Readiness Toward AI (Artificial Intelligence): A Cross-Sectional Study," J Med Educ Curric Dev, vol. 10, Jun. 2023, doi: 10.1177/23821205231201164.
13. N. Zhao, J. Hong, and K. H. Lau, "Impact of supply chain digitalization on supply chain resilience and performance: A multi-mediation model," Int J Prod Econ, vol. 259, p. 108817, Jun. 2023, doi: 10.1016/j.ijpe.2023.108817.
14. A. A. A. Ali, A. A. A. Sharabati, M. Allahham, and A. Y. Nasereddin, "The Relationship between Supply Chain Resilience and Digital Supply Chain and the Impact on Sustainability: Supply Chain Dynamism as a Moderator," Sustainability, vol. 16, no. 7, p. 3082, Jun. 2024, doi: 10.3390/su16073082.
15. M. Zhang and Z. Huang, "The Impact of Digital Transformation on ESG Performance: The Role of Supply Chain Resilience," Sustainability, vol. 16, no. 17, p. 7621, Jun. 2024, doi: 10.3390/su16177621.
16. C. Cordón, "The Surprising Developments of Digital Supply Chains to Raise Resilience in the Face of Disruptions," Jun. 2023. doi: 10.56506/kpjd9061.
17. C. Le, A. Kumar, and S. J. Shim, "Exploring Virtual Value Chain in Hospitals: A Case study at Singapore Hospital."
18. [18] E. Almustafa, A. Assaf, and M. Allahham, "Implementation of Artificial Intelligence for Financial Process Innovation of Commercial Banks," Revista de Gestão Social e Ambiental, vol. 17, no. 9, Jun. 2023, doi: 10.24857/rgsa.v17n9-004.
19. P. K. Singh, "Transforming Healthcare through AI: Enhancing Patient Outcomes and Bridging Accessibility Gaps," Jun. 2025, doi: 10.2139/ssrn.5115767.
20. M. Alirezaie, W. Hoffman, P. Zabihi, H. Rahnama, and A. Pentland, "Decentralized Data and Artificial Intelligence Orchestration for Transparent and Efficient Small and Medium-Sized Enterprises Trade Financing," Journal of risk and financial management, vol. 17, no. 1, p. 38, Jun. 2024, doi: 10.3390/jrfm17010038.
21. T. E. Edunjobi and O. A. Odejide, "Theoretical frameworks in AI for credit risk assessment: Towards banking efficiency and accuracy," International Journal of Scientific Research Updates, vol. 7, no. 1, pp. 92–102, Jun. 2024, doi: 10.53430/ijsru.2024.7.1.0030.
22. C. S. Veluru, "Impact of Artificial Intelligence and Generative AI on Healthcare: Security, Privacy Concerns and Mitigations," Journal of Artificial Intelligence & Cloud Computing, vol. 3, no. 1, pp. 1–6, Jun. 2024, doi: 10.47363/jaicc/2024(3)347.
23. C. Mennella, U. Maniscalco, G. De Pietro and M. Esposito, "Ethical and regulatory challenges of AI technologies in healthcare: A narrative review," Jun. 2024, Elsevier BV. doi: 10.1016/j.heliyon.2024.e26297.
24. J. Waring, C. Lindvall, and R. Umeton, "Automated machine learning: Review of the state-of-the-art and opportunities for healthcare," Apr. 01, 2020, Elsevier B.V. doi: 10.1016/j.artmed.2020.101822.

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WEARABLES IN HEALTHCARE: A STUDY OF PATIENT PERCEPTIONS, USAGE, AND BARRIERS TO EFFECTIVE INTEGRATION

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ABSTRACT

Wearable devices are transforming the healthcare sector by facilitating continuous health monitoring, promoting proactive patient management, and enhancing overall health outcomes. From basic fitness bands to sophisticated health sensors, these devices gather real-time data on vital signs, physical activity, and other physiological metrics, providing crucial insights for both patients and medical professionals. Despite the growing adoption of wearables, there remains a need to understand user perceptions, actual usage patterns, and challenges. Such insights can help bridge gaps in healthcare delivery and improve patient outcomes, for various patient groups.

This study investigates patients' perceptions, usage behaviour, and the perceived limitations of wearable health technologies through a structured survey.

Findings indicate that while awareness and adoption levels are relatively high, a significant proportion of users remain sceptical about the effectiveness of wearables for long-term health monitoring. The most valued benefits cited by respondents are physical activity tracking, sleep monitoring, and stress tracking. However, key challenges include concerns over data privacy and accuracy, lack of seamless integration with formal healthcare systems, limited digital literacy, accessibility issues, high costs, and inadequate battery performance.

The findings highlight a critical gap between adoption and trust in wearable health technologies, underscoring the need for improved reliability, data privacy, user education, and healthcare integration to enhance patient confidence and outcomes. Overcoming these challenges is key to unlocking the full benefits of wearables in delivering accessible and effective healthcare.

KEYWORDS

data security and privacy, healthcare integration, Health Belief Model (HBM) Patient Empowerment, user adoption, wearable devices

INTRODUCTION

India's healthcare sector has witnessed tremendous growth in the past few years attracting substantial investments amounting to Rs. 2,61,900 crore (US$ 30 billion) between 2022 and 2024. The foreign direct investment (FDI) in healthcare and diagnostics has reached Rs. 27,140 crores ($3.27 billion USD) [1]. Increased demand for quality healthcare, deep insurance penetration and post pandemic resilience have contributed to remodelling this industry.

Despite this promising future, the healthcare sector in India sector faces several challenges. The biggest challenge is the urban-rural bed disparity. While 60% beds are available in metropolitan cities, 70% of Indian population resides in rural areas. According to a report on the state of healthcare in India [2] rural areas face a critical shortage of trained healthcare staff, resulting in limited diagnostic services. The report highlights that 73% of households with elderly members require constant care. Doctor vacancies in Primary Healthcare Centres (PHCs) are alarmingly high, with Chhattisgarh at 71%, followed by West Bengal (44%), Maharashtra (37%), and Uttar Pradesh (36%). India's doctor-patient ratio stands at about 1:1456, below the WHO's recommended 1:1000. Additionally, government health spending is low—around 1.28% of GDP—with rural health infrastructure receiving only a small portion, leading to underfunded facilities.

A report on Statista [3] shows that healthcare professionals are concentrated more in cities due to better career progression opportunities and pay scale. India is among the 57 countries facing a shortage of human resources for health. Against the WHO's recommended standard of 44.5 doctors, nurses, and midwives per 10,000 people, India's current density stands at 20.6. This marks a notable rise from 13.6 per 10,000 in 2005 [4]. This shortage causes delays in diagnosis and treatment, leading to long patient wait times. Rising lifestyle diseases and road accidents have increased emergency care demand, overcrowding tertiary hospitals and emergency departments, which compromises care quality and increases risks [5].

Another challenge is access to healthcare facility. Rural India has limited access to Primary Health Centres (PHCs) and Community Health Centres (CHCs), forcing many to rely on unregistered private practitioners. Rural populations often bypass primary care facilities due to low trust in public healthcare, overcrowding higher-level hospitals [6]. Additionally, high treatment costs pose a challenge, despite government health insurance schemes aimed at improving access to care [7]. High workload in the medical field leads to poor performance, increased errors, medical negligence and discharge against medical advice resulting from overworked healthcare professionals [8].

Even in developed cities, healthcare systems often face significant challenges such as overcrowded hospitals, long wait times, and staff shortages. Despite advanced infrastructure, unequal access to care and high treatment costs affects many patients. Additionally, gaps in digital health adoption and administrative inefficiencies reduce overall effectiveness. Given these critical gaps, India urgently needs a shift toward patient-empowered, preventive, and technology-driven healthcare. One of the most promising solutions lies in the integration of Artificial Intelligence (AI) and the fast-evolving wearable technology which is expected to bring a paradigm shift in the healthcare sector. AI-driven predictive analytics and remote healthcare solutions can improve diagnosis accuracy and help address disparities. Healthcare practitioners can adopt AI for patient monitoring, treatment planning, and administrative efficiency [9].

When incorporated into wearable devices, AI-powered wearables enable continuous, real-time health monitoring and early detection of complications—crucial for chronic disease management and preventive care [10]. Guo & Li [11] have confirmed that unobtrusive sensors effectively track heart rate, blood pressure, and oxygen levels to detect health deterioration. Wearable devices that track health signs like heart rate, blood pressure, blood sugar, and even heart rhythms (ECG) have shown to improve the management of long-term conditions such as heart disease and diabetes. Some advanced wearables use smart sensors and artificial intelligence to detect serious issues like irregular heartbeats with up to 95% accuracy [12].

Wearable devices empower patients by promoting engagement in their own health and ensuring better adherence to treatment plans, ultimately improving clinical outcomes. The integration of wearable technology into healthcare systems fosters precision and efficiency in clinical decision-making. By continuously tracking vital parameters like heart rate, blood glucose levels, and blood pressure, healthcare providers can develop personalized therapeutic strategies for conditions such as diabetes, hypertension, and cardiovascular diseases.

While wearable technology offers promising benefits, key challenges such as data privacy, system compatibility, and user acceptance continue to hinder its full integration into mainstream healthcare. Addressing these concerns is essential to realizing the true potential of wearables in supporting accessible and efficient care. Wearable technology, if implemented thoughtfully, has the potential to bridge gaps in access, enable early interventions, and empower patients.

THEORETICAL FRAMEWORK:

To better understand user adoption and engagement with wearable health devices, this study draws on the Health Belief Model (HBM), developed by social psychologists *Irwin M. Rosenstock, Godfrey M. Hochbaum, S. Stephen Kegeles, and Howard Leventhal* (1950) [13]. The HBM model suggests that an individual's decision to engage in a health behavior (e.g. using wearable health devices) is influenced by six key constructs: 1) Perceived susceptibility (e.g. risk of complications from uncontrolled diabetes or hypertension) 2) Perceived severity (e.g. fear of heart attacks or long-term disability) 3) Perceived benefits (when patients believe that wearables can improve health outcomes, they are more likely to accept and use the technology) 4) Perceived barriers like cost, data privacy, device complexity, or lack of awareness may hinder adoption 5) Cues to Action (may include physician recommendations, a recent health scare, peer influence, or exposure to promotional campaigns highlighting the benefits of wearable tech.) 6) Self-Efficacy (patients who feel confident in using wearable technology are more likely to engage with these devices consistently).

This study investigates whether wearable technology can serve as a feasible and scalable solution for improving chronic disease management and in reducing the burden on India's conventional healthcare systems. Prior research indicates that despite potential benefits, patients often show reluctance due to usability challenges, cost and data privacy issues [14]. It further explores barriers to adoption and patient experiences to understand its practical role in preventive healthcare.

However, ensuring equitable access and sustainable implementation will require collaborative efforts from policymakers, healthcare providers, technology developers, and end users alike.

LITERATURE REVIEW:

In India, low public healthcare spending and minimal insurance push millions into poverty due to medical expenses, disproportionately impacting marginalized groups. This study reveals high out-of-pocket expenses, especially in private healthcare, with low Epidemiological Transition Level (ETL) states facing greater financial distress, emphasizing the need for targeted health reforms [15]. Government healthcare spending remains low at 0.9% of GDP [16], which rose to 1.84 % in 2021-2022 [17] leading to high out-of-pocket expenses, pushing many into poverty. Poor sanitation and polluted water contribute to widespread health issues, while inadequate staffing and absenteeism further weaken healthcare delivery. Strengthening infrastructure, increasing skilled workforce, and community participation are essential for effective rural healthcare reforms [5]. Densely populated urban slums contribute to faster disease spread, raising hospitalization demands. Rural areas struggle with insufficient healthcare facilities, including a shortage of hospitals and beds. Moreover, despite government health insurance initiatives designed to enhance access, high treatment costs remain a significant barrier [18]. Research by Kesarwani & Garg [19] highlights several key factors contributing to burnout among Indian doctors. Prolonged working hours, professional dissatisfaction, and perceived stress are major causes. Low remuneration, insufficient time for leisure activities, and disturbed sleep patterns further elevate the risk. Additionally, a lack of respect in the workplace has been identified as a significant factor impacting doctors' mental well-being. Existing literature by Player

[20] highlights the challenges faced by rural population in accessing the healthcare facilities. The public healthcare funding is spent on urban settings while the private healthcare setups operate in cities leaving rural communities underserved. Shortage of trained healthcare providers often forces the rural population to rely on unqualified local providers or travel up to 100 kms for proper care.

India has integrated technology into healthcare through initiatives like the National Medical College Network and National Rural Telemedicine Network, improving e-health services. Enhanced broadband connectivity has expanded telehealth, addressing gaps from population growth and workforce shortages. Wider telemedicine adoption can improve public health, elderly care, and pandemic preparedness [21]. A study by Md Faiyazuddin [22] highlights AI's role in enhancing healthcare in India by improving diagnosis, treatment personalization, and resource management. AI solutions can address healthcare gaps, particularly in low-resource areas. However, collaboration among stakeholders is essential for ethical and equitable AI integration. The study by Kacker [23] found that 47.7% of adults surveyed in an urban Indian IT sector setting used health promotion-oriented smart devices, primarily smartwatches, with 55% using them daily to track physical activity. Key barriers to wider adoption included concerns about data reliability (53.8%), cost (37.2%), and privacy (21.8%). Another study by Ferguson & Davidson [24] highlights key barriers and facilitators affecting the acceptance of wearable devices among older adults, patients, caregivers, and healthcare professionals. Some of the reasons for reluctance are - concerns about device design, usability, affordability, and lack of timely feedback.

OBJECTIVES OF THE STUDY:

- To assess awareness and adoption of wearable devices for chronic disease management.
- To identify patient perceptions and barriers to wearable health technology.
- To recommend strategies for effective integration of wearables into healthcare systems.

RESEARCH METHODOLOGY

To assess the effectiveness of wearable technology in addressing healthcare disparities, a quantitative research approach was adopted. A structured questionnaire was designed to collect data on patient awareness, usage, perceived benefits, and barriers related to wearable health devices. Primary data was collected from the Pune region in Maharashtra. As there is no specific database providing an exact count of patients in the area, the population was considered infinite. Using Cochran's formula for an infinite population, a minimum sample size of 384 was determined [25]. A total of 435 questionnaires were distributed to respondents visiting in hospitals located in Kothrud, Pune, out of which 421 were returned. After excluding 11 incomplete responses, the final sample size for analysis was 410. Secondary data was sourced from various credible materials including research papers, academic journals, articles, newspapers, and verified online platforms to support the study and provide contextual background.

RESEARCH DESIGN

This study adopts a quantitative research design to examine awareness, adoption, perceptions, and barriers related to wearable health technologies among patients with chronic diseases in India. A structured survey was used to gather numerical data that can be statistically analysed to identify patterns and relationships. Patients diagnosed with chronic diseases such as diabetes, hypertension, and cardiovascular conditions, residing in both urban and rural areas in Pune, Maharashtra, India is considered as research population. Researchers have considered an infinite population as there is no database to provide exact number of patients in Pune, Maharashtra region, India. Snowball sampling method is used for collection of data. Based on Cochran's formula for an infinite population, a minimum sample size of 384 was determined, researchers collected data from the 410 patients for more inclusiveness [25].

DATA COLLECTION METHODS

A structured questionnaire was designed based on the Health Belief Model (HBM). The questionnaire was administered in person or digitally, depending on participant's accessibility and preference.

Ethical Considerations

- Informed consent was obtained from all participants prior to data collection.

- Anonymity and confidentiality of participants were strictly maintained.

PRIMARY DATA ANALYSIS

To ensure reliability, Cronbach's alpha was calculated, and content validity assessments were conducted to confirm the questionnaire's validity. The questionnaire was developed by identifying key variables through a review of existing literature, an analysis of secondary data and with unstructured discussion with patients.

TABLE NO 1: CASE PROCESSING SUMMARY

		N	%
Cases	Valid	410	100.0
	Excluded[a]	0	.0
	Total	410	100.0

[a]. Listwise deletion based on all variables in the procedure.

TABLE NO 2: RELIABILITY STATISTICS

Cronbach's Alpha	N of Items
.834	19

A reliability test was performed using Cronbach's alpha based on the internal consistency method. The computed Cronbach's alpha value was 0.834, with a standardized items alpha of 0.834. Since Cronbach's alpha value above 0.70 is deemed acceptable [26], it confirms that the data collected through the questionnaire is reliable. To validate the content, the drafted questionnaire was reviewed by six experts. Additionally, reliability and validity tests were conducted to ensure their appropriateness.

DEMOGRAPHIC PROFILE-

TABLE NO 3: DEMOGRAPHIC PROFILE

Gender	Frequency	Percent (%)	Valid Percent (%)	Cumulative Percent (%)
Male	226	55.1	55.1	55.1
Female	184	44.9	44.9	100.0
Region				
Rural	25	6.1	6.1	6.1
Semi Urban	70	17.1	17.1	23.2
Urban	315	76.8	76.8	100.0
Family Annual Income				
Less than 8 Lac	209	51.0	51.0	51.0
8L-16 L	126	30.7	30.7	81.7
16 L-24 L	51	12.4	12.4	94.1
24 L and above	24	5.9	5.9	100.0
Age				
60 and above	17	4.1	4.1	4.1
45-60	257	62.7	62.7	62.7
30 -45	136	33.2	33.2	100.0

- Among the respondents, 226 patients (55.1%) identified as male, while 184 individuals (44.9%) identified as female.
- The majority of the respondents' patients (315) reside in urban areas, whereas 70 respondents are from semi-urban localities, and 25 respondents are from rural regions.
- A significant portion of the respondents' patients (51%) fall into the income bracket of less than 8 lakhs annually, while 126 patients belong to the income range of 8 to 16 lakhs.
- The majority, comprising 257 of the respondents' patients, fall within the 45–60 age group, followed by 136 patients in the 30–45 age group, and the remaining 17 patients belong to the 60 and above age group.

TABLE NO 4: AWARENESS FOR WEARABLE DEVICES AND IT'S ALL FEATURES

Awareness for wearable devices	Frequency	Percent (%)	Valid Percent (%)	Cumulative Percent (%)
1 (No)	20	4.9	4.9	4.9
2(Yes)	390	95.1	95.1	100.0
Awareness about all features of the device	**Frequency**	**Percent (%)**	**Valid Percent (%)**	**Cumulative Percent (%)**
1 (No)	342	83.41	83.41	83.41
2(Yes)	68	16.59	16.59	100.0
Adoption and usage	**Frequency**	**Percent (%)**	**Valid Percent (%)**	**Cumulative Percent (%)**
1(No)	25	6.1	6.1	6.1
2 (Yes)	385	93.9	93.9	100.0

- Among all respondents, 390 patients (95.1%) reported awareness of wearable devices, while 20 individuals (4.9%) indicated a lack of awareness.
- 83.41 % of the respondents are not aware of complete features of their device whereas only 16.58 % of them are aware of all the features.
- Out of the total respondents, 385 patients have adopted and are currently using wearable devices, whereas 25 patients have not adopted or are not using them.

TABLE NO 5: RESPONSES TO HEALTH BELIEF MODEL (HBM) CONSTRUCTS

HBM Construct	Response Level	Frequency	Percent (%)	Valid Percent (%)	Cumulative Percent (%)
Perceived Susceptibility	Low (1)	280	68.3	68.3	68.3
	High (2)	130	31.7	31.7	100
Perceived Severity	Low (1)	290	70.7	70.7	70.7
	High (2)	120	29.3	29.3	100
Perceived Benefits	Low (1)	270	65.9	65.9	65.9
	High (2)	140	34.1	34.1	100
Perceived Barriers	Low (1)	120	29.3	29.3	29.3

	High (2)	290	70.7	70.7	100
Cues to Action	Low (1)	110	26.8	26.8	26.8
	High (2)	300	73.2	73.2	100
Self-Efficacy	Low (1)	275	67.1	67.1	67.1
	High (2)	135	32.9	32.9	100

- Perceived Barriers were reported as high by 70.7% of respondents, indicating that concerns such as cost, data privacy, or device complexity are significant challenges to the adoption of wearable technology.
- Cues to Action were also rated high by 73.2%, suggesting that physician recommendations, recent health scares, or peer influences are strong motivators driving patients toward wearable tech adoption.

In contrast, the following constructs were rated low by most participants:

- Perceived Susceptibility (68.3% low): Many patients do not feel at immediate risk from unmanaged chronic conditions like diabetes or hypertension.
- Perceived Severity (70.7% low): Patients may not fully grasp the seriousness of complications that could arise from untreated conditions.
- Perceived Benefits (65.9% low): A relatively small portion of the population perceives significant health advantages from using wearable devices.
- Self-Efficacy (67.1% low): Many patients lack confidence in their ability to effectively use wearable health technologies.

HYPOTHESIS

Ho: Patients using wearable devices do not believe that wearable devices are effective for health monitoring.
H1: Patients using wearable devices believe that wearable devices are effective for health monitoring.

TABLE NO 6: CASE PROCESSING SUMMARY

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Current using * perceived benefits	410	100.0%	0	.0%	410	100.0%

TABLE NO 7: CURRENT USING * PERCEIVED BENEFITS CROSS TABULATION

		Perceived benefits					Total
		1	2	3	4	5	
Current using	1	7	8	0	3	2	20
	2	131	133	32	57	37	390
Total		138	141	32	60	39	410

TABLE NO 8: CHI-SQUARE TESTS

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.852[a]	4	.763
Likelihood Ratio	3.402	4	.493
Linear-by-Linear Association	.058	1	.810
N of Valid Cases	410		

Since the p-value (0.763) is much greater than 0.05, so it is observed that, researchers fail to reject the null hypothesis [27]. There is no statistically significant association between patients using wearable devices and their belief in the effectiveness of these devices for health monitoring. Patients do not feel using wearable devices are effective for health monitoring.

TABLE NO 9: BARRIERS FOR NOT CONSIDERING WEARABLE DEVICES EFFECTIVE-

Barriers For Not Considering Wearable Devices Effective	Frequency	Percentages %
Data Accuracy and Reliability	345	84.15
Data Privacy and Security	369	90
Accessibility	214	52.2
User Awareness and Participation	164	40
Battery Life and Maintenance	174	42.4
Cost and affordability	185	45.1
Ease of Use & Digital Literacy	215	52.4
Compatibility with healthcare systems	227	55.4
Lack of Standardization	205	50
Unclear health benefits	369	90

The primary barriers patients do not consider wearable devices effective include concerns about data privacy and unclear health benefits (both at 90%), followed closely by data accuracy issues (84.15%). Other notable challenges are poor compatibility with healthcare systems (55.4%), digital literacy barriers (52.4%), and accessibility (52.20%). Cost, battery life, and lack of standardization also contribute to the skepticism.

TABLE NO 10: PERCEIVED BENEFITS OF WEARABLE DEVICES

Perceived benefits of Wearable devices	Frequency	Percentages %
Heart Rate Tracking	140	34.15
Physical Activity Tracking	271	66.10
Blood Oxygen Monitoring	91	22.20
Sleep Tracking	214	52.20
Stress Monitoring	181	44.15
ECG & Blood Pressure Monitoring	107	26.10
Fall Detection & Emergency Alerts	16	3.90
Blood Glucose monitoring	58	14.15

Table 10 shows that among patient respondents, the most commonly perceived benefit of wearable devices is physical activity tracking (66.10%), followed by sleep tracking (52.20%) and stress monitoring (44.15%). Heart rate tracking (34.15%) and ECG & blood pressure monitoring (26.10%) are also notable benefits. Less commonly perceived benefits include blood oxygen monitoring (22.20%), blood glucose monitoring (14.15%), and fall detection/emergency alerts (3.90%).

KEY FINDINGS:

- The majority of patient respondents are male (55.1%), urban residents, and fall within the 45–60 age group. Over half have an annual income below 8 lakhs (c$USD9,078), indicating a middle-income, aging urban demographic.
- A vast majority of patient respondents (95.1%) are aware of wearable devices, and 94.1% have adopted and are currently using them. This indicates high awareness and adoption rates among the patient population.
- Although respondents are aware of and actively using wearable devices, they do not perceive them as effective tools for health monitoring.
- Despite being aware of and using wearable devices, respondents do not view them as effective for health monitoring. This view is influenced by concerns over data accuracy and privacy, poor integration with healthcare systems, limited digital literacy, and unclear health benefits.

- Patients primarily perceive wearable devices as useful for tracking physical activity, sleep, and stress. Less emphasis is placed on features like blood glucose monitoring and fall detection.
- Patients cite key reasons to accepting the effectiveness of wearable devices, including concerns about data privacy, uncertain health benefits, and issues with data accuracy. Other contributing factors are poor integration with healthcare systems, limited digital literacy, accessibility challenges, and practical issues such as cost and battery life.
- Analysis based on the Health Belief Model revealed that while most participants reported high perceived barriers (70.7%) and strong cues to action (73.2%), indicating concerns about cost and privacy but also external motivators such as physician recommendations, the majority exhibited low perceived susceptibility (68.3%), severity (70.7%), benefits (65.9%), and self-efficacy (67.1%).

RECOMMENDATIONS:

- Collaborate with healthcare professionals to validate wearable device readings and enhance sensor accuracy, ensuring alignment with medical standards.
- Provide transparent privacy policies and user controls over data sharing, while implementing robust encryption and secure storage to protect sensitive information.
- Expand awareness campaigns to promote wearables and its important features for health monitoring and chronic disease management, partnering with healthcare providers to increase medical acceptance.
- Introduce affordable pricing models, subsidies, or financing options to make wearable devices accessible to lower-income populations.
- Design user-friendly interfaces and offer digital literacy programs focused on elderly and less tech-savvy users to improve adoption and effective use.

CONCLUSION

Wearable devices are revolutionizing the healthcare industry by enabling continuous health monitoring, proactive patient care, and improved health outcomes. Research highlights a high level of awareness and adoption of wearable devices among patients, particularly urban, middle-income, and middle-aged individuals. While users appreciate benefits like activity, sleep, and stress tracking, their confidence in the devices' health monitoring capabilities is undermined by concerns over data privacy and accuracy. Additional obstacles include poor integration with healthcare systems, limited digital literacy, accessibility and affordability issues, and practical concerns like battery life and standardization. These findings reveal disconnect between usage and trust—underscoring the urgent need for improved reliability, seamless healthcare integration, robust privacy protections, and supportive user education to truly realize the potential of wearable health technologies.

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CONFLICTS OF INTEREST:

All the authors declare there are no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

ETHICAL APPROVAL:

The waiver of any requirements for an ethics committee consideration for this study was given by the Medwin Cares Hospital, Pune [LCBP-2022-00167] (16.08.2025) Appropriate consent was sought from the respondents before filling in the questionnaire. They were clearly told that the data collected will be purely used for the purpose of research and data privacy will be strictly maintained.

References

1. India GT. Healthcare clocked Rs. 2,61,900 crore (US$30 billion) investment in two years. New Delhi: IBEF. 2025.
2. Vision T. State of Healthcare in Rural India 2024. Delhi: Drishti Publications. 2024.
3. Statista. Healthcare in India - statistics & facts. India: A Minhas. 2024.
4. Vini Mehta, P. A. (2024). Human resource shortage in India's health sector: a scoping review of the current landscape. BMC Public Health, 1-13.
5. Tiwari Y, Goel S, Singh A. Arrival time pattern and waiting time distribution of patients in the emergency outpatient department of a tertiary level health care institution of North India. J Emerg Trauma Shock. 2014;160-5.
6. Singh SS, Bandyopadhyay S. Health care in rural India: A lack between need and feed. South Asian J Cancer. 2014;143-4.
7. Bandyopadhyay SN. Developing a Unique Model on Bed Per Doctor & Bed Per Nurse for Increased Patient Satisfaction in India Post Covid-19 Outbreak. Int J Adv Bus Manag Res. 2023;30-7.
8. Azhar GS, Azhar AZ, Azhar AS. Overwork Among Residents in India: A Medical Resident's Perspective. J Family Med Prim Care. 2012;141-3.
9. Neyigapula BS. AI in Healthcare: Enhancing Diagnosis, Treatment, and Healthcare Systems for a Smarter Future in India. Adv Bioeng Biomed Sci Res. 2023;6(10) 171-7.
10. Mattison G, Canfell O, Forrester DA, Dobbins C, Mattison GC. The Influence of Wearables on Health Care Outcomes in Chronic Disease: Systematic Review. J Med Internet Res. 2022.
11. Guo Y, Li X. A review of wearable and unobtrusive sensing technologies for chronic disease management. Comput Biol Med. 2021.
12. Voisin M, Y S. Ambulatory Atrial Fibrillation Monitoring Using Wearable Photoplethysmography with Deep Learning. Phys Med Biol. 2018.
13. Murphy TF. The Key to Health Choices: Demystifying the Health Belief Model. The Psychology Fanatic Newsletter. 2024 Jun 1.
14. Alzghaibi, H. (2025). Perspectives of people with diabetes on AI-integrated wearable devices: perceived benefits, barriers, and opportunities for self-management. Frontiers in Medicine, 1-14.
15. d JY. Health care utilization and expenditure inequities in India: Benefit incidence analysis. Clin Epidemiol Glob Health. 2022;1-10.
16. Sriram, S. (2018). Availability of infrastructure and manpower for primary health centers in a district in Andhra Pradesh, India. Journal of Family Medicine and Primary Care, 1256-1262.
17. Perappadan, B. S. (2024). India registers decline in out-of-pocket expenditure for health: report. New Delhi: The Hindu.
18. Bardosh KL, Jones S. Addressing vulnerability, building resilience: community-based adaptation to vector-borne diseases in the context of global change. PubMed. 2017.
19. Kesarwani V, Garg Z. Prevalence and Factors Associated with Burnout among Healthcare Professionals in India: A Systematic Review and Meta-Analysis. Indian J Psychol Med. 2020;108-15.
20. Player J. Healthcare Access in Rural Communities in India. Ballard Brief. 2019.
21. Maroju R, Chandana S. Role of Telemedicine and Digital Technology in Public Health in India: A Narrative Review. Cureus. 2023;1-8.
22. Md Faiyazuddin S. The Impact of Artificial Intelligence on Healthcare: A Comprehensive Review of Advancements in Diagnostics, Treatment, and Operational Efficiency. Health Sci Rep. 2025.
23. Kacker H. Association of the Self-Assessed Health, Lifestyle and Use of Health Promotion Oriented Smart Devices of Adults in India [dissertation]. Lithuania: Lithuanian University of Health Sciences. 2024.
24. Ferguson C, Davidson L. "Wearables only work on patients that wear them": Barriers and facilitators to the adoption of wearable cardiac monitoring technologies. Cardiovasc Digit Health J. 2021;137-47.
25. Johnson, C. Cochran's Sample Size Calculator. (2025, April 1). Retrieved from dissertation data analysis help: https://dissertationdataanalysishelp.com/cochrans-sample-size-calculator/
26. Cortina JM. What Is Coefficient Alpha? An Examination of Theory and Applications. J Appl Psychol. 1993;98-104.
27. Byjus. P-Value [Internet]. [cited 2025 Jul 14]. Available from: https://byjus.com/maths/p-value/

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EVALUATING AI-ENABLED HEALTHCARE SERVICES: A BIBLIOMETRIC AND TOPIC MODELLING ANALYSIS OF SCHOLARLY PUBLICATIONS

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ABSTRACT

This study examines emerging topics and trends in Artificial Intelligence (AI)-enabled healthcare services, with a particular emphasis on service quality, diagnosis, and treatment enhancement due to the emergence of technology. This study aimed to identify the primary themes found in scholarly publications and examine how those themes have significance in the healthcare sector.

Bibliometric and topic modelling techniques were used to analyse the extracted set of relevant publications. For bibliometric analysis, the bibliometric package Biblioshiny was used in R version 4.4.1, and Latent Dirichlet Allocation (LDA) was utilised for topic modelling. Academic papers from Scopus are included in the dataset, covering the period from 2011 to 2024.

The research analysis highlights that there is a substantial emphasis placed on the use of artificial intelligence in the healthcare industry, notably in the areas of improving diagnosis, treatment personalisation, and operational efficiency related to services provided in the healthcare sector.

KEYWORDS

Artificial intelligence, healthcare, topic modeling, bibliometric analysis, service quality, precision medicine

INTRODUCTION

Artificial Intelligence (AI) has catalyzed a revolution in the healthcare industry that can match the disruption that the industry has observed in the industrial past and it is altering diagnosis, treatment, monitoring and service delivery [1]. This change can be best conceptualized in the context of social-technical system theory, innovation diffusion theory, and theory of quality in healthcare that can explain the opportunities, in addition to, impediments in the change adoption. The term AI used in the study means computational systems that can accomplish tasks that usually demand human intelligence, including the interpretation of data, decision-making, and responsive learning, and in the given study, related to healthcare governance, diagnosis, and patient care. As much as AI has brought better precision, efficiency, and personalisation, regulatory compliance (GDPR, HIPAA, TGA), ethical aspects, cost of deployment and organisational

preparedness limit its injection into reality. Hence, general statements of the allegedly revolutionary impact of AI on the healthcare system should be counter prevented by the recognition of such systemic and contextual shortcomings [2, 3]. This study seeks to achieve three objectives: first, to identify the underlying themes present in articles related to AI-enabled healthcare and service quality; second, to analyse the temporal trend of these themes to determine if they are trending positively, neutrally, or negatively over time; and finally, to identify areas within each theme that offer potential for more influential research by reviewing the existing literature. The following research questions were posed, guided by the following fundamental objectives:

1. What are the emergent topics of research in the fields of artificial intelligence-enabled healthcare services, healthcare service quality, and AI-enabled healthcare practices?
2. How has research in each area progressed over the past two decades?
3. What are the prospects for conducting significant future research in the field of AI-enabled healthcare services?

We utilised bibliometric network analysis and topic modelling to emphasise the interconnections between technology-enabled healthcare facilities and services, as well as the overall structure of health services within the technology-driven knowledge domain. Through this study, we assert that we have made at least three significant contributions to the current corpus of knowledge. First, this is an endeavour to scrutinise the available literature from its inception. Hence, it examines the patterns of scholarly articles focused on artificial intelligence in the healthcare industry, specifically exploring the management of healthcare in the context of technological advancements. Furthermore, by focusing exclusively on scholarly articles related to AI, technology, and service quality in healthcare management, we enhance the existing body of literature in this area. Moreover, emphasis on empirical contributions has resulted in broad and disjointed research streams [4]. Bibliometrics offers a systematic method for examining large quantities of data, enabling researchers to deduce patterns over time, identify recurring topics of study, detect changes in disciplinary boundaries, highlight the most productive scholars and institutions, and present a comprehensive overview of the existing research [5].

The remainder of this study is structured as follows. Section 2 provides detailed explanations of the study methodology, and Section 3 includes the processes of data gathering and pre-processing. Section 4 provides an overview of the findings, which encompass descriptive statistics, word clouds, key topic matrices, topic labelling, and the progression of each topic over time. Section 5 presents conclusions and limitations.

METHODOLOGY

Bibliometric and topic-modelling methods are the research method utilized in the current study. In order to conduct a Bilbilometric analysis the Bibiloshiny R package was utilized [6].

The literature analysis was completed based on the words used in the available literature, the most common words with the help of word cloud, annual scientific production, and descriptive statistics undertaken on literature published in the period between 2011 and 2024 using Scopus database. Aria, M, Cuccurullo, C. [7]. Topic-modelling was incorporated in the study using Latent Dirichlet Allocation which was used to relate words that share certain contexts and differentiate the different meanings of the words. Different Topic Modelling techniques are the Vector Space Model (VSM), Latent Semantic Indexing (LSI), Probabilistic Latent Semantic Analysis (PLSA) and Latent Dirichlet Allocation (LDA). And since all of it has gone to new homes [8]. With the assistance of Latent Dirichlet Allocation (LDA), in the present study, the reasons why the authors use the LDA computational approach to content analysis has been analysed to support the process to explore the underlying structure of theme in a set of given texts. LDA is suitable in the study because this method significantly cuts the time and reliability to uncover topic structure on a large volume of reading. This approach uses an inductive approach and quantitative measures thus it makes it extremely applicable in exploratory and description studies. Companies or institutions ban the use of the internet because of their incapacity to control the quantity of internet users [9][10]. We chose the number of topics (k=5) minimising the perplexity and optimising the coherence to have interpretable results. These values might, however, be taken with caution since the size of the data set used is relatively

small (n=63). Two healthcare informatics experts, who were neutral, reviewed topic labelling to enhance level of theoretical coverage and limited subjectivity.

DATA COLLECTION:

The study aims at disclosing the range of healthcare research in authoritative international journals on AI-enabled technology in terms of healthcare services and its quality, diagnosis, and treatment. The data used were retrieved using the Scopus database, one of the major abstract and citation databases of scholarly work [11, 12]. To get as many materials as possible on the subject, a broad list of keywords has been developed based on the substantial knowledge of the authors in the research area and the review of the literature available in the topic. The reason why Scopus was chosen has to do with a broad interdisciplinary coverage, which includes healthcare, computer science, and management studies. Although Web of Science, PubMed and IEEE Xplore would have provided beneficial sources, they had to be omitted because of limited resources and the choice to rely on only one substantial database. This choice has been recognized as a weakness given that it could make differences on the comprehensiveness and impose a selection bias. Inclusion and exclusion filters were used such as (i) the type of documents: articles, reviews, conference papers, or book chapters; (ii) language: English; (iii) publication status: final published version; and (iv) whether it touches upon AI-enabled healthcare-related themes.

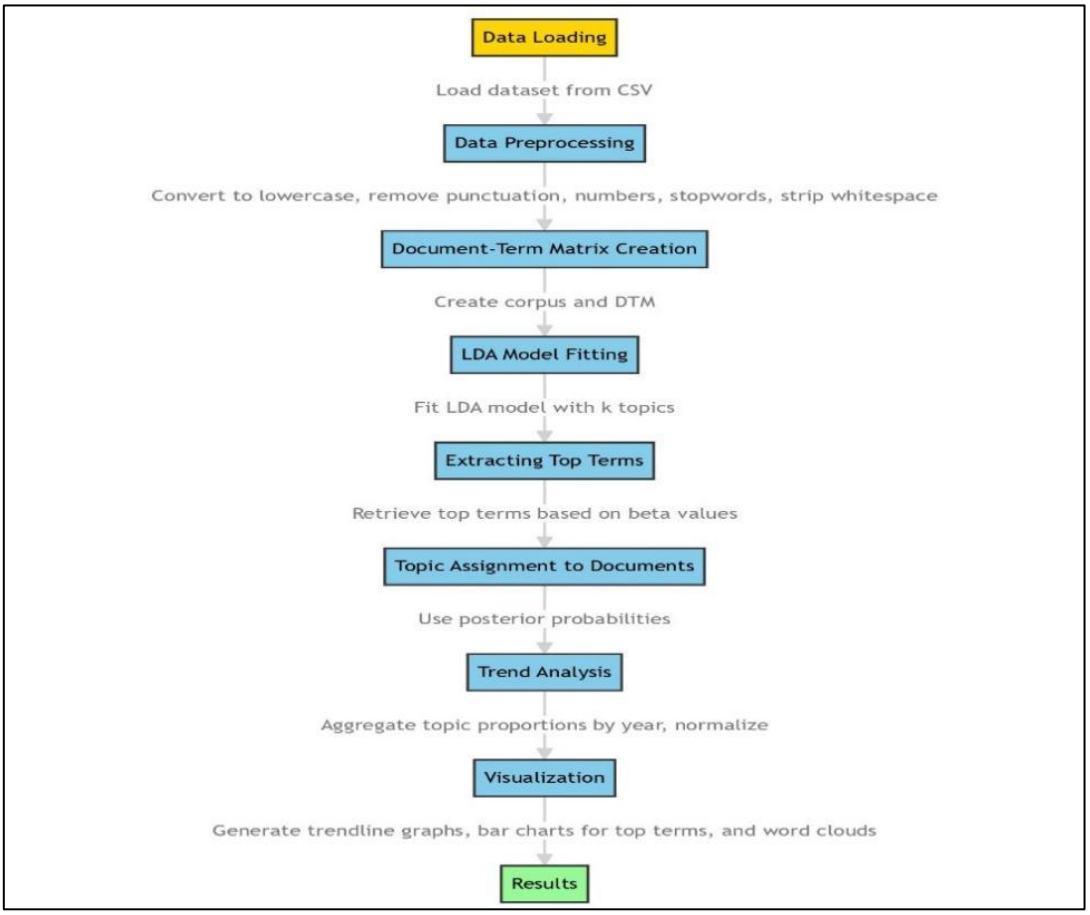
To gather a wide variety of content on the subject, a comprehensive set of keywords was created by combining the authors' considerable understanding of the field and an examination of the existing literature in the field. Various inclusion and exclusion queries were incorporated for the search of relevant literature the search refinement is as firstly the keywords deployed were AI OR artificial AND intelligence OR artificial AND intelligence AND technologie* OR ai AND tools OR artificial AND intelligence AND tool* resulted into 2323 documents further the inclusion and exclusion query to this query was limit to articles, review articles, conference paper and book chapters language choice restricted to English and article stage was at published state selected which resulted in 1917 documents.

Further narrowing to query as AI OR artificial AND intelligence OR ai AND enabled OR artificial AND intelligence AND enabled AND healthcare OR healthcare AND facility OR healthcare AND service AND quality OR healthcare AND services OR treatment OR diagnosis OR precision AND medicine OR healthcare AND systems AND efficiency OR healthcare AND practices OR quality AND healthcare AND service* resulted in 63 documents with all exclusion criteria.

DATA PREPROCESSING FOR TOPIC MODELLING ANALYSIS

The Latent Dirichlet Allocation (LDA) topic modelling in R needs to process several steps to extract and visualise themes upon a textual data. Figure 3 indicates the outline of the process of topic modelling. The first data are usually given in the CSV format to R. In the preprocessing data step, the punctuation symbols, numbers, and the stop words as well as whitespace were removed, and the text was subjected to the lowercase text. A document-term matrix (DTM) is formed after preprocessing; this is a matrix of phrase frequencies in the documents. Topic modelling is created on this matrix. The main element of this method is that the Latent Dirichlet Allocation (LDA) model is used to process the document term matrix (DTM), and the number of topics (k) depends on the purpose of the study. After fitting the model, the most outstanding phrase in each topic category is retrieved and is normally done through the determination of the highest magnitude of the beta values. A document is then assigned to topics in accordance with posterior probabilities, which relay the affiliation to each theme. The analysis of the trend was done by combining and standardising the ratio of subjects by year to see changes over time. The issue of the number of topics (k=5) was chosen with optimisation of coherence score and minimisation of perplexity so that the results can be explained. Nevertheless, because the data (n=63) is somewhat small, these values are to be understood critically. Two independent people who have a degree in healthcare informatics reviewed topic labelling to enhance theoretical coverage and minimize subjectivity.

FIGURE 1: TOPIC MODELING PROCESS FLOW CHART ADOPTED (AUTHOR SELF-CREATED)



ANALYSIS

This study has two main components. First, a bibliometric analysis was conducted using biblioshiny to describe the data. Second, topic modelling using LDA (R version 4.4.1) was performed to identify latent themes and topics in the selected databases.

BIBLIOMETRIC ANALYSIS

Table 1 provides a succinct overview of the significant and pertinent information from the utilised dataset. The final analysis utilised important variables and data from a bibliometric analysis conducted between 2011 and 2024. This material provides a comprehensive summary of these facts. This study encompasses 54 sources, which consist of 63 documents and have an annual growth rate of 16.15%. The documents include a mean age of 1.95 years and an average of 21.51 citations per document. The keyword "plus" has a total count of 677 occurrences in the Keywords Plus (ID) category and 249 occurrences in the Author's Keywords (DE) category. The author made 266 contributions, with just 3 of those being single-authored documents.

TABLE 1: CONCISE SUMMARY OF IMPORTANT AND RELEVANT INFORMATION IN THE DATASET USED.

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2011:2024
Sources (Journals, Books, etc.)	54
Documents	63
Annual Growth Rate %	16.15
Document Average Age	1.95
Average citations per doc	21.51

References	0
DOCUMENT CONTENTS	
Keywords Plus (ID)	677
Author's Keywords (DE)	249
AUTHORS	
Authors	266
Authors of single-authored docs	3
AUTHORS COLLABORATION	
Single-authored docs	3
Co-Authors per Doc	4.49
International co-authorships %	47.62
DOCUMENT TYPES	
article	53
review	10

FIGURE 2: WORD CLOUD FOR ABSTRACTS (AUTHOR SELF-CREATED)

Additional word clouds were built on the abstract of the article using the cluster option in the biblioshiny and the keywords of the authors which is shown in Figure 1 and 2 respectively. The word cloud 1 includes the 63 abstracts of articles, and it is needless to mention that the word cloud is a visual presentation that reveals the most prominent topics within analyzed information. The font size of every word in the cloud is proportional to the frequency and significance of the word. The most notable phrases used in the cloud are the phrases artificial intelligence and the phrase medical care or rather the phrase healthcare implying that this is the predominant topics or rather the themes. The other key terms include the phrases of internet of things," deep learning," blockchain, and cloud computing, which highlights a strong focus on technology advancement and their application. Although these visualisations allow a thematic overview, they fail to depict systemic problems and their causes like asymmetries of power, publication trends biases, or barriers to clinical adoption. The terminology and its involvement of socio-technical dimensions highlights that some topics related to AI are underdiscussed, because of technological optimism, and other regulatory, ethical, and practical integration areas are underrepresented.

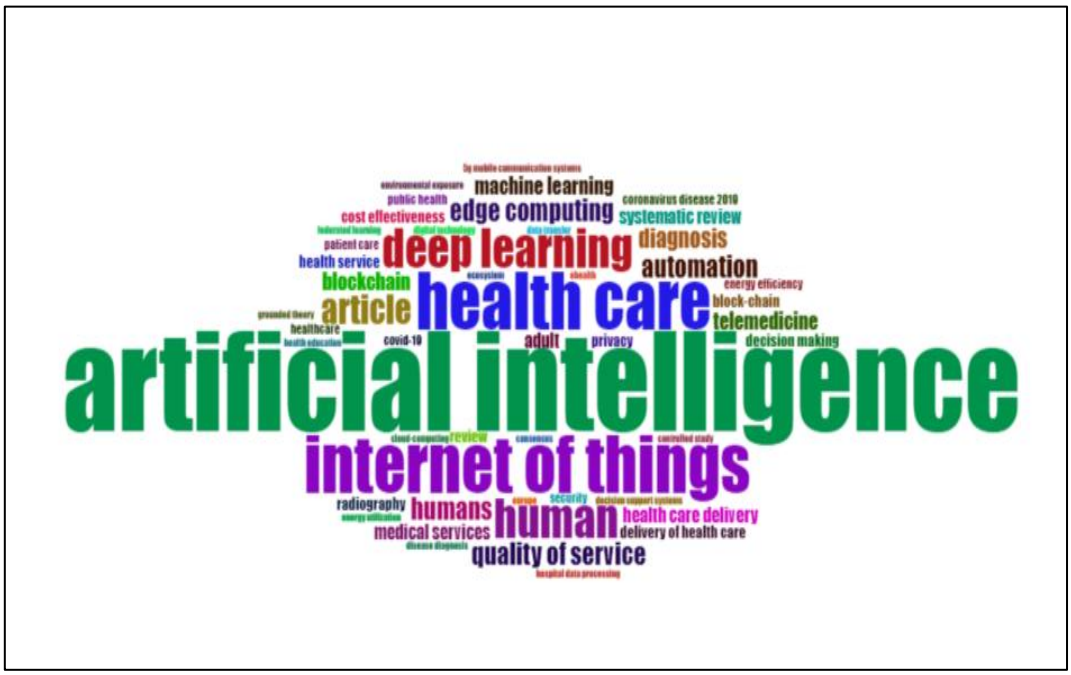
Figure 2 demonstrates the word cloud created using all the keywords stated in 63 articles. The word cloud describes that the terms "artificial intelligence" and "health care" are the most prominent, suggesting that they are the main subjects in the collection. The figure above indicates a notable emphasis on the implementation of artificial intelligence in health care.

Additional significant terms encompass "internet of things," "deep learning," "human," and "quality of service." The significance of these terms emphasises important areas of focus, including the incorporation of cutting-edge technology, such as IoT and deep learning in healthcare systems, together with the examination of human factors and service quality.

Specialized subtopics and issues within the broader subject are indicated by terminology such as "automation," "diagnosis," "telemedicine," "edge computing," and "privacy." The inclusion of the terms "machine learning", "systematic review", and "cost effectiveness" indicates the concentration of methodological strategies and economic assessments within this framework.

In summary, the word cloud reveals a notable convergence of cutting-edge technologies, including artificial intelligence and IoT, within the healthcare sector.

FIGURE 3 WORD CLOUD FOR AUTHORS' KEYWORDS (AUTHOR SELF-CREATED)



TOPIC MODELING:

Although the word clouds give an overall view of the study patterns within the literature, they fail to give quantitative facts on the associations between various notions. Unless one had the quantitative data on all the significant terms, it would be difficult to gather the related words and organize them in the categories. Topic modelling through LDA was used to obtain the proper data on the correlation between various terms by generating specific topics through a combination of correlated terms in the dataset through the analysis of hidden structures and underlying structures. As Torous et al. [13] state, there are other limits or boundaries, which are described as living in the past or looking back. Figure 1 depicts the specifics of the process flowchart of the topic modelling that was adopted in this study. According to the extraction of the most related keyword, there are in total, 5 topics extracted as reflected in the table below (Table 2). Although these visualisations provide a thematic overview, they fail to capture system related complications like power asymmetries, publication bias, or barriers to clinical adoption. Socio-technical integration brings forward the notion that some of the AI subjects are over-covered by technological optimism, and regulatory, ethical, and practical integration research areas remain understudied.

TABLE 2: TOPIC LABELS

Topic	Topic Labels	Most used words (based on frequency and beta value)
1	Review the internet digital trauma health	healthcare, intelligence, artificial, technologies, review, intelligent, usage, smartwatch, satisfaction, applied
2	Technologies model health via federated learning	learning, healthcare, review, federated, health, challenges, approach, practice, intelligence, artificial.
3	An artificial deep framework enabled review	healthcare, health, framework, digital, artificial, intelligent, remote, patient, intelligence, care
4	Intelligence learning healthcare	trauma, support, intelligence, enabled, decision, artificial, application, healthcare, perspectives
5	Healthcare-enabled artificial learning	enabled, learning, deep, things, model, internet, medical, data, optimization, based

Figure 4 (see apprendex I) represents the top terms inside a separate topic, as determined by the beta values of those terms in a topic-modelling analysis.

The first chart in Figure 4 pertains mainly to terms such as "internet," "digital," "trauma," and "health." The significance of these terms lies in the evaluation of digital technologies and their use in the medical field, particularly with trauma treatment. Digital technologies are transforming mental health care, particularly in trauma and post-traumatic stress disorder (PTSD) treatment. Smartphones, wearables, and sensors enable the development of digital features of PTSD, is improve prediction and assessment [13]. Integrating technology offers opportunities for self-monitoring and self-management, also facilitates remote intervention, and hence overcomes barriers to traditional care [14]. Key considerations include privacy, intuitive design, inclusive language, and the standardisation of care processes [15, 16].

The second chart in Figure 4 highlights the terms "technologies", "model", "health",, and "federated" technologies. Federated learning (FL) has emerged as a promising approach in healthcare, enabling the development of machine-learning models across distributed datasets while preserving data privacy and security [17, 18]. This technology addresses the challenges of data silos, privacy concerns, and regulatory requirements in healthcare, allowing collaborative model training without compromising sensitive patient information [19].

The third chart in Figure 4 demonstrates the topics as "artificial," "deep," "framework," "enabled," and "review." The chart clearly highlights that artificial intelligence, deep-learning frameworks, and the evaluation of these technologies are prominent in healthcare. Enormous potential has been demonstrated by Artificial Intelligence (AI) and Deep Learning (DL) frameworks to revolutionise healthcare, predominantly in medical imaging, diagnostics, and decision support systems. Shaban-Nejad et al. [20] stated the importance of Explainable AI (XAI) methods in medical image analysis, advocating the need for transparency and trust in AI decisions within clinical settings. They also highlighted that it is vital to overcome the "black-box" nature of AI systems and promote their adoption in healthcare [20]. The field of AI continues to evolve, and it is central for healthcare professionals to enthusiastically engage with and lead the development of AI-powered solutions to reap maximum benefits in patient care.

The fourth chart (Figure 4) displays the keywords such as "intelligence", "learning", and "healthcare", together with additional terms that are connected to these concepts, indicating that there is an emphasis on intelligence systems and learning models in healthcare applications. Artificial intelligence (AI) and machine learning are transforming health care systems through various applications. Health intelligence leverages AI and data science to provide insights, reduce waste, and increase the efficiency of healthcare delivery [21].

An expanding corpus of research underscores the crucial functions of AI and learning models in health care. Reinforcement learning (RL) has emerged as a viable technique for addressing complex healthcare issues through its application to adaptive treatment protocols, smart core networks, and edge intelligence. Automated methods can enhance supported living and health monitoring, especially for the elderly and individuals with mental health conditions [2].

An image typically categorises the most significant concepts and terms in the dataset into five basic groups. The subjects encompass all facets of the interplay between technology and healthcare, focusing on digital technologies, federated systems, artificial intelligence (AI), and the assessment and use of these innovations in health-related fields. Table 2 presents a synopsis of the five subjects. Machine learning (ML) and artificial intelligence (AI) are transforming healthcare by improving patient care, clinical decision support, monitoring, and interventions [2]. These technologies enable complex data mining, language and picture processing, and real-time risk assessments [21]. Nonetheless, challenges persist in ensuring that AI-driven healthcare is equitable and that it adheres to medical ethics [21]. As AI continues to advance, e-healthcare platforms will assume a progressively more significant role in safeguarding patients' physical and mental health [21].

TOPIC TRENDS OVER TIME:

The line graphs depicted in Figure 5 (see appendex II) demonstrate the trends in topic proportions from 2011 to 2024. The years covered by the graphs are from 2011 to 2024. Each graph illustrates a distinct subject matter, illustrating how the focus on each subject matter has shifted over time.

Artificial Intelligence and Learning in Healthcare: The trendline for this topic has an upward slope, which indicates that the topic shows an increasing trend. In 2017, the proportion reached its highest point, then suffered some oscillations, and has recently climbed again, indicating that there is a growing interest in this field.

Intelligence Learning with Healthcare Intelligence Healthcare: The trend line of this topic demonstrates that there is a general upward tendency, with major peaks occurring in the years 2019 and 2021. The upward slope of the trend line indicates that there has been a consistent concentration on this subject, even though there has been some variation in certain years.

Technologies Model Health via Federated, the trend line of the topic exhibits a negative trend, as indicated by the downward slope of the trend line. The significance of the subject has drastically reduced since it reached its highest point in 2011-2012, with a minor rebound occurring in recent years.

Internet and Digital Trauma Health, the trendline that is growing, indicates that this subject is moving in a somewhat positive direction. At some point around the year 2018, there was a substantial increase in the proportion of topics, which was then followed by variations, indicating varying levels of emphasis but usually increasing interest.

The topic **Artificial Deep Framework Enabled Review**, the trendline in this case exhibits a discernible rising slope, which indicates that there is increasing interest in this subject. After a period of very low interest in the subject until 2017, there was a gradual growth that reached its highest point around 2023-2024.

The overall analysis revealed that the graphs together indicate a growing emphasis on artificial intelligence and related technologies in the healthcare industry, with an upward trend in many of the areas investigated. The topic of federated technologies, on the other hand, demonstrates a growing trend of decreasing interest.

CONCLUSION

Medical care has undergone substantial modifications with the help of AI-powered solution by assisting in making the diagnostic process even more efficient and tailored to the specific needs of a particular patient, simplifying the process

of operating the process. This has been extremely efficient in improving patient care and expediting the administrative task such that health professionals can devote more time on the patients. However, certain barriers remain, such as the trustworthiness of data published by different organizations and addressing the concept of transparency in regard to AI algorithms, especially in the models founded on deep learning. A huge problem could be the data security and privacy when all this personal health information must be revealed to achieve the application of AI. To resolve these concerns, they will have to align to the current regulatory frameworks, including General Data Protection Regulation (GDPR), Health Insurance Portability and Accountability Act (HIPAA), and Therapeutic Goods Administration (TGA), etc., to meet compliance and trust.

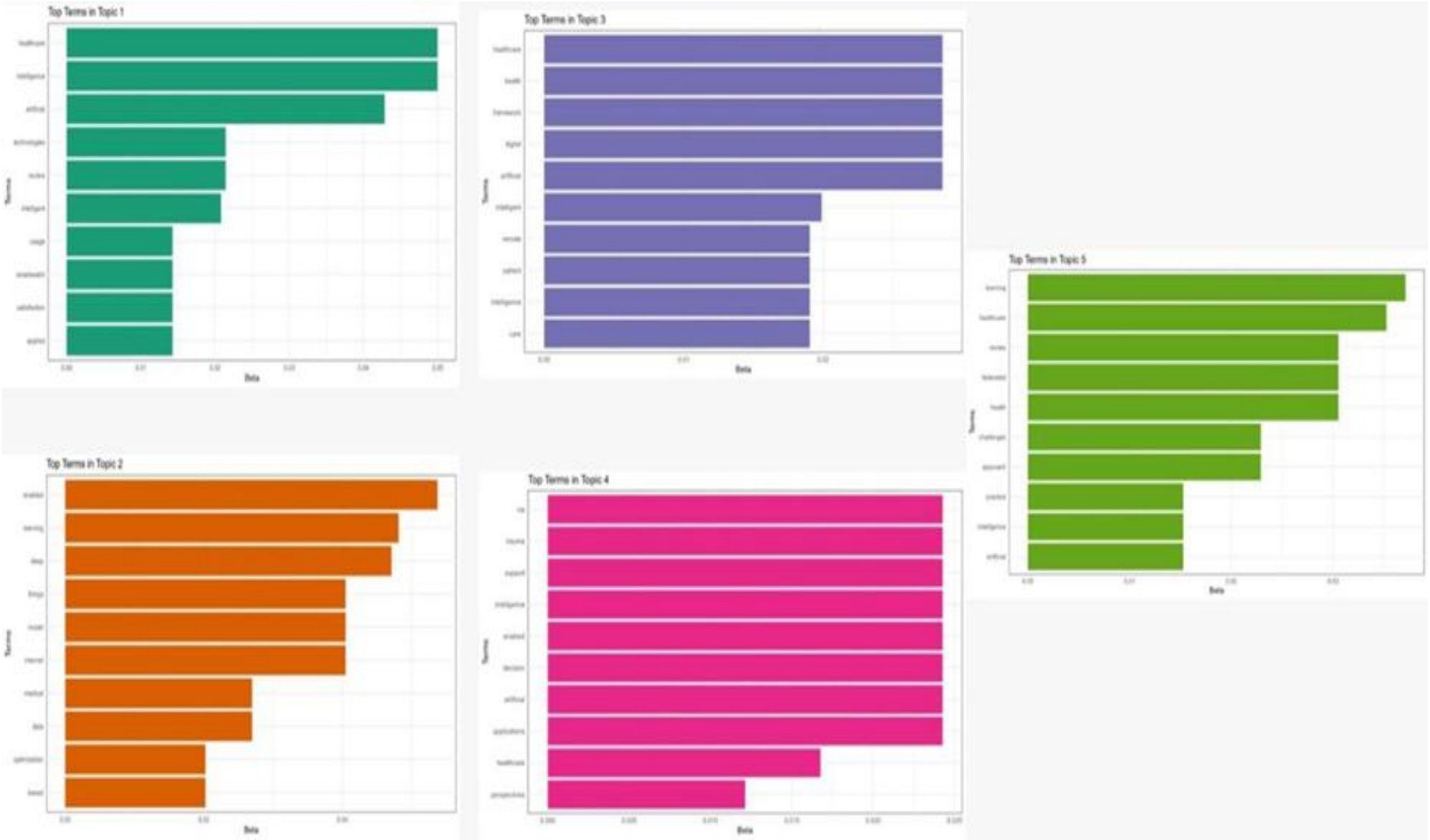
Companies that use AI in healthcare can increase the quality of the provided services, lower costs, and optimize their use of resources. Still, proper governance frameworks are required because they are required to address ethical and legal concerns, such as data security and sharing the benefits of the system fairly. Proper training of healthcare professionals is important to make AI complete the picture in human judgment instead of displacing it. Research studies need to focus on the societal, legal, and ethical effects of AI in healthcare, create user-friendly data management tools and provide equal access to AI innovations. Interdisciplinary collaboration is important in implementing AI in the clinical field, especially in cases where resources are scarce.

References

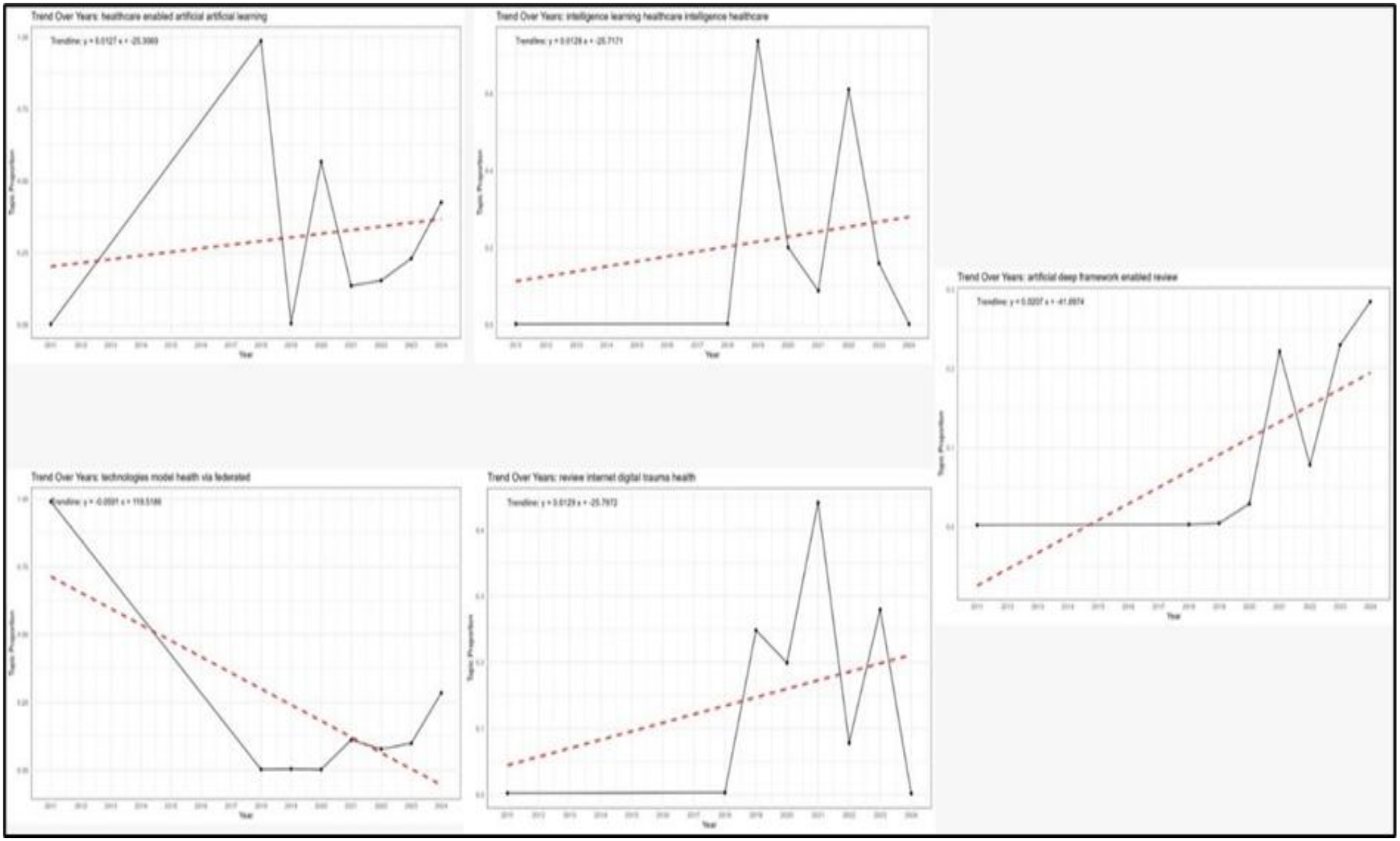
1. Gouripur K. The impact of artificial intelligence on healthcare: a revolution in progress. North West Lond J Gen Pract. 2024 Feb 14;10(1).
2. Reddy S, Fox J, Purohit MP. Artificial intelligence-enabled healthcare delivery. J R Soc Med. 2019;112(1):22-8.
3. McCoy LG, Banja JD, Ghassemi M, Celi LA. Ensuring machine learning for healthcare works for all. BMJ Health Care Inform. 2020;27(3).
4. Briner RB, Denyer D. Systematic review and evidence synthesis as a practice and scholarship tool. In: Barends E, Rousseau DM, Briner RB, editors. Handbook of evidence-based management: companies, classrooms, and research. Oxford (UK): Oxford University Press; 2012. p. 112-29.
5. Crane D. Invisible colleges: diffusion of knowledge in scientific communities. Chicago (IL): University of Chicago Press; 1972.
6. Thakuria A, Chakraborty I, Deka D. A bibliometric review on serendipity literature available in Web of Science database using HistCite and Biblioshiny. Inf Discov Deliv. 2024 Mar 26;52(2):227-42.
7. Aria M, Cuccurullo C. bibliometrix: an R-tool for comprehensive science mapping analysis. J Informetr. 2017;11(4):959-75.
8. Barde BV, Bainwad AM. An overview of topic modeling methods and tools. In: 2017 International Conference on Intelligent Computing and Control Systems (ICICCS). Madurai (IN): IEEE; 2017. p. 745-50. doi:10.1109/ICCONS.2017.8250563
9. Elgesem D, Steskal L, Diakopoulos N. Structure and content of the discourse on climate change in the blogosphere: the big picture. In: Climate change communication and the Internet. Abingdon (UK): Routledge; 2019 May 16. p. 21-40.
10. Koltsova O, Shcherbak A. LiveJournal Libra!: the political blogosphere and voting preferences in Russia in 2011–2012. New Media Soc. 2015;17(10):1715-32. doi:10.1177/1461444814531875
11. Ali I, Sultan P, Aboelmaged M. A bibliometric analysis of academic misconduct research in higher education: current status and future research opportunities. Account Res. 2021;28(6):372-93.
12. Bourla A, Mouchabac S, El Hage W, Ferreri F. e-PTSD: an overview on how new technologies can improve prediction and assessment of posttraumatic stress disorder (PTSD). Eur J Psychotraumatol. 2018 Nov 1;9(suppl 1):1424448.
13. Torous J, Bucci S, Bell IH, Kessing LV, Faurholt-Jepsen M, Whelan P, et al. The growing field of digital psychiatry: current evidence and the future of apps, social media, chatbots, and virtual reality. World Psychiatry. 2021;20(3):318-35.
14. Banabilah S, Aloqaily M, Alsayed E, Malik N, Jararweh Y. Federated learning review: fundamentals, enabling technologies, and future applications. Inf Process Manag. 2022;59(6):103061. doi:10.1016/j.ipm.2022.103061
15. Hsu JM. Digital health technology and trauma: development of an app to standardize care. ANZ J Surg. 2015;85(4):235-9.

16. Joshi M, Pal A, Sankarasubbu M. Federated learning for healthcare domain-pipeline, applications and challenges. ACM Trans Comput Healthc. 2022 Nov 3;3(4):1-36.
17. Zhang H, Jiang S, Xuan S. Decentralized federated learning based on blockchain: concepts, framework, and challenges. Comput Commun. 2024 Feb 15;216:140-50.
18. Antunes RS, André da Costa C, Küderle A, Yari IA, Eskofier B. Federated learning for healthcare: systematic review and architecture proposal. ACM Trans Intell Syst Technol. 2022 May 4;13(4):1-23.
19. Muhammad D, Bendechache M. Unveiling the black box: a systematic review of explainable artificial intelligence in medical image analysis. Comput Struct Biotechnol J. 2024 Dec 1;24:542-60.
20. Shaban-Nejad A, Michalowski M, Buckeridge DL. Health intelligence: how artificial intelligence transforms population and personalized health. NPJ Digit Med. 2018;1(1):53.
21. Tiwari A. Artificial intelligence and machine learning empowering the mass medicine. Adv Mater Lett. 2019;10(5):302.

APPENDIX I - FIGURE 4: TOPIC MATRIX USING LDA IN R



APPENDIX II- FIGURE 5 GRAPHS SHOWING TRENDING TOPICS



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CROSS-BORDER MERGERS & ACQUISITIONS AND BUSINESS GROWTH IN NOVARTIS'S VACCINE DIVISION: AN ABSORPTIVE CAPACITY PERSPECTIVE

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ABSTRACT

OBJECTIVE:

This study explores the impact of cross-border mergers and acquisitions (M&As) on the business growth of pharmaceutical companies. Based on evidence from the 2015 acquisition of Novartis's vaccine division by GlaxoSmithKline (GSK) as a paradigmatic case study, we also explore how this M&A led to business growth during the COVID-19 pandemic.

DESIGN:

We employ qualitative analysis of 10 years of executive reports, annual reports, market research, and peer-reviewed journal articles from Business Source Premier. Then, we developed a thematic analysis of this secondary data based on five critical dimensions of post-merger success, including strategic rationale, after-acquisition growth, operational synergies, cultural integration, and competitive positioning.

RESULTS:

Our findings suggest that the acquisition's success was fundamentally driven by its tight strategic alignment with GSK's long-term objectives of specialising in vaccines and innovative healthcare. Operational efficiencies were achieved through phased integration, while proactive leadership and open communication were found to be crucial in reducing cultural challenges.

CONCLUSIONS:

We conclude that in the intricate healthcare ecosystem, carefully planned and executed M&As that prioritise cultural alignment in addition to financial and operational objectives can result in substantial, long-term value. For executives, academics, and policymakers navigating international M&A strategy in the healthcare industry, the paper offers insightful theoretical analysis and useful recommendations.

KEYWORDS

cross-border merger & acquisition, business growth, absorptive capacity, COVID-19 vaccination

INTRODUCTION

Mergers and Acquisitions (M&As) are a corporate strategy with a powerful mechanism to achieve rapid growth, expand market access, and develop novel capabilities [1]. In the pharmaceutical industry, such a strategy enhances research and development (R&D) costs, stringent regulatory hurdles, and intense competition as an indispensable instrument for portfolio expansion and the realisation of economies of scale [2].

Our review of the literature in the healthcare industry shows that when pharmaceuticals take part in cross-border M&As, they often gain more chances to grow into different parts of the world, expand what they offer, and bring together their operations across countries [3].

Right now, the industry's going through a tough time. Patents are running out, costs for R&D keep going up, and there's constant pressure to come up with something new. Because of all this, more companies are turning to M&As as a way to stay ahead. Still, these deals are risky. It's not uncommon to see problems like teams struggling to work together, differences in workplace culture, or even the whole merger falling short of what it was supposed to achieve [4]. There is a gap in knowledge on how pharmaceuticals and regulators of the healthcare industry deal with major integration challenges, cultural clashes, and the potential failure to achieve expected synergies [5] [6].

In this study, we address the long-term consequences of GlaxoSmithKline's 2015 purchase of Novartis's vaccine division and how this led to business growth. We investigate the motives behind this M&A, what changed afterwards, what operational benefits came through, and how well the companies blended culturally, and how it all shaped GSK's place in the market.

LITERATURE REVIEW

This review synthesises key scholarly insights across four central themes: the strategic motivations driving these deals, the critical success factors for post-merger integration, the significant challenges and pitfalls encountered, and the theoretical lenses used to understand value creation.

THE STRATEGIC IMPERATIVE FOR PHARMACEUTICAL M&AS:

The motives for M&As in the pharmaceutical sector have evolved after COVID-19, but there are core strategic objectives that remain fixed, including expanding to new markets, upgrading the R&D capabilities, and acquiring technology developers to innovate new drugs. Expanding to new markets, particularly in emerging economies across Asia, Latin America, and Africa, which offer significant growth potential compared to mature Western markets [7] [8].

Another motive for cross-border M&A is to establish distribution channels and local supply chains to bypass local regulatory barriers in the healthcare industry [9]. Developing a diversified product portfolio and diversification of operations are other motives for M&A in healthcare [10]. Big pharma used to establish 20-year patents, but medium-sized and start-up firms face patent cliffs on blockbuster drugs, and they need to merge with R&D centres to keep innovating pipelines or complementary product lines as a strategy for sustainable growth. Big pharma also faces reform on the drug patents, and they need to acquire smaller, innovative biotech firms to gain expertise in burgeoning fields like biologics and personalised medicine [11]. To face the COVID-19 pandemic, pharmaceuticals and local hospitals had to merge to enhance their mutual R&D operations for effective vaccination development [12]. It also facilitates economies of scale via mass production, and administration remains a fundamental objective, alongside leveraging regulatory expertise to navigate complex international compliance landscapes [13].

CRITICAL SUCCESS FACTORS FOR POST-MERGER INTEGRATION:

The literature highlights three critical success factors for post-merge integration. First is the degree of alignment between the partners' objectives, resources, and business models [14]. The higher the alignment, the higher the firm's ability to capitalise on complementary R&D, market access, and distribution, providing a clear competitive advantage [15].

The second is cultural integration, which is a "*make-or-break*" element in international M&As, particularly in the pharmaceutical industry [14]. Disparities in organisational and national cultures can cause a lot of conflict, which lowers morale and causes operational inefficiencies. Therefore, it is crucial to manage cultural integration proactively through inclusive leadership, transparent communication, and system alignment [4]. As recent research emphasises, a people-centric approach that fosters a shared vision and mutual respect between legacy firms is crucial for retaining key talent and ensuring a smooth transition [16].

Third, long-term alignment depends on leadership stability and management alignment. During the frequently turbulent integration process, disagreements can be avoided, and a consistent strategic direction can be guaranteed with a well-defined decision-making process and a cohesive leadership team [14].

CHALLENGES AND PITFALLS IN CROSS-BORDER M&AS:

Pharmaceutical M&As are often regarded as strategic, but they pose difficulties. Regulatory obstacles are a significant challenge. There are very strict regulations throughout the industry in almost every market, and there can be significant delays and complexity due to various antitrust laws, IP protections, or process differences in drug approval processes across jurisdictions [11]. An exemption was made for Pfizer and AstraZeneca during the COVID-19 Pandemic to speed up production and facilitate local supply and administration of the vaccine [17].

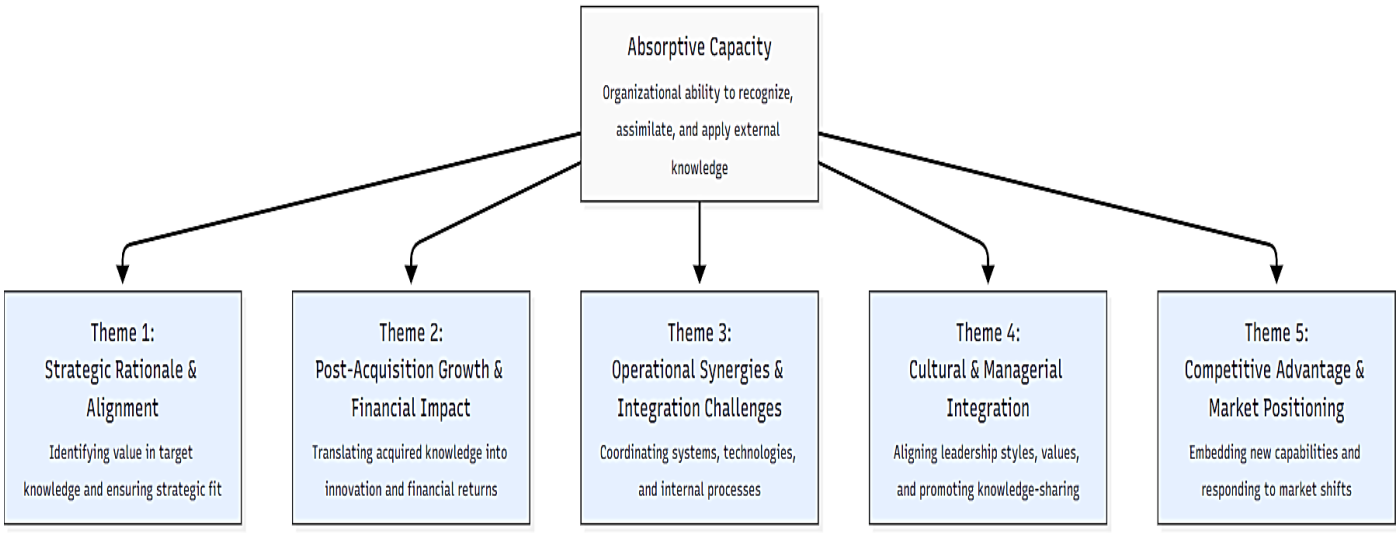
The alignment of various IT systems, manufacturing processes, and supply chains is another challenge in operational integration in the healthcare industry. The absence of effective operational synergy can diminish the projected savings and efficiency [18]. Another important matter is the retention of talent. The long-term innovation capabilities of the merged entity are severely compromised by uncertainty and cultural shifts that can occur when certain scientific and managerial talents leave the merger [19].

THEORETICAL LENSES ON ABSORPTIVE CAPACITY:

Our study adopts the absorptive capacity theory (ACT) to conceptualise the process that GSK followed in making an M&A with Novartis's vaccine [20]. Godfrey et.al. [23] use ACT to explain how drug companies make the most out of new knowledge when they take over or join with another firm. First, they spot and buy companies with valuable drug pipelines or smart research ideas. After the deal, they do not just sit on that knowledge; they change their own systems and bring in new skills to make use of what they've gained. They then pool their resources, creating diverse teams and joint research initiatives. This makes dispersed information more useful. They employ improved business tactics to sell the merged products or broaden their customer base once everything begins to make sense.

ACT provides a practical and insightful framework for examining why some M&As succeed while others struggle or fall short (Figure 1). At its foundation lies the need for strategic clarity and alignment (Theme 1). Companies need to begin by identifying and appreciating the worth of the knowledge held by the target firm, ensuring that this knowledge aligns with their own broader strategic objectives. Absorptive capacity plays a key role here, as it enables firms to evaluate, capture, and prioritise the external knowledge that best serves their long-term vision. When it comes to outcomes after the acquisition, particularly in terms of financial performance and business growth (Theme 2), firms that are skilled at internalising and applying new knowledge tend to fare better. They can turn acquired insights into practical innovations and cost-effective processes, both of which can contribute to increased revenue and a stronger return on investment. This capacity for learning and adapting underpins improved post-merger outcomes.

FIGURE 1: A FRAMEWORK FOR ABSORPTIVE CAPACITY IN PHARMACEUTICALS M&AS



The problem of friction is often caused by differences in systems, tools, and workflows, making operational integration (Theme 3) a difficult area to work with. Better coordination between the merging organisations' operations is facilitated by absorption capacity, which facilitates better coordination across platforms and procedures. Another difficulty lies in achieving cultural and leadership alignment (Theme 4). Changing management styles, workplace values, and communication habits are frequently linked to challenges in mergers. The capacity to absorb energy is strong, which helps firms cope with these tensions by promoting flexible leadership and creating environments that encourage knowledge sharing and mutual understanding. A firm's absorption capability can enhance its market position in the long term (Theme 5). The capacity for learning fosters the integration of novel capabilities, encourages innovation, and enhances organisational resilience by transforming acquired strengths into long-term assets that strengthen competitiveness.

RESEARCH METHODOLOGY

This research employs a qualitative, single-case study methodology to explore the long-term effectiveness of cross-border M&As in the pharmaceutical industry, using the 2015 acquisition of Novartis's vaccine division by GSK as a critical and illustrative case. This approach is particularly well-suited for investigating contemporary, real-life phenomena in-depth and within their specific context [24].

To capture the intricate socio-economic, cultural, and strategic factors that are present in M&A outcomes, the study is situated within an interpretivist research philosophy [25]. An abductive approach is adopted, where initial themes are set based on the theoretical framework presented in Figure 1, and new patterns are allowed to emerge organically from the data rather than being tested against pre-existing hypotheses.

Due to the historical nature of the acquisition and the requirement to examine strategic documents and industry-wide analyses over a ten-year period (2015–2025), data collection is solely dependent on secondary sources. These sources include company annual reports and financial statements, regulatory filings with bodies like the U.S. SEC, peer-reviewed academic articles on M&A strategy, industry reports from market research organisations (e.g., IQVIA, Deloitte), and news coverage from reputable financial media. The primary analytical technique is thematic analysis, a rigorous method for identifying, analysing, and reporting patterns within the qualitative dataset. Trustworthiness of the analysis is ensured through the triangulation of these multiple data sources, which allows for cross-validation and provides a deeper, more reliable contextual understanding of the transaction's evolving narrative.

STAKEHOLDERS OF M&A IN NOVARTIS'S VACCINE DIVISION BY GLAXOSMITHKLINE

The cultural gap between GSK and Novartis will likely be smaller than when there are mergers between companies from institutionally diversified countries such as Africa, Asia, or the Middle East. Novartis is headquartered in Basel, Switzerland,

and is a highly internationalised company with extensive global operations and high American shareholder ownership, making it already consistent with Anglo-American corporate governance practices. Similarly, U.S.-headquartered, London-based GSK has a strong U.S. presence and shares a transatlantic identity shaped by Western financial, regulatory, and market influences. Its mutual exposure mitigates some integration risks generally characteristic of institutionally more distant mergers. Accordingly, we developed a brief stakeholder analysis in Table 1.

TABLE 1: NOVARTIS VACCINES' STAKEHOLDER ANALYSIS

Stakeholder	Origin / Ownership	Role in Merger Context
Novartis	Swiss, global (US shares)	R&D leadership, EU/US market reach
GSK	UK/USA footprint	Vaccine expertise, global supply
Regulators (FDA, EMA)	USA / EU	Market authorisation, compliance
Global Patients	Worldwide	Beneficiaries of the combined portfolio

Organisational dissimilarities between the above-mentioned stakeholders challenge the M&A process. Such differences were represented in the varied governance models adopted by Novartis and GSK, and the decision-making processes. In addition, both are subject to various national health policies, which may impact their international strategy differently. These differences may continue to affect integration outcomes, albeit less significantly than intercontinental mergers. In contrast, Western-to-non-Western mergers are likely to be faced with more complex infrastructure gaps, regulatory environments, and organisational cultures that prevent the achievement of synergy.

RESEARCH FINDINGS & RESULTS

THEME 1: STRATEGIC RATIONALE AND ALIGNMENT

GSK did not buy the company just because it was a good deal; they did it on purpose to strengthen their position as the leader in the global vaccine market [26]. At the time, the company's main strategy was to "*prioritise investment in vaccines and respiratory medicines*," which it saw as the main areas for long-term, sustainable growth [26].

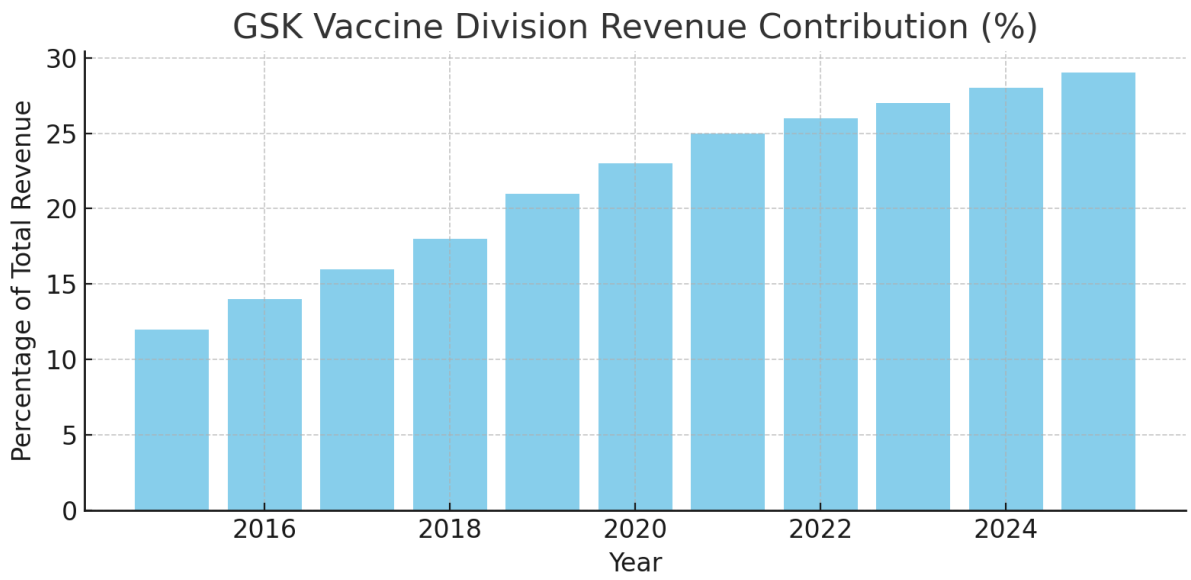
GSK filled important gaps in its product line and made its specialisation even stronger by buying Novartis's non-influenza vaccine portfolio, which included valuable assets like Bexsero for meningitis B. This focused approach is very different from the more varied M&A strategies that are common in the industry. For example, Pfizer's earlier purchase of Wyeth aimed to expand its market rather than deepen its market [17].

The deal's structure, which included selling its oncology business to Novartis and starting a new consumer healthcare joint venture, made this strategy of focusing resources on core, high-potential areas even clearer [27]. In the end, the strict alignment of this deal with a clear corporate mission was a key part of its later success. This is a well-known principle in M&A literature that says that a high strategic fit leads to better performance after the merger [14].

THEME 2: POST-ACQUISITION GROWTH AND FINANCIAL IMPACT

GSK's vaccine division outperformed the company's other business segments in the years after the acquisition, delivering notable and consistent growth. With the vaccine division's revenue contribution gradually rising to roughly 25% of total pharmaceutical revenue by 2021, this strong performance validated the deal's financial justification [28]. The company gained a substantial market share in both developed regions, like North America and Europe, and important emerging markets by successfully positioning key Novartis products like Bexsero and Menveo as market leaders [28].

FIGURE 2: GSK VACCINE DIVISION REVENUE CONTRIBUTION POST-ACQUISITION (%)



The company's overall financial performance managed broader market challenges, such as Brexit-related uncertainties and unfavourable exchange rate fluctuations, which tempered consolidated results, even though the vaccine segment thrived [28]. The strategic use of milestone-based payments was a key component of the deal's architecture. Investor confidence was increased by this contingent consideration structure, which successfully decreased GSK's initial financial risk and demonstrated a dedication to fiscal restraint, a strategy known to align incentives and control post-acquisition uncertainty [13].

THEME 3: OPERATIONAL SYNERGIES & INTEGRATION CHALLENGES

The desire to achieve significant operational synergies, especially in its manufacturing, supply chain, and R&D domains, was the primary motivator behind GSK's decision to pursue this acquisition. The company started an extensive restructuring program in the early phases of integration, which lasted from 2016 to 2018. This included consolidating manufacturing sites and standardising clinical research protocols, strategies that, as [22] suggests, are theoretically sound approaches to value creation in pharmaceutical M&As.

These integration efforts were not merely procedural; they translated into tangible results. Industry analyses indicate that, by 2020, GSK had succeeded in reducing operational costs within its vaccine division by approximately 15% compared to pre-acquisition figures [21]. This achievement was made possible through a series of targeted initiatives: "*supplier contracts were rationalised*", "*manufacturing processes were standardised to capitalise on economies of scale*", and "*previously fragmented IT systems were brought together under a unified framework*".

However, the integration journey was not without its difficulties, echoing the well-documented challenges that often beset post-merger environments. The process of aligning complex technological infrastructures and harmonising clinical trial protocols proved to be more time-consuming and resource-intensive than initially projected. Additionally, the need to ensure regulatory compliance across multiple international jurisdictions introduced another layer of complexity, a challenge frequently encountered in cross-border transactions [18]. In order to reduce the risk of regulatory delays and streamline compliance procedures, GSK relied heavily on the experience of its seasoned international regulatory affairs team.

THEME 4: CULTURAL AND MANAGERIAL INTEGRATION

Harmonising two distinct corporate cultures was a significant hurdle faced by GSK during the integration process, which has been deemed highly challenging. Academic literature consistently highlights the importance of cultural integration, stating that the effective harmonisation of organisational values and practices can significantly impact M&As in the long run [4]. The tradition of consensus-driven, stakeholder-based decision-making was unique to GSK, which had a more

hierarchical structure and greater emphasis on innovation than Novartis. If cultural differences are not acknowledged, it can result in friction, sluggish decision-making, and a reduction in the value of the merger [21].

GSK identified the risks in advance and followed several best practices for cultural integration. This was their response. To address cultural friction, the company established cross-functional teams consisting of employees from both legacy organisations. Through this approach, not only did it encourage dialogue but also a sense of collective responsibility towards the process of integration.

The leadership of GSK in the same period placed a high priority on regular and transparent communication, which is thought to be an essential tactic for reducing uncertainty and boosting trust during organisational disruptions [6]. The appointment of Emma Walmsley as CEO in 2017 was a crucial turning point. Her human-centred management style strengthened the business's dedication to openness and diversity. To promote a unified organisational identity, GSK turned to initiatives like executive town halls and targeted cultural integration workshops as the focal point of efforts to bridge cultural divides.

Notwithstanding their attempts, there was bound to be some employee turnover. In the first year after the merger, about 12% of employees were reported to have lost their jobs. Nevertheless, the amount matches industry norms as post-merger attrition rates frequently surpass 20% [16]. GSK's focus on talent retention is largely due to its deliberate approach of placing emphasis on human interaction. Additionally, internal mobility was implemented, enabling former Novartis staff members to assume leadership positions within the new business.

THEME 5: COMPETITIVE ADVANTAGE AND MARKET POSITIONING

The acquisition represented a transformation for GSK's operations and radically increased the company's global market share in the vaccination manufacturing. By effectively incorporating new resources, GSK joined well-established industry leaders Pfizer and Sanofi to rank among the top three companies in the non-influenza vaccine market [29]. This change was more than just a scale issue; GSK was able to compete more aggressively in important therapeutic areas, such as meningitis and shingles, thanks to its expanded vaccine portfolio, which now includes highly sought-after products [30]. GSK's reputation as a strategic partner for well-known global health organisations was also enhanced by the expanded portfolio. The company became a more valuable partner for organisations like the World Health Organisation (WHO) and Gavi, the Vaccine Alliance, as a result of its improved capabilities and product offerings. In turn, these collaborations increased GSK's participation in crucial international public health programs, with a focus on expanding vaccine access in low- and middle-income nations [12].

In addition to broadening its product line, the acquisition greatly increased GSK's manufacturing and R&D capabilities. During the COVID-19 pandemic, this infrastructure and expertise investment proved particularly significant. In response to the worldwide health crisis, GSK was able to expedite the development of several vaccine candidates by working with other manufacturers and utilising its exclusive adjuvant technology [29].

The deliberate focus on vaccines produced observable financial gains. From 19% of the global vaccine market in 2015, GSK's share grew to an estimated 25% by 2022. In addition to the range of products it offers, the company's increased presence in strategic areas like Asia-Pacific and Sub-Saharan Africa also contributed to this notable growth, highlighting its increasing clout and influence in the global healthcare market [30].

The 2015 Novartis–GSK asset swap offers a clear, human-centred example of how M&A can accelerate vaccine innovation and R&D capacity. By transferring Novartis's vaccine assets and adjuvant capabilities to GSK, the transaction concentrated complementary knowledge and manufacturing scale that later proved valuable during COVID-19 partnerships and adjuvant-enabled vaccine development [28,27]. From an absorptive-capacity perspective, the deal created the structural conditions—overlapping technical bases, dedicated R&D teams, and production infrastructure—that allowed GSK to quickly recognise, assimilate, and exploit external scientific advances under pandemic pressure [33,24]. Empirical and theoretical work on M&A and innovation indicates that such focused transactions increase the

likelihood of successful pipeline advancement when firms realise genuine synergies rather than mere portfolio aggregation [14] [3] [23].

Crucially, absorptive capacity also depends on people and processes: preserving inventor productivity and research continuity mitigates the post-acquisition innovation dip noted in knowledge-intensive sectors [35] [36].

RESEARCH DISCUSSION

Deep insights into the dynamics of successful cross-border M&As in the healthcare industry can be gained from the GSK-Novartis case study. The deal's success stands in stark contrast to other large-scale pharmaceutical mergers, such as the Sanofi-Aventis case, which suffered from a lack of tight strategic alignment and significant cultural friction [22]. GSK's experience strongly validates the theoretical assertion that a clear, focused strategic rationale, in this case, specialisation in vaccines, is a more potent driver of long-term value than broad, unfocused diversification [14]. The significant growth in the vaccine division, even as the company's overall financial performance faced external headwinds, underscores the value of acquiring unique and valuable resources (VRIN), consistent with the Resource-Based View [22].

Our research findings highlight the significance of addressing cultural and human integrations in M&A processes. GSK's emphasis on human orientation and proactive approach aligns with the extensive literature indicating that cultural integration is one of the key factors behind M&A success [16]. Despite the high rates of attrition and productivity loss in these transactions, GSK made significant investments in communication, cross-functional teams, and a commitment to hiring talent from both legacy firms. A crucial message for healthcare management is that in knowledge-intensive industries like pharmaceuticals, where human capital is the primary asset and integration is not optional, it is essential to manage the non-traditional aspects of the process as rigorously as financial and operational ones to preserve or enhance value.

FINAL THEORETICAL FRAMEWORK FOR THE AC CYCLE IN HEALTHCARE M&A

In order to offer a sustainable plan for M&A in healthcare in general and in the case of Novartis's vaccine division by GlaxoSmithKline (GSK), this section presents the final theoretical framework (Figure 3) that could be tested in future research.

Stage 1: At its foundation lies the need for strategic clarity and alignment between the merging parties. Healthcare organisations should begin by identifying and appreciating the value of knowledge owned by the target company so that such knowledge is aligned with their own broader strategic objectives. At this stage, ACT plays a key role in explaining how firms can evaluate, capture, and prioritise the external knowledge that best serves their long-term vision (especially with potential pandemics or times of natural disasters). Harvey et al. (2014) also attest that this phase is imperative for those healthcare organisations possessing a larger AC which exhibits greater sustainable performance with accelerated quality improvement rates.

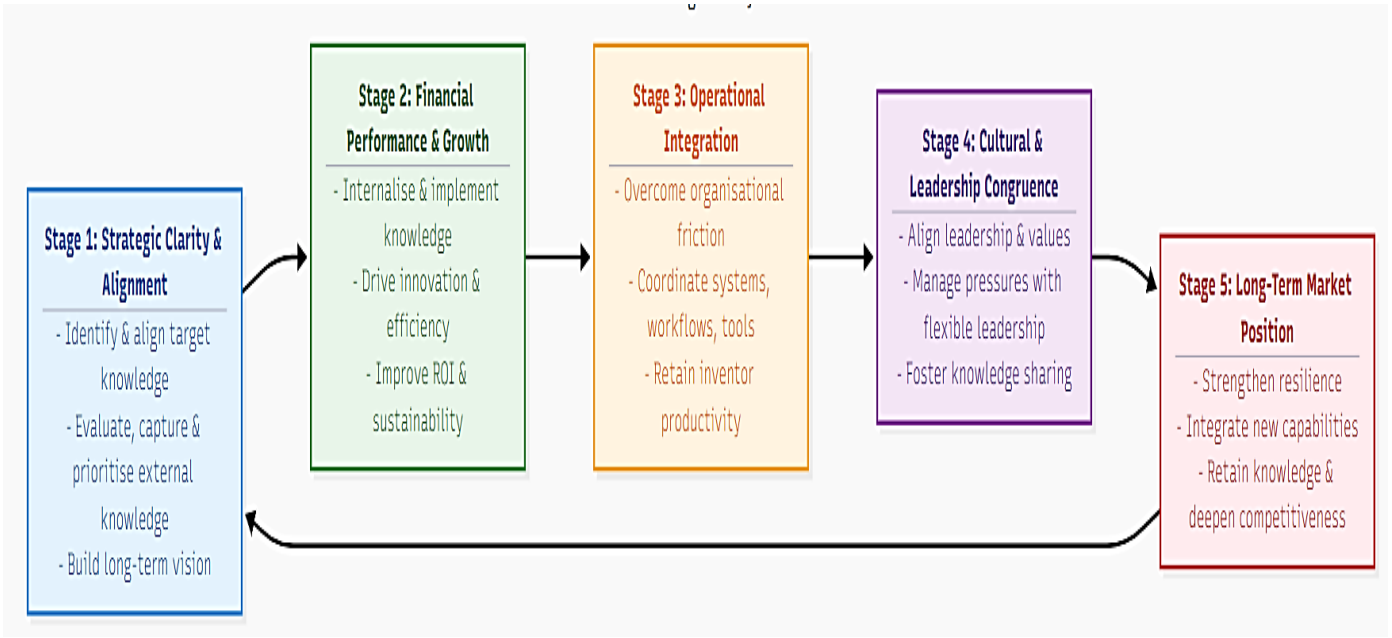
Stage 2: Respond to the post-acquisition, specifically financial performance and business expansion. Here, companies with the ability to internalise and implement new knowledge perform better. We conclude that such companies are able to convert acquired knowledge into practical innovation and efficient processes, which are cost-effective in nature and help in generating more revenue with a better return on investment. This capacity for learning and adapting underpins improved post-merger outcomes such as Financial Performance, Business Growth, and sustainability. These findings support [31] that in innovation-rich industries such as pharmaceuticals, AC serves as a key moderator of post-acquisition performance via turning the acquired knowledge into product and process innovations.

Stage 3: Discuss how organisations are able to overcome organisational friction stemming from variations in systems, tools, and workflows, creating operational integration. Here, our results verify that enhanced coordination of operations between merging organisations is enhanced by AC, which forges improved coordination between platforms and procedures. Paruchuri [32] is an extremely cited paper which tackles post-acquisition inventor productivity and verifies

that those companies which are more AC-oriented are better able to prevent innovation loss by fostering an environment in which acquired talent is able to excel and continues to contribute value. Here, it adds an essential human capital aspect to the model, claiming that AC is not merely a matter of integration of systems.

Stage 4 focuses on cultural and leadership congruence for successful absorption of AC. Management style shifts, workplace values, and communication behaviors are commonly attributed to merger problems. The ability to absorb energy is robust, which assists companies in managing such pressures by fostering flexible leadership and environments for knowledge sharing and common comprehension. Absorption capacity in a company can strengthen its marketplace position in the longer term (Stage 5). Learning capacity creates integration of new capabilities, stimulates innovation, and develops organisational resilience by converting learned strengths into assets for the longer term, which deepens competitive positions. It directly supports Stage 5 (Long-Term Market Position) by outlining a specific mechanism whereby companies innovate. Precisely, robust absorptive capacity allows the acquiring company to retain valuable knowledge possessed by key individuals in the target company.

FIGURE 3: FINAL THEORETICAL FRAMEWORK FOR AC IN HEALTHCARE M&A



Below, we synthesise how AC has been used to understand performance, innovation, and integration in healthcare management and adjacent pharma contexts.

First, Currie et al [33] in BMJ Leader offer a concise, practice-oriented argument that translational health research succeeds when organisations deliberately build AC—linking "what we know" to "what we do." Their contribution is conceptual and managerial: they translate AC's stages (acquire–assimilate–transform–exploit) into leadership routines (boundary spanning, protected time, and feedback loops) that clinicians and managers can enact. While not M&E-specific, it clarifies the governance levers for making research usable in-service redesign.

Second, Harvey et.al [34] provide multi-site NHS case evidence that variation in quality-improvement outcomes is patterned by contextual AC. They show how external ties, slack, and receptive climate enable faster and more durable gains, directly relevant to hospital groups integrating after mergers. Their strength is empirical granularity across organisations; a limitation is that causality remains interpretive rather than experimental.

Third, Godfrey et al. [24] explicitly map how AC is operationalized and conceptualized in health-innovation adoption research. They expose instrument inconsistency and AC dimension under-specification in healthcare, warning against

conceptual agglomeration. This review advances methodology by proposing clearer construct boundaries and more standardised operationalisation for future service-improvement and evaluation studies.

Lastly, pharma/knowledge-intensive setting acquisition studies shed light on AC post-acquisition's role. Hussinger [35] illustrates that purchasing firms with more effective AC more successfully maintain post-takeover inventor productivity, suppressing the innovation trough prevalent following transactions. Supporting this, Kapoor and Lim (2007) illustrate how integration mechanisms that rely on knowledge condition inventor productivity following takeover, providing micro-foundations that accord with AC. Together, these studies sharpen healthcare M&A lessons: beyond financial fit, absorptive structures (overlapping knowledge bases, integrative routines, boundary spanners) are pivotal to protect clinical-scientific innovation and commercialisation capacity.

TABLE 2: THE SIGNIFICANCE OF AC FOR M& A IN THE HEALTHCARE MANAGEMENT INDUSTRY

Study / Setting	Design & Scope	How AC is Framed	What AC Explains for Healthcare Management	Limitations / Gaps
Currie et al [33] / Translational health	Conceptual, leadership focus	Managerial routines enabling acquire–assimilate–exploit	Bridges research–practice; identifies leadership levers for uptake	Not M&A-specific; lacks measurement guidance
Harvey et al. [34] / NHS Improvement	Multiple case studies (England)	Organisational context (ties, slack, climate) as AC enablers	Explains inter-organisational variation in improvement speed and durability	Observational; generalisability beyond NHS uncertain
Godfrey et al. [24] / Health innovation adoption	Scoping review	Constructs and instruments for AC in health studies	Clarifies measurement inconsistencies; agenda for robust AC metrics	Limited outcome synthesis; calls for standardised tools
Hussinger [35] / Post-acquisition innovation (pharma/tech)	Empirical analysis of inventors	Acquirer AC preserves/leverages acquired knowledge	Guidance for hospital/biotech M&A to protect innovation output	Working-paper provenance; sectoral transfer needs care
Kapoor & Lim [36] / Acquisitions & inventor productivity	Archival, AMJ	Knowledge integration mechanisms consistent with AC	Micro-foundations for integrating expert staff post-deal	Not explicitly labelled AC; industry (semiconductors) not health

CONCLUSION

Our study highlights the importance of cross-border M&As, such as Glaxo Smith Kline's acquisition of Novartis' vaccine division, to ensure strategic clarity, operational discipline, and cultural sensitivity in the highly regulated and capital-intensive pharmaceutical industry. The success of this deal was not a fluke; it was the outcome of thorough preparation, clear strategic planning, and long-term integration.

Our study offers practical lessons to healthcare executives based on the case study evidence provided. M&A deals that reinforce a company's core mission are more likely to be successful than those that pursue broad-scale expansion without any specific purpose. Rather than a quick consolidation, operational alignment must be integrated gradually and carefully. How to manage cultural integration through proactive measures is another practical contribution that this research offers by giving a guideline on how to maintain talent retention and operational stability. With the evolving challenges in global health, this research provides a valuable roadmap for how M&As can be utilised to achieve corporate growth goals and broader societal healthcare objectives.

In terms of theoretical contribution, we developed a framework based on the ACT that helps understand how mutual resources and capacities are evolving during and post M&A. Based on our longitudinal analysis of all corporate reports and the literature, we provided thorough narratives of the entire M&A value creation process over tens of years. Pharmaceuticals may face unique integration challenges when compared across different industries. By utilising purpose-driven transformation, this case highlights the effectiveness of M&As in driving growth and evolving healthcare companies.

References

1. Way PL, Davidson PM, Winkworth G, White M. The pursuit of purposeful partnerships-making a health matrix successful. Asia Pacific Journal of Health Management. 2019 Jan;14(1):85-93. https://doi.org/10.24083/apjhm.v14i1.211
2. Mariani M, Sisti LG, Isonne C, Nardi A, Mete R, Ricciardi W, Villari P, De Vito C, Damiani G. Impact of hospital mergers: a systematic review focusing on healthcare quality measures. European Journal of Public Health. 2022 Apr 1;32(2):191-9. https://academic.oup.com/eurpub/article-abstract/32/2/191/6528407
3. Büssgen M, Stargardt T. To merge or not to merge? The impact of mergers and acquisitions on corporate success in the pharmaceutical industry. Managerial and Decision Economics. 2024 Jun;45(4):2196-209. https://onlinelibrary.wiley.com/doi/abs/10.1002/mde.4129
4. Altamuro JL, Gray JV, Zhang H. Corporate integrity culture and compliance: A study of the pharmaceutical industry. Contemporary Accounting Research. 2022 Mar;39(1):428-58. https://onlinelibrary.wiley.com/doi/abs/10.1111/1911-3846.12727?casa_token=b-2gFYAlYYwAAAAA:oaCf4tkZl-pWB9ATNg7QeuKQU3af_T-shycJeLe6HUevU7d1LO7TRJHMWL8HLlMxieJazpLiE4Mdx1k6
5. Battisti E, Christofi M, Vrontis D, Nirino N. Past, present, and future of mergers and acquisitions in the MENA region: a systematic review and integrative framework. International Studies of Management & Organization. 2021 Jul 3;51(3):276-96. https://www.tandfonline.com/doi/abs/10.1080/00208825.2021.1959876
6. Lloyd S, Upton M, Scanlan J. Leveraging partnerships for microcredential design in digital health: Key success factors. Asia Pacific Journal of Health Management. 2024 Dec;19(3):56-65. https://search.informit.org/doi/abs/10.3316/informit.T2025012800009290932780927
7. KPMG, Mergers & Acquisitions magazine, Tiemann D, Moyers M. 2015 M&A Outlook [Internet]. KPMG Research. KPMG LLP; 2015. Available from: https://imaa-institute.org/wp-content/uploads/statistics_files/kpmg/kpmg_us-m-and-a-outlook-2015.pdf
8. Srivastava RK. Managing mergers and acquisitions in health care: A case study in the pharmaceutical sector. International Journal of Healthcare Management. 2020 Dec 15;13(sup1):61-73. https://www.tandfonline.com/doi/abs/10.1080/20479700.2017.1422337
9. Schneller E, Abdulsalam Y, Conway K, Eckler J. Strategic management of the healthcare supply chain. John Wiley & Sons; 2023 Jul 11. https://books.google.co.in/books?hl=en&lr=&id=RgTLEAAAQBAJ&oi=fnd&pg=PR11&dq=9.%09Schneller,+E.,+Abdulsalam,+Y.,+Conway,+K.,+%26+Eckler,+J.+(2023).+Strategic+management+of+the+healthcare+supply+chain.+John+Wiley+%26+Sons.&ots=VxFsoF87vR&sig=CodTzntD16EnrsyiNwEl413JUno&redir_esc=y
10. Euh Y, Lee D. How do pharmaceutical companies overcome a corporate productivity crisis? Business diversification into medical devices for growth potential. International Journal of Environmental Research and Public Health. 2021 Feb;18(3):1045. https://www.mdpi.com/1660-4601/18/3/1045
11. Mphil IA, Dehury RK, Behera MR. Access to Essential Medicines in India: The role of innovations, patents, and intellectual property rights. Asia Pacific Journal of Health Management. 2024 Dec 22;19(3). http://journal.achsm.org.au/index.php/achsm/article/view/1697
12. Kooli C, Lock Son M. Impact of COVID-19 on mergers, acquisitions & corporate restructurings. Businesses. 2021 Aug 16;1(2):102-14. https://www.mdpi.com/2673-7116/1/2/8
13. Verulava T. Economies of scale, efficiency and optimal size of the hospital. Globalization and Business. 2024 Jun 24;9(17):129-49. https://eugb.ge/index.php/111/article/view/365
14. Wajid A, Khan KH, Handa H. Innovations through mergers and acquisitions in the pharmaceutical sector. In Technological innovations for sustainability and business growth 2020 (pp. 91-104). IGI Global Scientific Publishing. https://www.researchgate.net/publication/372244444_Innovations_Through_Mergers_and_Acquisitions_in_the_Pharmaceutical_Sector

15. Hu M, Ngo MT. Cross-border mergers and acquisitions: An overview. Corporate Finance Review. 2015 Mar 1;19(5):17. https://search.proquest.com/openview/1e51cc388d9745fbc2e189120ecf9186/1?pq-origsite=gscholar&cbl=46775
16. Ghosh A, Verghese M, Vyas JH. Impact of Talent Management Strategies on Retaining the Talented Employees of the Pharmaceutical Industry. In Computational Optimization, Modeling, and Simulation for Engineering Applications 2024 Dec 6 (pp. 159-168). Apple Academic Press. https://www.taylorfrancis.com/chapters/edit/10.1201/9781003454021-16/impact-talent-management-strategies-retaining-talented-employees-pharmaceutical-industry-ambarish-ghosh-manoj-verghese-vyas
17. Dezi L, Battisti E, Ferraris A, Papa A. The link between mergers and acquisitions and innovation: A systematic literature review. Management Research Review. 2018 Jun 5;41(6):716-52. https://www.emerald.com/insight/content/doi/10.1108/mrr-07-2017-0213/full/html
18. Mercurio B. WTO waiver from intellectual property protection for COVID-19 vaccines and treatments: A critical review. Va. J. Int'l L. Online. 2021;62:9. https://heinonline.org/HOL/LandingPage?handle=hein.journals/vajoillw62&div=3&id=&page=
19. Chabel S. Technological Integration in Pharmaceutical Logistics. Advances in Transdisciplinary Engineering. 2023 Dec 15. https://hal.science/hal-04634278/
20. Teerikangas S, Colman HL. Theorizing in the qualitative study of mergers & acquisitions. Scandinavian Journal of Management. 2020 Mar 1;36(1):101090. https://www.sciencedirect.com/science/article/pii/S0956522118303245
21. GlaxoSmithKline. Annual Report 2016 [Internet]. 2016. Available from: https://www.gsk.com/media/x13jvhrx/annual-report-2016.pdf
22. Upadhyay S, Weech-Maldonado R, Lemak CH, Stephenson A, Mehta T, Smith DG. Resource-based view on safety culture's influence on hospital performance: The moderating role of electronic health record implementation. Health care management review. 2020 Jul 1;45(3):207-16. https://journals.lww.com/hcmrjournal/abstract/2020/07000/resource_based_view_on_safety_culture_s_influence.4.aspx
23. Feldman ER, Hernandez E. Synergy in mergers and acquisitions: Typology, life cycles, and value. Academy of Management Review. 2022 Oct;47(4):549-78. https://journals.aom.org/doi/full/10.5465/amr.2018.0345
24. Godfrey CM, Kircher C, Ashoor HM, Ross-White A, Glandon L, Wilson R, McSharry J, Tricco AC, Zitzelsberger L, Kaan D, Sears K. Absorptive capacity in the adoption of innovations in health: a scoping review. JBI Evidence Synthesis. 2023 Jan 1;21(1):6-32. https://journals.lww.com/jbisrir/abstract/2023/01000/absorptive_capacity_in_the_adoption_of_innovations.3.aspx
25. Yin RK. Case study research and applications. Thousand Oaks, CA: Sage; 2018 Jan. Sage Publications.
26. Saunders M, Lewis P, Thornhill A. Research methods for business students. Pearson education; 2009. https://amberton.edu/wp-content/uploads/2024/07/RGS6035_E2_Fall2024.pdf
27. Julie, Sir Andrew Witty. Annual Report 2014 [Internet]. 2014. Available from: https://www.gsk.com/media/0rtp1qlp/annual-report-2014.pdf
28. Herman M. Wenger banking on Arsenal consistency in top-four fight [Internet]. Reuters. 2015. Available from: https://www.reuters.com/article/us-gsk-novartis-idUSKBN0LZ18A20150302/
29. Annual Report 2022 [Internet]. Available from: https://www.gsk.com/media/9956/annual-report-2022.pdf
30. GSK. GSK Annual Report 2023 [Internet]. 2023. Available from: https://www.gsk.com/media/11007/annual-report-2023.pdf
31. Schleimer S, Shulman A. Value-adding contributions of firm internal and external collaboration in new product development. In Academy of Management Annual Meeting 2008. No data provided. https://research-repository.griffith.edu.au/items/8a0ddb83-da6b-5092-b2b4-d427422b04b0
32. Paruchuri S, Han JH, Prakash P. Salient expectations? Incongruence across capability and integrity signals and investor reactions to organizational misconduct. Academy of Management Journal. 2021 Apr;64(2):562-86. https://journals.aom.org/doi/full/10.5465/amj.2018.0698
33. Currie G, Spyridonidis D, Kiefer T. From what we know to what we do: enhancing absorptive capacity in translational health research. BMJ Leader. 2019 Nov 12. https://wrap.warwick.ac.uk/id/eprint/126005/7/WRAP-from-what-know-enhancing-health-research-Currie-2019.pdf

34. Harvey G, Jas P, Walshe K. Analysing organisational context: case studies on the contribution of absorptive capacity theory to understanding inter-organisational variation in performance improvement. BMJ quality & safety. 2015 Jan 1;24(1):48-55. https://qualitysafety.bmj.com/content/qhc/24/1/48.full.pdf
35. Hussinger K. Absorptive capacity and post-acquisition inventor productivity. The Journal of Technology Transfer. 2012 Aug;37(4):490-507. https://link.springer.com/article/10.1007/s10961-010-9199-y
36. Kapoor R, Lim K. The impact of acquisitions on the productivity of inventors at semiconductor firms: A synthesis of knowledge-based and incentive-based perspectives. Academy of Management Journal. 2007 Oct 1;50(5):1133-55. https://journals.aom.org/doi/full/10.5465/amj.2007.27169706

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BIBLIOMETRIC MAPPING OF ARTIFICIAL INTELLIGENCE APPLICATIONS IN HEALTHCARE: A SCIENCEDIRECT AND SCOPUS-BASED ANALYSIS

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ABSTRACT

BACKGROUND

Artificial Intelligence (AI) makes the healthcare industry modern and responsive by enhancing diagnosis, description, and planning for treatment. Machine learning and deep learning algorithms have made it possible to automate diagnosis, improve the quality of images, and make medicine more personalized. But there are still ethical and privacy issues to think about.

OBJECTIVE

This study performs a bibliometric analysis to map key trends, thematic clusters, and author collaborations in AI in healthcare using ScienceDirect and Scopus-indexed literature published between January 2021 and August 2025.

METHODOLOGY

A systematic review was performed for ScienceDirect with the keywords Artificial Intelligence in Healthcare or AI in Medicine to retrieve research papers. The growth in publications, productive authors, top-cited research articles, resources, and authors' collaboration publications in AI in healthcare for keyword network analysis figures using bibliometric analysis (specifically using the Bibliometrix Shiny dashboard) were identified.

KEY FINDINGS / RESULTS

The number of AI publications in the healthcare and medical fields has grown quickly each year with an average growth rate of 62.66% from 2021 to 2024. Yogesh K. Dwivedi, A.S. Albahri, Patrick Mikalef, Rajesh Gupta, and Suddeep Tanwar are the most productive authors identified in this study. A paper by Chanyuan Zhang is one of the most cited manuscripts. It has 2,293 authors and 2,442 author appearances. The keyword co-occurrence network helps find patterns and research trends in this field. Central keywords show well-established research areas, while peripheral nodes show new or niche topics. The network reporting shows that AI in healthcare is a field of study that brings together different areas of research, such as diagnostics, data analytics, medical informatics, and patient monitoring.

CONCLUSION / IMPLICATIONS

By applying bibliometric analysis to the literature identified from ScienceDirect, this study offers valuable insights into emerging trends, thematic patterns, and strategic directions in the field of AI in healthcare. ScienceDirect was selected

due to its high-quality peer-reviewed content, institutional access rights, and strong emphasis on technology and applied sciences. However, relying solely on one database is a limitation, as it may not fully represent the breadth of influential research in this area. Future studies should consider incorporating additional databases such as Scopus, Web of Science, and PubMed to improve the comprehensiveness, representativeness, and generalizability of the results. Further research could also examine the integration of AI and the Internet of Things (IoT) in clinical healthcare settings to enable intelligent diagnostics, personalized treatment, and better patient outcomes.

KEYWORDS

artificial intelligence, bibliometric analysis, healthcare, scientific collaboration

INTRODUCTION

As every operation in some way is being technology-driven, in the complex, uncertain, and technology-driven environment, Artificial Intelligence (AI) blended with computer science, medical, and data analytics has transformed healthcare enormously. AI in healthcare enables smart diagnosis, tailored treatment plans, and immediate patient monitoring, which attracts various stakeholders. However, this interdisciplinary approach of AI in healthcare also raises serious concerns about data integrity, algorithmic partiality, and transparency in healthcare decisions [6, 7].

AI-driven innovations such as machine learning, neural networks, voice recognition, and wearable health technologies are increasingly deployed to support healthcare delivery, yet their rapid adoption also presents challenges in terms of standardization and ethical application [4, 8]. Recent studies have highlighted the rapid global expansion of AI research in healthcare, with countries like the United States and China leading high-impact contributions [9–11]. Nevertheless, methodological limitations, small sample sizes, and data quality issues remain prevalent [5, 7].

To understand the structure, trends, and emerging areas in this dynamic field, bibliometric analysis has emerged as a powerful tool [6]. Unlike traditional narrative or systematic reviews, bibliometric mapping allows researchers to quantitatively analyze publication patterns, thematic clusters, influential contributors, and collaboration networks. This is particularly valuable in fast-evolving domains like AI in healthcare, where the volume of literature is growing exponentially and manual synthesis is increasingly infeasible [13].

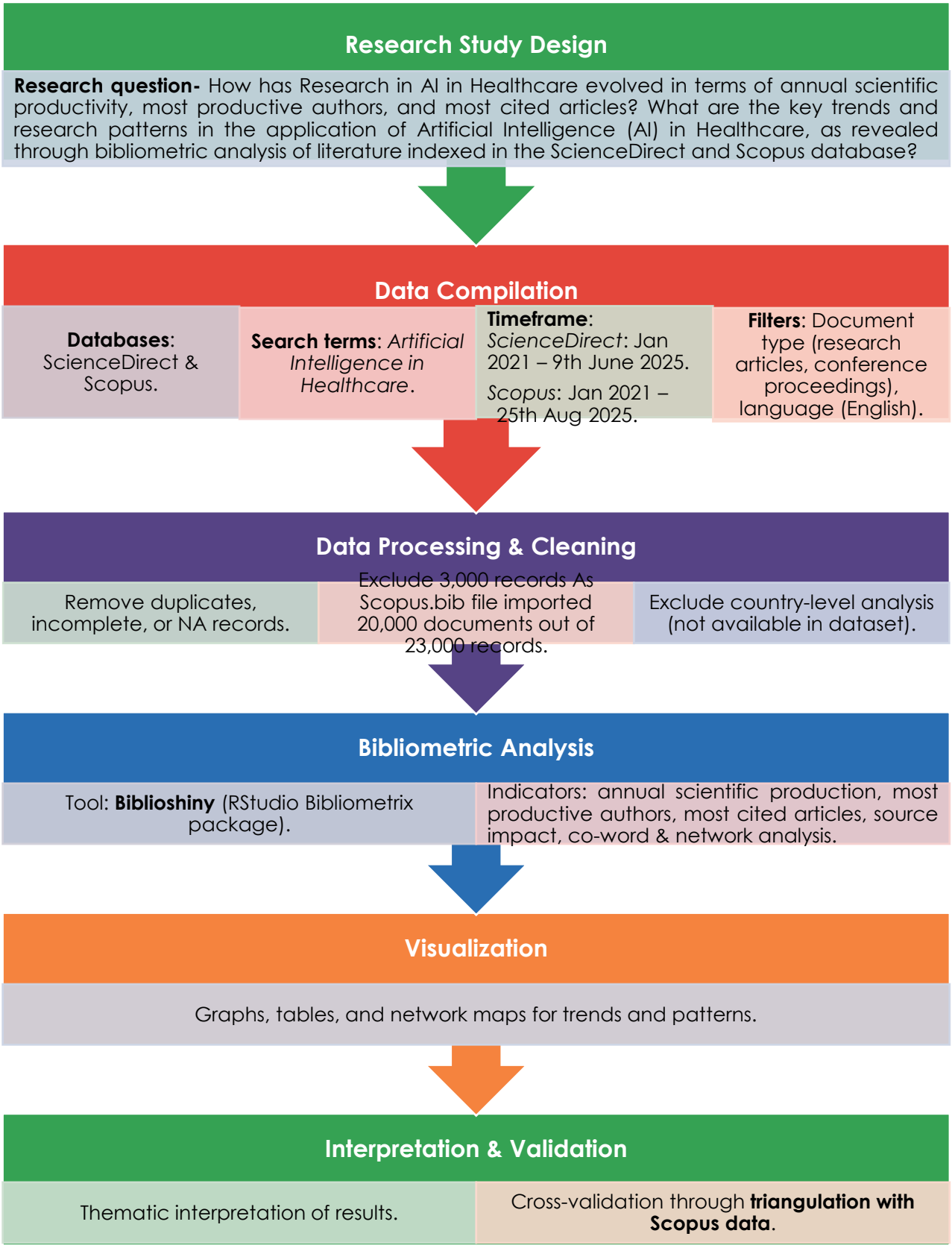
Most prior bibliometric studies on this topic have relied on databases like Scopus, Web of Science, or PubMed [1, 3, 5]. In this context, the present study conducts a bibliometric analysis of publications related to AI in healthcare from January 2021 to June 2024, as indexed in ScienceDirect and up to 29th Aug 2025 in Scopus. The goal is to map thematic evolution, author productivity, publication trends, and research collaboration patterns that can guide future inquiry and policy decisions in this transformative field. This study examines trends, productivity, collaboration patterns, and thematic evolution in the domain of AI in healthcare.

METHODOLOGY

STUDY DESIGN

This study utilizes a bibliometric review methodology, which involves the systematic retrieval and quantitative analysis of bibliographic metadata to examine trends, productivity, collaboration patterns, and thematic evolution in the domain of AI in healthcare. The study aligns with the Scopus Triangulation for qualitative cross validation [13], which filter Scopus.bib. Most prior bibliometric studies on this topic have relied on databases like Scopus, Web of Science, or PubMed [1, 3, 5]. In addition to ScienceDirect (2021 to 2024), this study includes publications extracted from Scopus (AIScopus.bib) up to 29th August 2025, ensuring broader coverage of relevant research.

FIGURE 1: METHODOLOGICAL STEPS FOR THIS BIBLIOMETRIC INVESTIGATION



DATA SOURCE

Bibliographic data were retrieved exclusively from the ScienceDirect database. ScienceDirect was selected due to its comprehensive access rights, focus on high-quality, peer-reviewed literature, and its orientation toward applied science and technology research, especially in domains like medicine, engineering, and computer science. In addition, publications from Scopus up to 29th Aug 2025 were included to provide broader coverage and qualitative representation.

ScienceDirect

- *16,269 Research Articles*

Scopus Database Overview

- Number of documents: 20,000 out of a total 23,000+ documents .bib file import allowed 20,000, so only 20,000 Scopus Documents considered for analysis.
- Number of Scopus authors: 18,634
- Number of Scopus sources: 3,508

However, the limitation of using only these two databases is acknowledged, as this excludes potentially relevant literature from PubMed and Web of Science. While the reliance on only two databases is recognized as a limitation—given that potentially relevant literature from sources such as PubMed and Web of Science may be excluded—this study nonetheless adds value by drawing upon two of the largest and most widely used bibliographic databases, thereby providing a robust and representative overview of the field. Future studies should integrate multiple databases to improve generalizability and reduce selection bias.

RESEARCH QUESTION

For this bibliometric study we have focused on two research questions: How has research in AI in healthcare evolved in terms of annual scientific productivity, most productive authors, and most cited articles? What are the key trends and research patterns in the application of Artificial Intelligence (AI) in healthcare, as revealed through bibliometric analysis of literature indexed in the ScienceDirect and Scopus databases?

SEARCH STRATEGY

The literature search was performed on August 9th, 2025, using ScienceDirect's advanced search interface. The following Boolean keyword string was used:

("Artificial Intelligence" OR "AI" OR "Machine Learning") AND ("Healthcare" OR "Medicine")

The search was limited to titles, abstracts, and author keywords, and filtered to include peer-reviewed journal articles published in English between January 2021 and 9th August 2025.

The Scopus document search performed to date: 29th August 2025. Search Keywords used were Artificial Intelligence for Healthcare.

INCLUSION AND EXCLUSION CRITERIA

Inclusion criteria:

• Articles published between Jan 2021 – 9th August 2024 in ScienceDirect 4207 and Scopus 20,000 documents to 29th August 2025
• ScienceDirect Peer-reviewed journal articles/ Scopus Peer-reviewed journal articles and Conference Articles
• English language
• Relevance to AI in healthcare, determined via title and abstract

```
Data and PRISMA
Cleaned dataset ready. Records: 4,207
```

Step	Count
Initial records (raw .bib)	4,441
Records after import	4,441
Removed (year filter)	0
Removed (non-article)	0
Removed (missing keywords)	234
Removed (duplicates)	0
Final included	4,207

```
Records (final included): 4,207
Removed 1,302 duplicated documents
Years covered: 2021 - 2024
Top 10 keywords (DE):
artificial intelligence, machine learning, deep learning, healthcare, AI, ChatGpt, COVID-19, artificial intelligence (AI), internet of things, explainable AI
```

Exclusion criteria:

- Editorials, letters to the editor, book reviews
- Articles unrelated to AI or medicine after screening

Scopus single file download of 20,000 documents out of 23,000 documents (out of total 23,000 Scopus indexed documents 3,000 excluded)

QUALITY ASSESSMENT

To ensure data quality and representativeness, only articles published in Q1 and Q2 journals (according to Scopus quartile rankings [18]) were included in the final analysis. This approach guarantees that only high-impact, peer-reviewed sources contribute to the review's conclusions.

REVIEW PROTOCOL

This bibliometric review followed guidelines adapted from PRISMA-ScR [19] to promote transparency and reproducibility in study selection and data analysis.

DATA PROCESSING AND CLEANING

The exported bibliographic metadata was stored in BibTeX (.bib) format. Data preprocessing steps included:

- Deduplication of entries
- Manual screening of titles and abstracts for relevance
- Cleaning of author, keyword, and journal fields using Biblioshiny (R package) [20]
- Network and cluster analysis using VOSviewer, Bibliometrix R, and Biblioshiny

RESULTS

To better understand the publication landscape of artificial intelligence in healthcare, this section presents the bibliometric results, including annual growth trends, keyword distributions, and thematic patterns derived from the analyzed dataset.

ANNUAL GROWTH IN AI PUBLICATIONS ON SCIENCEDIRECT

TABLE 1. ANNUAL PUBLICATION GROWTH IN AI AND HEALTHCARE (2021–2025)

Publication Year	Articles	Growth (%)
2021	22	–
2022	55	150%
2023	98	78.20%
2024	170	73.50%
2025*	154	-9.40%

*2025 data are provisional, based on publications indexed up to [2025].

Table 1 reflects strong growth in the AI-related publications from 2021 to 2024, and a sudden decline observed in the current year 2025. Whereas the average annual growth rate is 62.66%, which shows high growth and curiosity of researchers in the domain.

ANNUAL GROWTH IN AI PUBLICATIONS ON SCOPUS

TABLE 2. ANNUAL PUBLICATION GROWTH IN AI AND HEALTHCARE (2022–2026) SCOPUS

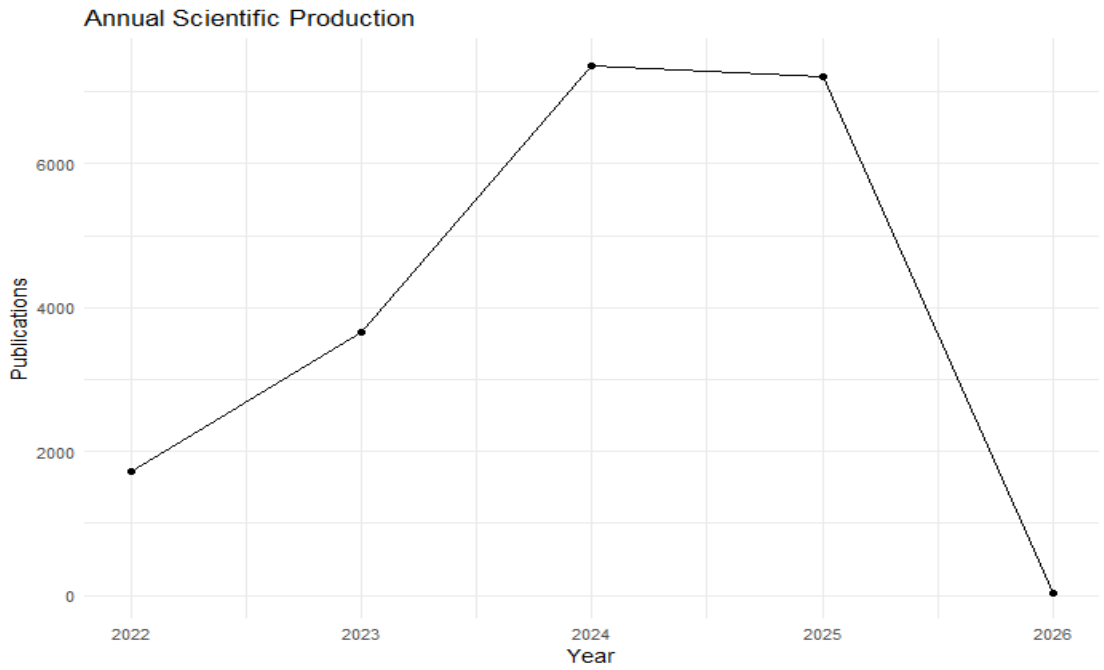
Publication Year	Publications	Growth (%)
2022	1,720	–
2023	3,656	53%
2024	7,367	50%
2025*	7,219	-2%
2026*	38	

*2025 data are provisional, based on publications indexed up to [2025].

Table 2 represents the strong growth of in AI in healthcare-related publications in 2022 to 2025, 38 publications for the publication year 2026 are also found in the Scopus document data source.

These results show that in just three years AI in healthcare publication count has increased by 4 times than earlier. Figure 2 also reflects post post-pandemic surge in AI in healthcare activities with increased usage and adoption of AI in healthcare as well as diagnostics.

FIGURE 2: PHASE OF ANNUAL SCIENTIFIC SCOPUS PRODUCTION IN AI IN HEALTHCARE



As a data source up to 29th August 2025, it shows explanatory deep and phase of maturity and plateau showing the consolidation phase of quality specializations and collaboration. The figure no1. depicts emergence, rapid expansion, and stabilization phases

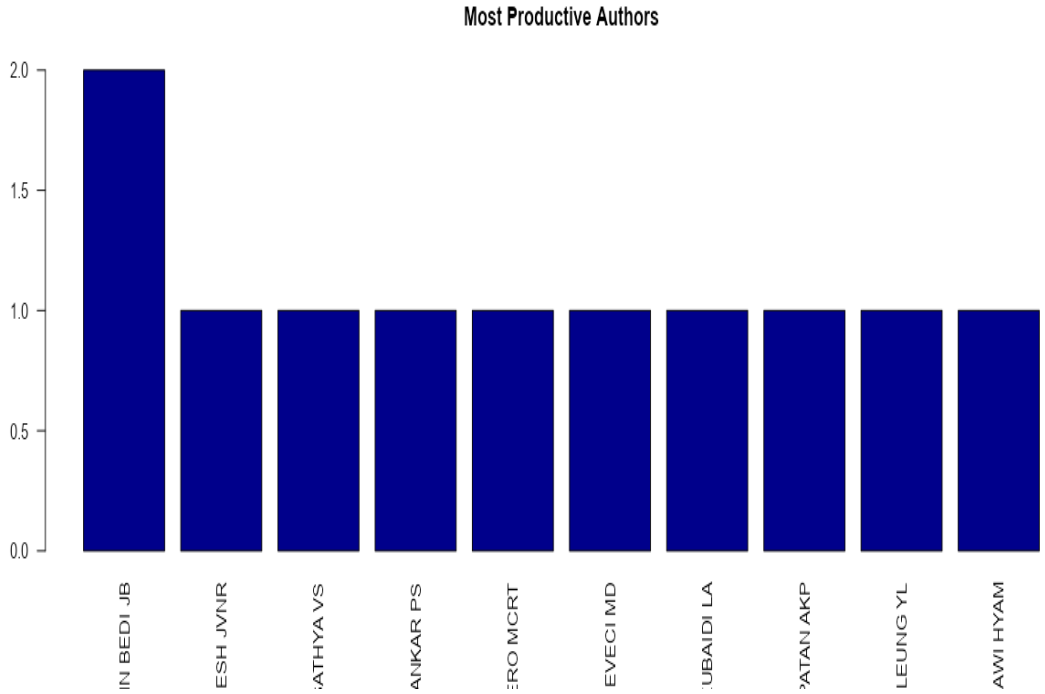
TOP PRODUCTIVE AUTHORS MATRIX

TABLE 3. MOST PRODUCTIVE AUTHORS IN AI AND HEALTHCARE LITERATURE

Author	Articles	Fractionalized Contributions
YOGESH K. DWIVEDI (YKD)	6	1.40
A.S. ALBAHRI (ASA)	4	–
PATRICK MIKALEF (PM)	4	1.08
RAJESH GUPTA (RG)	4	–
SUDEEP TANWAR (ST)	4	–

Yogesh K. Dwivedi is the most productive author with the highest number of articles, but his fractionalized contribution is 1.40, suggesting he is not the sole author of most papers. Patrick Mikalef (PM) has four articles with a fractionalized score of 1.08, suggesting moderate involvement. However, for ASA, RG, and ST, the fractionalized contribution is not provided, limiting a full comparative understanding. Despite this, ASA, RG, and ST are on par with PM based on article count alone. Further data is needed to determine contribution patterns.

FIGURE 3. AUTHOR PRODUCTIVITY DISTRIBUTION



The chart shows a right-skewed distribution, with a single author having higher output than peers. The field is either highly diverse or fragmented, lacking key leaders publishing heavily. Implications for the research community include fostering collaboration, encouraging prolific authors to mentor new researchers, and supporting mid-level contributors to increase publication frequency.

Most Productive Scopus Authors:

The most productive Scopus author (Table 4) is Shaffik Waswa, with 21 publications. The research leadership in healthcare AI is dominated by Shaffik Wasswa, with a strong research group affiliation. The field relies on multi-disciplinary teamwork and has a global footprint. While individual authors dominate output, large author consortia play a crucial role. The dual nature of AI in healthcare research highlights the importance of specialized experts and collaborative teams addressing complex problems. Future research directions should encourage cross-border collaborations and examine whether prolific authors focus on specific niches or span multiple healthcare subdomains.

TABLE 4: MOST PRODUCTIVE AUTHORS IDENTIFIED IN THIS STUDY

Rank	Authors Rank	Publications
1	Shaffik Wasswa	21
2	Tariq, Muhammad Usman	11
3	Kaur, Jaspreet	8
4	Singh, Bhupinder	7
5	Subasi, Abdulhamit	7
6	Lal, Mily and Nedunchelivan, Subbu	6
7	Singh, Bhupinder and Kaunert, Christian	6
8	Wah, Jack Ng Kok	6
9	da Silva, Tiago Horta Reis	6
10	Brady, Adrian Paul and Allen, Bibb and Chong, Jaron J.R. and Kotter, Elmar and Kottler, Nina E. and Mongan, John T. and Oakden-Rayner, Lauren and Pinto Dos Santos, Daniel and Tang, An and Wald, Christoph	5

TOP CITED MANUSCRIPTS MATRIX

TABLE 5. MOST CITED MANUSCRIPTS IN THE DATASET

Rank	Paper & Author	Year	Citations	Cit/Year	DOI
1	Chanyuan Zhang (CAZ)	2022	2021	505	Link

Chanyuan Zhang's 2022 paper is the top-cited in the dataset, with a high citation rate of 505 per year since its publication. This indicates its high impact and relevance in its research field. The paper's citation rate is exceptionally high, indicating its widespread recognition.

RELEVANT SOURCES MATRIX

1. Relevant Sources Matrix for ScienceDirect

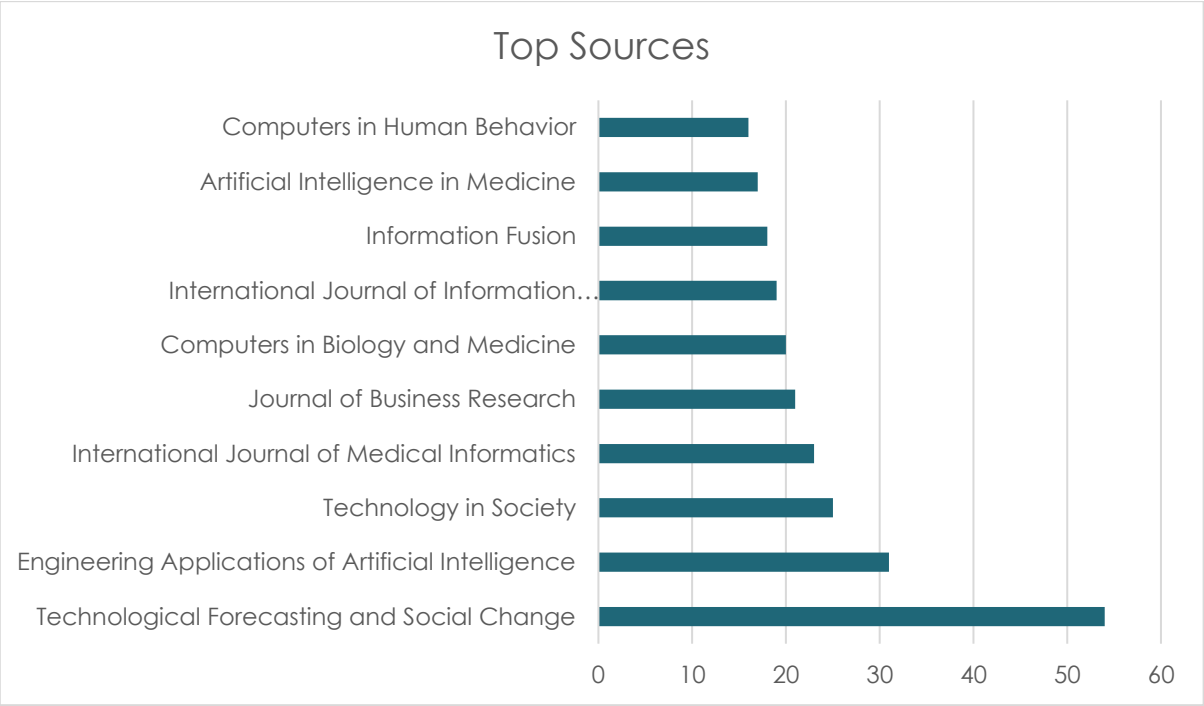
TABLE 6. LEADING JOURNALS PUBLISHING ON AI IN HEALTHCARE

Rank	Source Name	Articles
1	Technological Forecasting and Social Change	54
2	Engineering Applications of Artificial Intelligence	31
3	Technology in Society	25
4	International Journal of Medical Informatics	23
5	Journal of Business Research	21
6	Computers in Biology and Medicine	20
7	International Journal of Information Management	19
8	Information Fusion	18
9	Artificial Intelligence in Medicine	17
10	Computers in Human Behavior	16

Between 2021 and 2024, the number of publications related to AI in healthcare showed a compound annual growth rate (CAGR) of 62.66%, indicating robust research momentum. However, the slight publication decline observed in 2025 (-9.40%) may reflect either an incomplete data year or stabilization in output. Similar bibliometric studies [6, 12] have observed comparable peaks followed by plateauing trends, suggesting saturation in early-stage exploratory topics and a transition toward niche research areas like ethical AI or wearable systems.

Technological Forecasting and Social Change is the leading source for AI research, with 54 articles, indicating a strong focus on technology foresight, innovation, and socio-technical systems. Applied AI research, such as Engineering Applications of AI, Artificial Intelligence in Medicine, and Information Fusion, emphasizes practical implementations and real-world problem-solving using AI. These journals have an interdisciplinary reach, showcasing AI/tech crossover with healthcare, biology, and psychology. Additionally, they have a business and society lens, highlighting the societal and managerial impact of emerging technologies. These journals are priority targets for authors working in AI, technology forecasting, informatics, and socio-economic impacts. Researchers should align their problem statements and methodologies with the scope and themes of these top journals.

FIGURE 4. TOP SOURCES IN AI AND HEALTHCARE RESEARCH



The Figure 4 bar chart shows the top journal sources in a research domain, such as technology, AI, and health informatics. The most influential source is "Technological Forecasting and Social Change", followed by "Engineering Applications of Artificial Intelligence" with 31 articles. Mid-level sources like "Technology in Society", "International Journal of Medical Informatics", and "Journal of Business Research" have 20-25 articles each, showing moderate influence. Lower-tier sources like "Artificial Intelligence in Medicine", "Computers in Human Behavior", and "Information Fusion" have 16-19 article counts, representing specialized or interdisciplinary domains. The top source (TFSC) is a go-to journal for authors in the field, with a diverse range of topics spanning technology, business, society, healthcare, and behaviour. Authors should prioritize TFSC, AI application journals, and socio-technical platforms for visibility.

2. Relevant Sources Matrix for Scopus

By Documents

TABLE 7: TOP PERFORMING ARTICLES

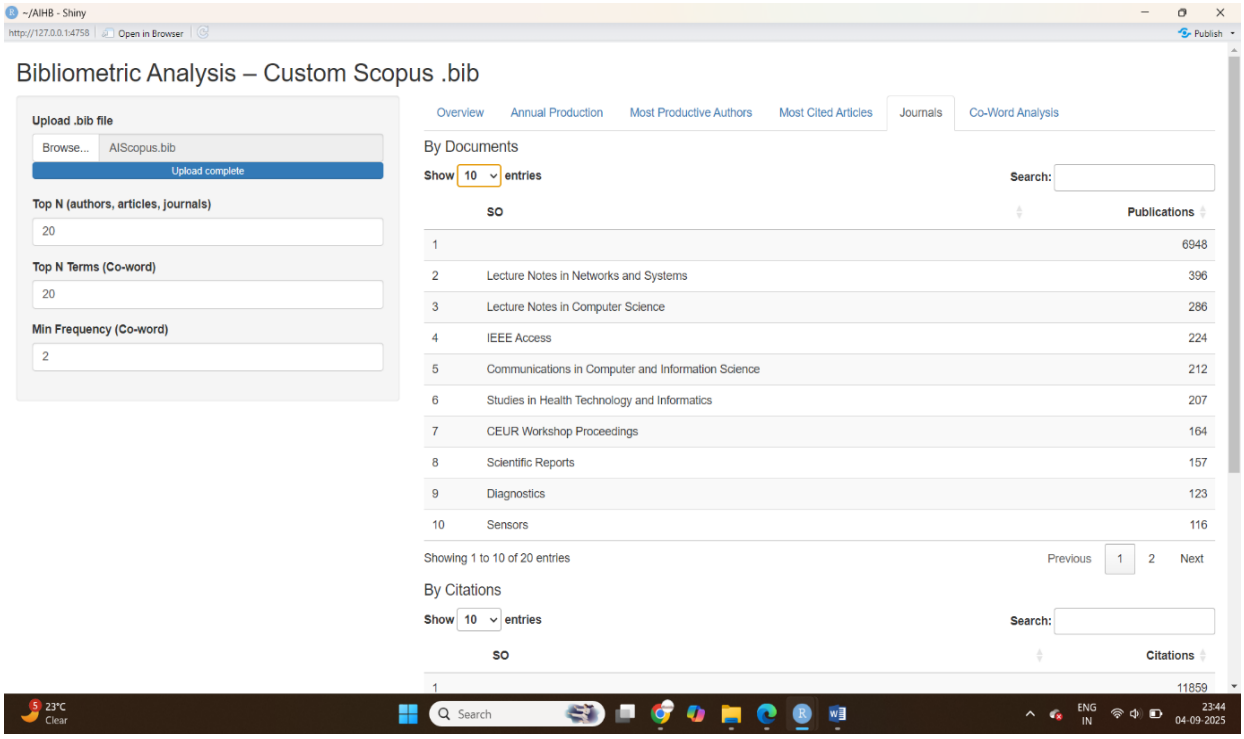
Rank	Source	Articles
1	Lecture Notes in Networks and Systems	396
2	Lecture Notes in Computer Science	286
3	IEEE Access	224
4	Communications in Computer and Information Science	212
5	Studies in Health Technology and Informatics	207
6	CEUR Workshop Proceedings	164
7	Scientific Reports	157
8	Diagnostics	123
9	Sensors	116
10	AIP Conference Proceedings	113

The AI in healthcare research is primarily based on conference proceedings, with the top-ranked sources being Lecture Notes in Networks and Systems, Lecture Notes in Computer Science, and CEUR Workshop Proceedings. Other key publications include Communications in Computer and Information Science and Studies in Health Technology and

Informatics. High-impact journals like Scientific Reports and Diagnostics also contribute significantly. The interdisciplinary nature of AI in healthcare requires collaboration between computer science, engineering, and clinical medicine. Researchers should focus on journal outlets for highly validated, clinically adoptable AI solutions.

Nature Medicine is the leading AI in healthcare journal with 2,196 citations, followed by IEEE Access and IEEE Internet of Things Journal. High-level review and survey journals contribute significantly to AI research, while the IEEE Journal of Biomedical and Health Informatics and International Journal of Medical Informatics stand out in the healthcare-specialized space.

FIGURE 4 JOURNAL TOP PUBLICATIONS



AI in healthcare research is deeply tied to IoT, big data, and real-time systems, with high citations in these areas. The interdisciplinary ecosystem driving AI in healthcare is demonstrated by the dual presence of top medical and computer science journals. A dual publishing strategy may maximize reach and adoption. Figure 4 is an outcome of the R shiny program designed and compiled by researchers for this research article.

By Citations

TABLE 8: TOP CITATIONS

Rank	Source	Citations
1	Nature Medicine	2,196
2	IEEE Access	1,215
3	IEEE Internet of Things Journal	934
4	IEEE Communications Surveys and Tutorials	690
5	Expert Systems with Applications	547
6	Information Systems Frontiers	545
7	ACM Computing Surveys	506
8	Information Fusion	490
9	IEEE Journal of Biomedical and Health Informatics	464
10	International Journal of Medical Informatics	441

Table 7 shows that IEEE Internet of Things Journal (934), Survey-oriented outlets (IEEE Communications Surveys and Tutorials – 690, ACM Computing Surveys – 506) which reflect the technological backbone of healthcare AI. Survey-oriented outlets emphasize the importance of review and synthesis in this emerging field. Domain-specific applied journals like Expert Systems with Applications (547) and International Journal of Medical Informatics (441) demonstrate high relevance for both academic and clinical audiences. The field is still in a knowledge-building and conceptual consolidation phase, with journals like Information Systems Frontiers, Information Fusion, and International Journal of Medical Informatics focusing on AI's translation into decision-making, data integration, and hospital informatics systems.

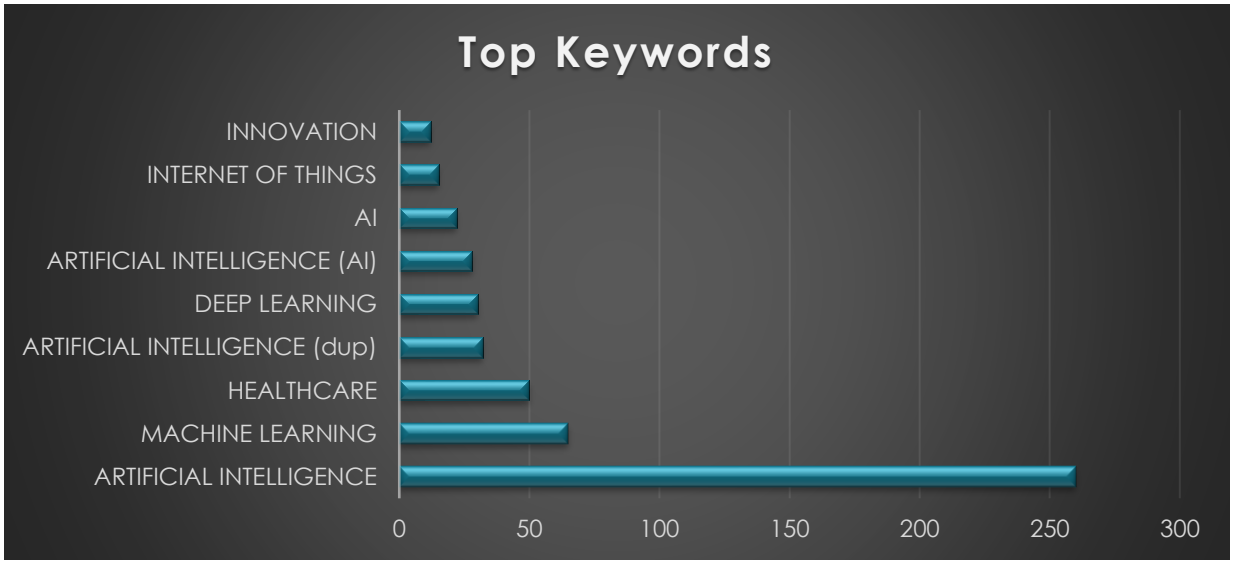
3. Authors' Collaboration Metrics Matrix

TABLE 9. AUTHOR COLLABORATION AND PRODUCTIVITY METRICS

Metric	Value
Total Authors	2,293
Author Appearances	2,442
Single-authored Documents	37
Documents per Author	0.218
Co-authors per Document	4.89
International Collaboration %	0%

The research scope should be expanded to include long-term projects, mentorship programs, and better retention for early-career researchers. Single-author contributions should be encouraged for originality, and collaborative structures should be utilized for depth. International collaborations should be established through cross-border funding schemes, publishing in international conferences, and partnering with researchers. Co-authorship networks should be mapped using tools like VOSviewer or Gephi.

FIGURE 5. KEYWORD FREQUENCY DISTRIBUTION



The study reveals a strong collaborative culture, with a high co-author rate and low single-authored documents. However, the authors' productivity is low, with an average author appearing in less than one document. The study also shows a zero (0%) international collaboration rate, which could be due to regional/national focus, barriers to international networking,

or limited global visibility. Recommendations for improvement include encouraging international co-authorship, supporting high-contribution authors, and using collaboration tools like ResearchGate, ORCID, and Scopus author IDs to expand professional networks.

KEYWORD CO-OCCURRENCE NETWORK

FIGURE 6. KEYWORD CO-OCCURRENCE NETWORK

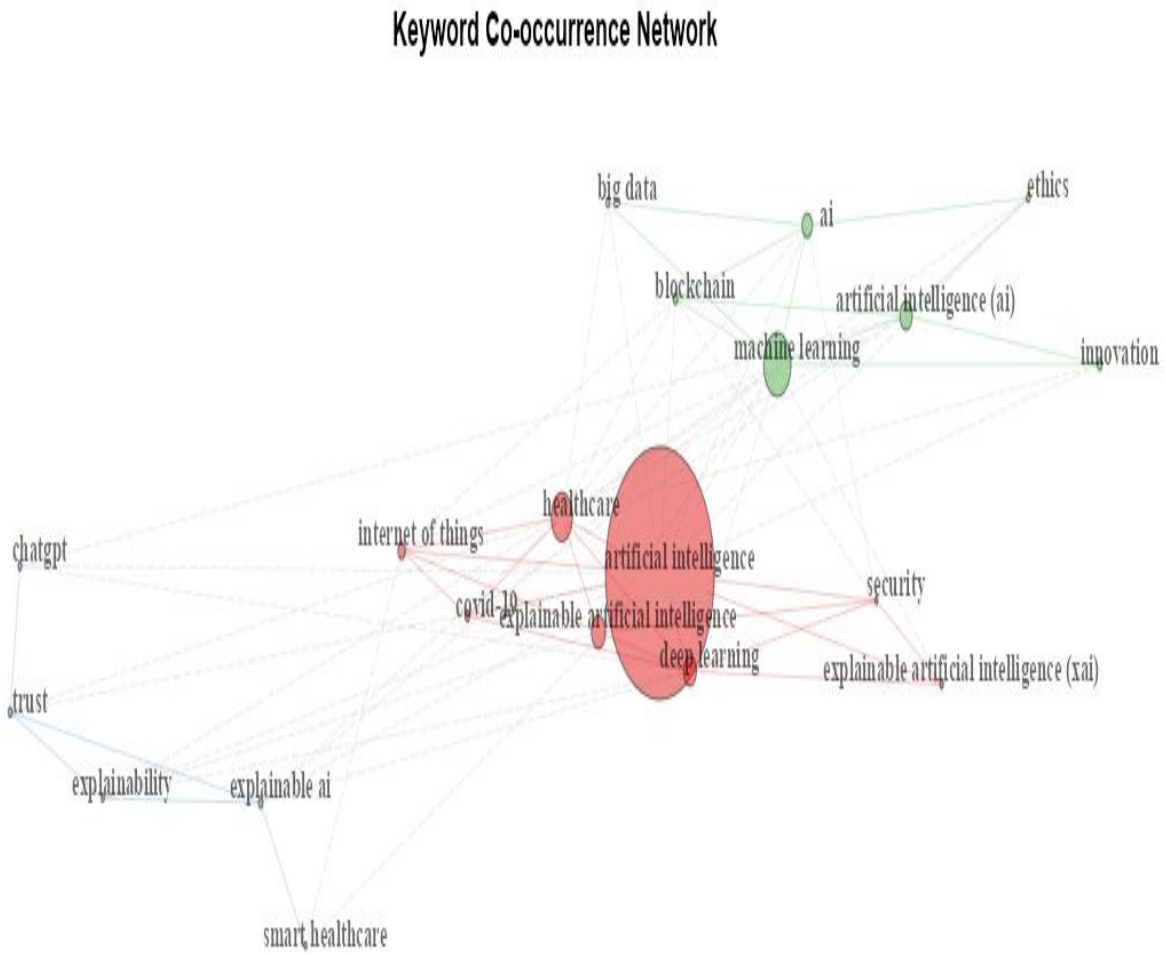


Figure 6 illustrates tightly linked keyword clusters such as {AI, Healthcare, Diagnosis, Machine Learning}, reflecting well-established research domains. In contrast, peripheral clusters featuring {COVID-19, IoT, Blockchain} represent emerging or interdisciplinary topics. Similar to Guo et al. (2022) [6], this clustering supports the dual nature of the field—both consolidated and exploratory.

AI in healthcare and medical fields is a multidisciplinary research area that connects fields such as diagnostics, data analytics, medical informatics, and patient monitoring. The keyword co-occurrence network, which is a powerful bibliometric visualization, helps uncover thematic structures and research trends in this domain. The network contains multiple distinct clusters, each colored differently, indicating thematic groupings of keywords. Highly central keywords, such as Artificial Intelligence, Machine Learning, Healthcare, Diagnosis, and Deep Learning, are critical to the research field. Strong links between keywords suggest frequent pairings and strong conceptual associations in the literature. Peripheral nodes represent emerging or niche topics, such as COVID-19, Wearable Sensors, or Blockchain. The network reveals that AI in healthcare is a multidisciplinary research area, connecting fields such as diagnostics, data analytics, medical informatics, and patient monitoring. Central keywords suggest mature and well-established research areas, while emerging themes at the periphery may indicate future research opportunities or gaps.

Keywords Concurrence cluster

FIGURE 7: KEYWORD CO-OCCURRENCE

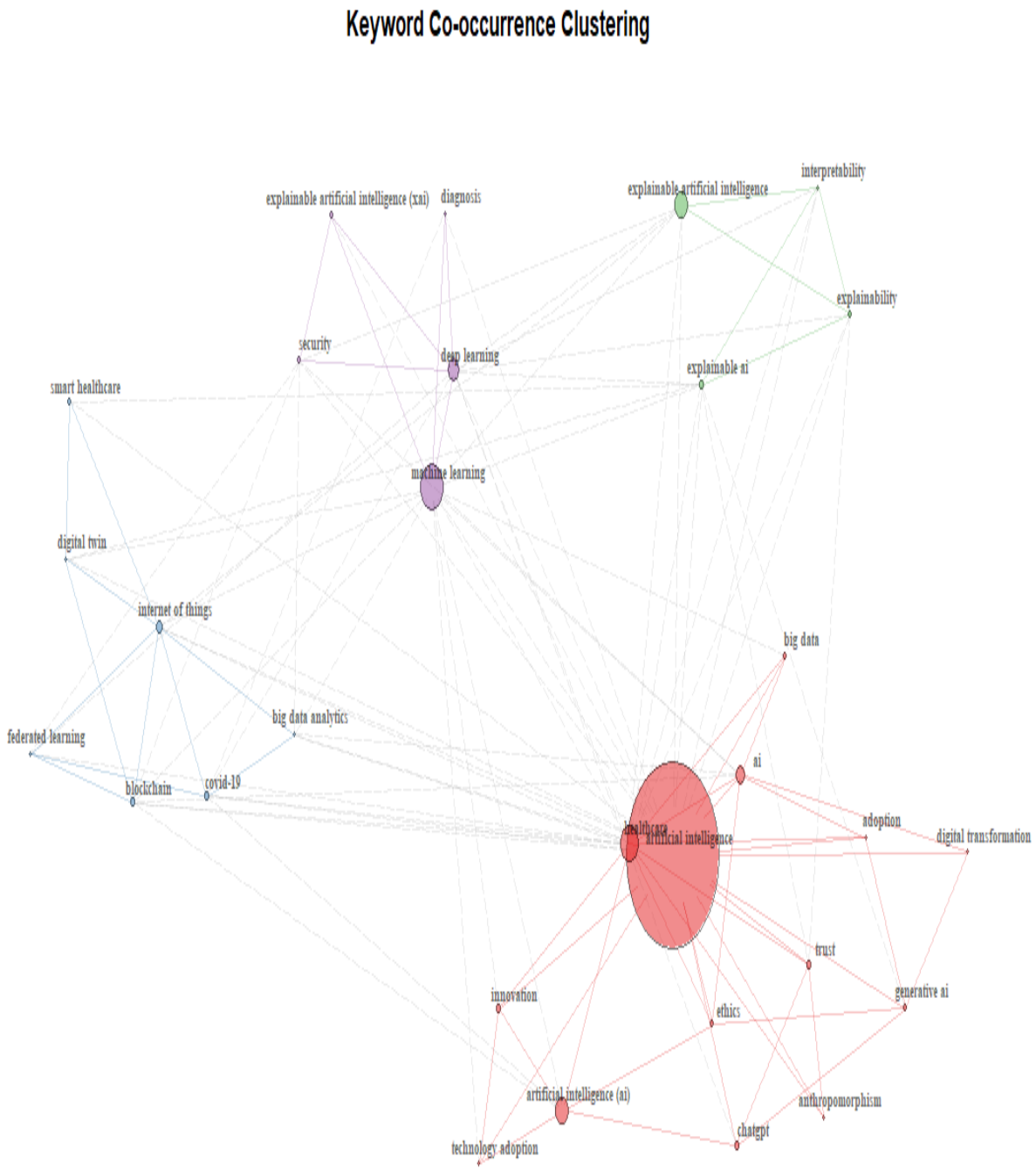
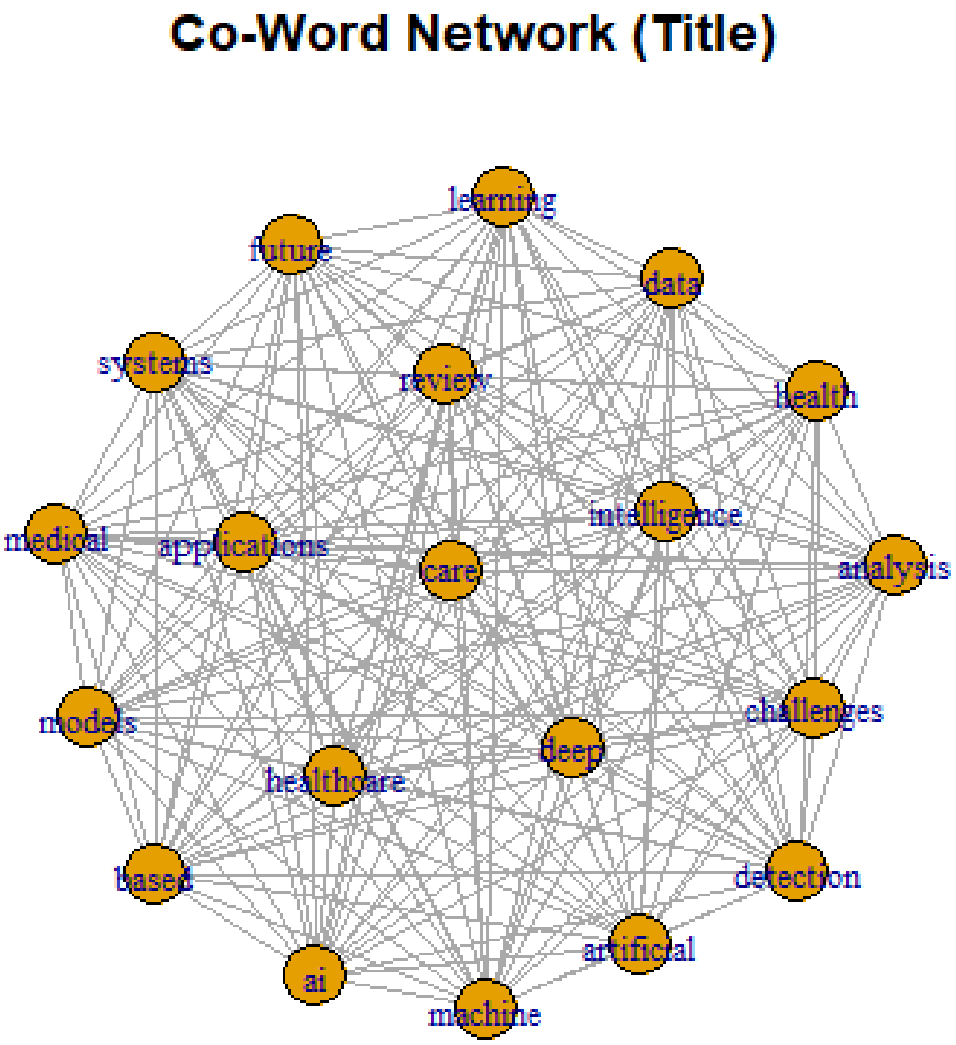


Figure 6 and 7 shows a cluster chart with the strategy identifying the keyword co-occurrence clustering is a group of journals around data center reflecting reveals around Artificial Intelligence, Machine Learning and Deep learning. With early focus on diagnostic applications shifting towards AI ethics and wearable health technologies in recent years.

Scopus Article Title Co-Word analysis

The network of AI in healthcare is densely connected, with terms like "healthcare," "care," "applications," "intelligence," "machine," "deep," "care," and "systems" indicating a high co-occurrence frequency across titles. The prominence of "healthcare," "care," "applications," and "systems" reflects the applied orientation of AI research towards improving clinical workflows, patient care, and hospital systems. The network structure suggests broad thematic overlap, indicating AI research in healthcare is not yet fragmented into isolated subfields but remains integrative.

FIGURE 8: CO-WORD NETWORK (TITLE)



DISCUSSIONS

The bibliometric results from ScienceDirect and Scopus show that AI research in healthcare is growing quickly, especially between 2021 and 2024. The yearly publication data (Tables 1 and 2) show that ScienceDirect's publications have grown at a compound annual growth rate (CAGR) of 62.66% and that Scopus's publications have quadrupled in three years. This shows that research interest has grown and that AI adoption in healthcare and diagnostics has sped up since the pandemic. The minor decrease in 2025 (-9.4% for ScienceDirect; -2% for Scopus) may signify data incompleteness, a stabilization phase, or a shift in the field towards specialized research domains such as AI ethics, wearable technologies, and clinical decision support systems. These trends align with prior bibliometric reviews [6, 12] that show a similar emergence, rapid expansion, and plateauing of early exploratory topics.

Author productivity analysis highlights both concentrated and distributed contributions. Yogesh K. Dwivedi and Shaffik Wasswa are among the top contributors, with fractionalized scores indicating collaborative authorship rather than dominance by individual researchers. The right-skewed distribution of author contributions (Figure 2) suggests that while the field is fragmented and multidisciplinary, productive authors can act as mentors to emerging researchers, reinforcing knowledge transfer. The low international collaboration rate (0%) signals a need for cross-border research partnerships, particularly to address global healthcare challenges and ensure AI solutions are generalizable across diverse populations.

Keyword co-occurrence and co-word network analyses (Figures 6–8) reveal a dual structure in the field: core, well-established themes such as AI, Machine Learning, Healthcare, Diagnosis, and Deep Learning, and emerging peripheral topics including COVID-19, IoT, Blockchain, and wearable health technologies. This suggests the field is both mature and exploratory, reflecting a balance between consolidated knowledge and novel, interdisciplinary directions. The thematic clusters also indicate applied research orientation, focusing on improving clinical workflows, patient care, and hospital systems.

Source analysis identifies top journals like *Technological Forecasting and Social Change*, *Engineering Applications of AI*, and *Nature Medicine* as primary publication venues, showing the interdisciplinary reach of AI research spanning technology, healthcare, socio-technical systems, and business. High citation counts in outlets such as *Nature Medicine* (2196 citations) and IEEE journals highlight the technological backbone and clinical relevance of the research, reinforcing the need for studies that bridge AI development and healthcare applications.

Policy and clinical implications emerge from these patterns. First, the concentration of AI research in applied journals emphasizes the translation of AI into actionable healthcare solutions, such as diagnostic support, real-time monitoring, and predictive analytics. Second, the limited international collaboration suggests policy interventions to promote global partnerships, funding schemes, and shared data infrastructures. Third, emerging themes like AI ethics, IoT, and wearable devices call for regulatory frameworks and clinical guidelines to ensure safe, equitable, and effective integration into healthcare systems. Finally, mentoring early-career researchers and fostering collaborative networks may enhance knowledge dissemination, innovation, and adoption of AI-driven healthcare solutions.

In summary, the bibliometric patterns indicate a dynamic and rapidly evolving AI in healthcare landscape, characterized by increasing publications, strong author collaboration, multidisciplinary thematic clusters, and influential journals shaping both academic and practical directions. Future research should emphasize cross-disciplinary collaboration, longitudinal studies on AI adoption in clinical settings, and policies addressing ethical, regulatory, and equity concerns in AI-enabled healthcare.

LIMITATIONS:

This study has several limitations that should be acknowledged. First, the analysis relied on only two bibliographic databases - *ScienceDirect* and *Scopus*. Although these provide extensive coverage of peer-reviewed literature, the exclusion of other databases such as PubMed and Web of Science may have restricted the breadth of literature considered and overlooked influential studies from other sources. Second, the dataset covers publications from January 2021 to August 2024. Since records for 2025 are incomplete, trends beyond mid-2024 should be interpreted with caution. Third, the study focused on journal articles, conference papers, and reviews, while excluding book chapters, editorials, and preprints. This may have underrepresented certain types of scholarly contributions. In addition, citation counts are influenced by the recency of publications. Newer works may not have had sufficient time to accumulate citations, which could underestimate the impact of emerging research. The bibliometric mapping and co-word analysis also relied heavily on author-assigned keywords, and inconsistencies in keyword usage and indexing practices may have affected thematic clustering. Moreover, the study emphasized bibliometric indicators such as publication counts, citations, and collaboration networks, without evaluating the methodological rigor or quality of the included studies. Finally, while the analysis identified research trends and collaboration patterns, it did not extend to a deeper exploration of policy, clinical, or ethical implications of AI in healthcare.

SCOPE FOR FUTURE RESEARCH

Future research should prioritize international collaboration, interdisciplinary integration, thematic network and semantic analysis, quality over quantity, policy and socio-ethical impact studies, and AI in niche domains. Research should focus on enhancing quality, visibility, and cultural breadth through joint publications, exchange programs, and international grants. Future research should explore AI in public policy, machine learning, behavioral sciences, and sustainable development. Improve methodology robustness, reproducibility, and ethical compliance.

CONCLUSION

The present study aimed to provide a bibliometric mapping of scientific production on AI in healthcare using publications from ScienceDirect and Scopus between 2021 and 2025. The analysis revealed a substantial growth in research output, reflecting post-pandemic acceleration in AI adoption for healthcare and diagnostics (3). Annual publication trends showed rapid expansion from 2021 to 2024, followed by stabilization in 2025, suggesting the field is transitioning from exploratory studies toward more specialized subdomains such as AI ethics, wearable technologies, and clinical decision support systems [15, 17].

Author productivity analysis highlighted both concentrated and distributed contributions, with key researchers such as Shaffik Wasswa and Yogesh K. Dwivedi leading collaborative efforts. The observed low international collaboration underscores the need for cross-border research partnerships to enhance generalizability and impact [10, 7]. Keyword co-occurrence and co-word network analyses revealed a dual structure in the field: core, well-established themes (AI, Machine Learning, Healthcare, Diagnosis, Deep Learning) and emerging peripheral topics (COVID-19, IoT, Blockchain, wearable health technologies), indicating a balance between consolidated knowledge and innovative, interdisciplinary directions [5, 3].

Top journals identified included Technological Forecasting and Social Change, Engineering Applications of AI, and Nature Medicine, demonstrating the interdisciplinary reach of AI research across technology, healthcare, socio-technical systems, and business [15, 17]. High citation counts in journals such as Nature Medicine and IEEE outlets reinforced the technological and clinical relevance of the field, emphasizing the translation of AI research into actionable healthcare solutions [10, 7].

Policy and clinical implications from these findings include the prioritization of international collaborations, the development of ethical and regulatory frameworks for AI integration, and support for mentoring early-career researchers to foster knowledge dissemination and innovation. Additionally, emerging areas such as AI in wearable devices, real-time monitoring, and predictive analytics require targeted funding and policy guidance to ensure safe, equitable, and effective adoption [3, 15, 17].

In conclusion, the bibliometric patterns indicate a dynamic and rapidly evolving AI in the healthcare landscape, characterized by increasing publications, strong author collaboration, multidisciplinary thematic clusters, and influential journals that shape both academic and practical directions. Future research should emphasize cross-disciplinary collaboration, longitudinal studies on AI adoption in clinical settings, and policies addressing ethical, regulatory, and equity concerns in AI-enabled healthcare [3, 10, 15, 17].

References:

1. Al-Dekah AM. Mapping research trends and hotspots of artificial intelligence, and machine learning in medicine and health within the Eastern Mediterranean region: A comprehensive bibliometric analysis. Pharmacol Res Rep. 2025;100048.
2. Balpande V, Rewatkar P, Dhole P, Alwadkar I, Gomase K. Artificial intelligence transforming healthcare and nursing: A comprehensive bibliometric analysis. Multidiscip Rev. 2025;8(9):2025267.
3. Bukke SPN, Chandrakala V, Maity A, Thalluri C, Goruntla N, Yadesa TM, John S. Artificial intelligence in post-pandemic healthcare. In: Healthcare Informatics Innovation Post COVID-19 Pandemic. Auerbach Publications; 2024. p. 41-54.
4. D'Ascenzo F, Rocchi A, Iandolo F, Vito P. Evolutionary impacts of artificial intelligence in healthcare managerial literature: A ten-year bibliometric and topic modeling review. Sustain Futures. 2024;7:100198.
5. Esteva A, Robicquet A, Ramsundar B, Kuleshov V, DePristo M, Chou K, et al. A guide to deep learning in healthcare. Nat Med. 2019;25(1):24-29.
6. Guo Y, Hao Z, Zhao S, Gong J, Yang F. Artificial intelligence in health care: Bibliometric analysis. J Med Internet Res. 2020;22(7):e18228.

7. Jiang F, Jiang Y, Zhi H, Dong Y, Li H, Ma S, et al. Artificial intelligence in healthcare: Past, present and future. Stroke Vasc Neurol. 2017;2(4).
8. Jimma BL. Artificial intelligence in healthcare: A bibliometric analysis. Telemat Inform Rep. 2023;9:100041.
9. Pan M, Li R, Wei J, Peng H, Hu Z, Xiong Y, Liu H, et al. Application of artificial intelligence in the health management of chronic disease: Bibliometric analysis. Front Med. 2025;11:1506641.
10. Reddy S, Fox J, Purohit MP. Artificial intelligence-enabled healthcare delivery. J R Soc Med. 2019;112(1):22-28.
11. Sarkar P, Gopinath K, Prakash AV. Healthcare AI: A bibliometric review. In: Int Working Conf Transfer Diffus IT. Springer Nature; 2023. p. 429-441.
12. Senthil R, Anand T, Somala CS, Saravanan KM. Bibliometric analysis of artificial intelligence in healthcare research: Trends and future directions. Future Healthc J. 2024;11(3):100182.
13. Shi J, Bendig D, Vollmar HC, Rasche P. Mapping the bibliometrics landscape of AI in medicine: Methodological study. J Med Internet Res. 2023;25:e45815.
14. Tang R, Zhang S, Ding C, Zhu M, Gao Y. Artificial intelligence in intensive care medicine: Bibliometric analysis. J Med Internet Res. 2022;24(11):e42185.
15. Topol E. Deep medicine: How artificial intelligence can make healthcare human again. Hachette UK; 2019.
16. Wang YJ, Choo WC, Ng KY. Review and bibliometric analysis of AI-driven advancements in healthcare. Multidiscip Rev. 2025;8(9):2025267. doi:10.31893/multirev.2025267.
17. Yu KH, Beam AL, Kohane IS. Artificial intelligence in healthcare. Nat Biomed Eng. 2018;2(10):719-731.
18. González-Pereira B, Guerrero-Bote V, Moya-Anegón F. The SJR indicator: A new indicator of journals' scientific prestige. arXiv preprint arXiv:0912.4141. 2009.
19. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA extension for scoping reviews (PRISMA-ScR): Checklist and explanation. Ann Intern Med. 2018;169(7):467-473.
20. Aria M, Cuccurullo C. Bibliometrix: An R-tool for comprehensive science mapping analysis. J Informetr. 2017;11(4):959-975.