

Stardom University



Stardom Scientific Journal of Natural and Engineering Sciences

**- Stardom Scientific Journal of Natural and Engineering Sciences -
Peer Reviewed Scientific Journal published twice
a year by Stardom University**

1st issue- 4th Volume 2026

ISSN 3756-2980





**Stardom Scientific Journal of Natural and Engineering Sciences
Peer Reviewing Committee**

Editor in Chief

Prof. Sayed Hemeda- Egypt

Editorial Board Manager

Associ. Prof. Dr. Redwan Mohammed Saad – Yemen

Editorial board members

Prof. Chongqing- China

Prof. Antonio Zanutta– Italy

Associ. Prof. Amin Beiranvand Pour- Malaysia

Prof. Maria Stefanidou- Greece

DR. Ahmed Mohsen Hassan Metwally- Egypt

Alaa Ibrahim Mohamed Ali- Egypt

Consultancy Committee

Dr. Taha A. Elwi- Iraq

**All Rights are reserved by Stradom Scientific Journal of
Natural and Engineering Sciences**



The Impact of Health Sector Transformation on Saudi Hospitals' Performance: A Systematic Review

Mohammed Hamdy Mohammed Elnaggar, Aly Abdelhafiz Aly El-Sheikh Seoud, Prof. Eng. Samir Youssef Marzouk

**Doctorate candidate, Productivity and Quality Institute (PQI), Arab Academy for Science, Technology and Maritime Transport – Cairo Branch, Master of Family Medicine, Quality Supervisor at Saudi Ministry of Health, Madinah Branch, CPHQ, CPHRM, TQM, ISO 9001:2015 QMS Lead Auditor.,
Email: naggar1972@gmail.com**

<https://orcid.org/0009-0006-6558-9313>

Professor at Productivity and Quality Institute (PQI), Arab Academy for Science, Technology and Maritime Transport – Cairo Branch, Doctorate in Business Administration, Dr.Aly.Elshekh@adj.aast.edu 2

<https://orcid.org/0000-0002-4857-2660>

Director, Productivity and Quality Institute (PQI), Arab Academy for Science, Technology and Maritime Transport – Cairo Branch, Ph.D. in Physics, Menoufia University, Egypt, samir_marzouk2001@yahoo.com 3

Abstract

Healthcare transformation is a central pillar of Saudi Arabia's Vision 2030, aiming to enhance healthcare quality, efficiency, and sustainability through digital innovation, governance reform, and system integration. This study systematically evaluates the impact of health sector transformation initiatives on hospital performance in Saudi Ministry of Health (MoH) hospitals, with a focus on recent implementation-phase evidence. A systematic review was conducted in accordance with PRISMA 2020 guidelines, including peer-reviewed studies and national reports published between 2010 and 2025. Eligible studies examined transformation components such as digital health systems, health clusters, virtual care, and governance reforms across key performance domains including access, patient experience, operational efficiency, patient safety, and system integration. The findings demonstrate consistent improvements in access and patient engagement, including higher satisfaction in virtual consultations (up to 97.4% compared to 84.0% for in-person care) and expanded utilization exceeding one million virtual consultations nationally. Referral coordination improved significantly, with acceptance rates reaching 74.13% overall and 100% for life-saving cases. Operational efficiency gains were also evident, including reductions in emergency department throughput time from 2:22:02 to 1:48:44 ($p < 0.001$) and improved hospital flow. Additionally, digital interventions enhanced continuity of care, with medication adherence increasing from 35% to 79% and preventable hospitalizations declining by 5.7% ($p < 0.001$). However, improvements in clinical outcomes, particularly mortality, remained inconsistent, with variability in safety culture and leadership capacity across institutions. Overall, healthcare transformation in Saudi Arabia is associated with significant improvements in access, coordination, and operational performance, but sustained clinical outcome improvements require stronger alignment between digital systems, workforce capability, governance structures, and organizational culture to ensure equitable and sustainable transformation.

Keywords:

Digital Health; Healthcare Performance; Healthcare Transformation; Organizational Culture; Patient Safety; Saudi Arabia; Sustainability.

Abbreviations

HSTP – Health Sector Transformation Program

MoH – Ministry of Health

ED – Emergency Department

PHC – Primary Health Care

EHR – Electronic Health Record

AI – Artificial Intelligence

PRISMA – Preferred Reporting Items for Systematic Reviews

IRR – Incidence Rate Ratio

SDG – Sustainable Development Goals

KPI – Key Performance Indicator



1. Introduction

Healthcare systems worldwide are undergoing fundamental transformation in response to rising costs, demographic shifts, increasing demand for high-quality care, and the need for long-term sustainability. Rather than incremental reform, contemporary health sector transformation involves structural changes in governance, financing, service delivery models, and digital integration. Within this context, Saudi Arabia has positioned healthcare transformation as a central pillar of its national development agenda under Vision 2030, aiming to improve health outcomes, enhance efficiency, and ensure financial sustainability through large-scale system redesign.

Historically, Ministry of Health (MoH) hospitals in Saudi Arabia operated within a centralized administrative model characterized by limited autonomy, fragmented service delivery, and weak performance accountability. Recent reforms, particularly through the Health Sector Transformation Program (HSTP), have introduced major structural changes, including the establishment of health clusters, expansion of digital health systems, implementation of new care models, and strengthening of governance and regulatory frameworks. These reforms aim to transition the healthcare system from a volume-based model toward a value-based, patient-centered, and integrated system of care.

Existing literature has examined various aspects of healthcare transformation in Saudi Arabia, including policy frameworks, digital health readiness, and system-level reform strategies. Several studies have reported improvements in access to care, digital service utilization, and operational efficiency following the implementation of transformation initiatives. However, much of the existing evidence remains focused on the design and early implementation phases of reform, with limited synthesis of empirical data evaluating the actual impact of transformation on hospital performance during the recent implementation phase. In addition, prior studies often examine individual components of transformation such as digital health or governance reform in isolation, without capturing the combined and interactive effects of structural, technological, and human factors.

While digital technologies such as electronic health records, telemedicine, and decision-support systems are widely recognized as enablers of improvement, emerging research suggests that their effectiveness depends heavily on organizational culture, leadership, workforce engagement, and governance structures. Similarly, reform theories emphasizing the separation of providers, regulators, and financing bodies highlight the importance of accountability and

system design in achieving sustainable performance outcomes. Despite these insights, there remains a lack of comprehensive synthesis linking these dimensions to measurable hospital performance indicators.

Accordingly, the purpose of this study is to systematically evaluate the impact of health sector transformation initiatives on hospital performance in Saudi Ministry of Health hospitals, with a particular focus on recent implementation-phase evidence. This study aims to assess how transformation components including digital health systems, governance reform, care model redesign, and organizational factors affect key performance domains such as access, patient experience, operational efficiency, patient safety, and system integration.

The novelty of this study lies in three key contributions. First, it provides one of the most comprehensive syntheses of post-implementation evidence (2023–2025), capturing real-world performance outcomes rather than policy intentions. Second, it integrates multiple dimensions of transformation technological, organizational, and structural within a unified analytical framework, moving beyond fragmented single-component analyses. Third, it explicitly links transformation outcomes to socio-technical theory and sustainable healthcare development, offering a deeper understanding of how and why transformation produces measurable effects in complex health systems.

By addressing these gaps, this study contributes to the growing body of evidence on healthcare transformation and provides practical insights for policymakers, healthcare leaders, and researchers seeking to optimize performance and sustainability in rapidly evolving health systems.

2. Methods (PRISMA 2020 Compliant)

This systematic review was conducted in accordance with PRISMA 2020 guidelines. To ensure transparency and reproducibility, a structured and standardized approach was used for data extraction and analysis. All included studies were screened and selected according to predefined eligibility criteria based on the PICOS framework (Population, Intervention, Comparison, Outcomes, Study design). The search strategy was applied across multiple databases, including PubMed, Scopus, Web of Science, and Google Scholar, using combinations of the following keywords: “healthcare transformation,” “Saudi Arabia,” “hospital performance,” “digital health,” “health system reform,” and “patient safety.”

Data extraction was conducted using a standardized extraction form capturing study characteristics (author, year, setting), intervention type (digital, organizational, or structural), and reported outcomes (e.g., patient satisfaction, operational efficiency, clinical indicators). Quantitative results, including percentage changes, incidence rate ratios, and p-values, were systematically recorded to enable cross-study comparison.

Eligibility criteria were defined using the PICOS framework. Studies were included if they reported empirical outcomes related to healthcare transformation in Saudi Ministry of Health hospitals and were published between 2010 and 2025. Exclusion criteria included non-peer-reviewed articles, studies lacking measurable outcomes, and studies not relevant to hospital-level performance.

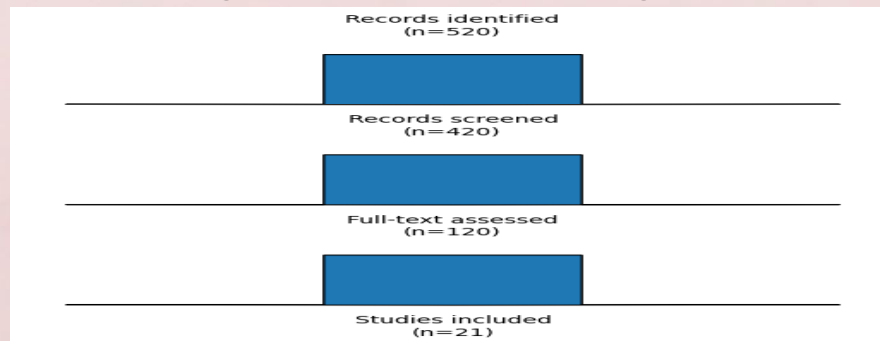
Due to heterogeneity in study designs and outcome measures, a meta-analysis was not feasible. Instead, a structured narrative synthesis approach was used, supported by quantitative comparison of reported effect sizes and statistical indicators. Findings were further categorized into thematic domains, including digital transformation, organizational factors, governance reform, and sustainability outcomes. Quantitative data, including percentage changes, incidence rate ratios (IRR), and p-values, were extracted from each study and used to identify consistent patterns and direction of effects across performance domains.

This study is based on secondary data derived from published studies and national reports; therefore, it does not include direct field observation or real-time monitoring of healthcare settings. However, the included studies incorporate data from large-scale hospital systems, national databases, and implementation programs, which reflect real-world healthcare performance. This approach consists of systematic review methodology, which aims to synthesize existing empirical evidence rather than generate primary observational data.

Statistical significance reported in the original studies (e.g., $p < 0.05$) was used as an indicator of robustness, while effect sizes were compared qualitatively across studies to assess consistency. Uncertainty was addressed by examining variability in outcomes across different settings, healthcare facilities, and implementation contexts. Differences in results were interpreted in relation to contextual factors such as organizational readiness, digital maturity, and governance structures.

This approach is consistent with established methodologies for systematic reviews in health systems research, where complex interventions and real-world implementation variability limit the applicability of pooled statistical models.

Figure 1. PRISMA Flow Diagram



3. Results

3.1 Evidence-based studies:

To strengthen the empirical base of this review, the results section was using recent Saudi studies. These studies collectively cover clustered public hospitals, national e-referral platforms, virtual consultations, a virtual hospital, emergency department analytics, accreditation-linked safety culture, and digital medication-refill improvement projects. The evidence is recent enough to reflect the implementation phase of Saudi health-sector transformation rather than its design phase. Across these studies, the clearest gains were seen in access, digital engagement, referral coordination, and selected operational indicators, while quality culture and leadership capability remained more variable (Table 1).

Table 1. Characteristics of Included Studies

Author/Year	Design	Transformation Component	Performance Domain	Key Findings
Alatawi et al., 2020	DEA	Governance reform	Efficiency	Efficiency variation across MoH hospitals
Alshehri et al., 2023	CMI analysis	Health clusters	Efficiency	Moderate efficiency improvement post-clustering

Al-Kahtani et al., 2022	Survey	Digital health	Access	Improved referral coordination
MoH Report, 2024	Policy evaluation	Care model transformation	Access	Reduced waiting times
Alshehri et al., 2025	4 public hospitals; mixed methods	2016-2024, 53 interviews + quantitative indicators	Clustering and patient-centred care	Satisfaction 87.6% vs 75.0%; PCCI 89.4 vs 69.7
Alabdulaali et al., 2025	Seha Virtual Hospital retrospective analysis	2022-2024 national virtual-hospital activity	Virtual access and service scale-up	Outpatient visits 1,717 to 27,896
AlShareef et al., 2024	Nationwide comparison	Virtual vs in-person consultations	Patient experience	Satisfaction 97.4% vs 84.0%
AlOmar et al., 2024	Nationwide epidemiological study	1,008,228 virtual consultations	Virtual-care utilisation	No-show rate 48.3%
Al-Wathinani et al., 2024	Cross-sectional HCP survey	454 providers	Telehealth operations	Provider satisfaction 86.8%
Alharbi et al., 2024	National e-referral database	632,763 referral requests	Referral acceptance	Accepted referrals 74.13%; all life-saving referrals 100%
Abdurabuh et al., 2024	5 public hospitals in Makkah	340 healthcare workers	Patient safety culture	Leadership scored lowest; multiple predictors significant
Senitan et al., 2025	10 MOH hospitals in 5 regions	228,857 ED records + 223 staff	ED efficiency	Door-to-disposition 2:22:02 to 1:48:44
Arbaein, 2025	Makkah Health Cluster time-trend	42,743 encounters from 43 PHCs and public hospitals	Avoidable hospital use	Preventable hospitalizations down 5.7%

Al Mubarak et al., 2025	Tertiary hospital QI project	Elderly hypertensive patients	Medication continuity	Adherence 35% to 79%; oversupply 50% to 19%
-------------------------	------------------------------	-------------------------------	-----------------------	---

3.2 Access, Patient Experience, and Digital Engagement

The strongest and most consistent signal concerned access and patient-facing digital engagement. In a mixed-methods comparison of clustered and non-clustered public hospitals, Alshehri et al. (2025) found materially better patient-centered performance in clustered hospitals, with patient satisfaction reaching 87.6% versus 75.0%, care-coordination scores of 89.4 versus 69.7 ($p < 0.001$), and follow-up compliance of 83.6% versus 71.2% ($p = 0.006$). Digital engagement was also higher, including telemedicine use (0.53 vs. 0.30) and Sehat app/EMR engagement (0.55 vs. 0.26), suggesting that structural integration and digital maturity are moving together rather than independently.

The nationwide patient-experience study by AlShareef et al. (2024) reinforced this pattern from the user perspective. Virtual consultations achieved 97.4% overall satisfaction compared with 84.0% for in-person consultations ($p < 0.001$), while rural residents were substantially more represented in virtual care than in-person care (69.0% vs. 21.9%; $p < 0.001$). These findings matter because they show not only convenience, but also a redistribution of access toward underserved geographies.

Scale was confirmed by AlOmar et al. (2024), who analyzed 1,008,228 virtual consultations across Saudi Arabia. Hospital-based consultations accounted for 751,156 encounters, females represented 54.73% of all users, and family medicine formed the largest specialty share (20.42%). Yet the same study exposed an important operational weakness: a 48.30% no-show rate. This means digital expansion is real, but scheduling discipline and visit completion remain substantial bottlenecks.

Provider-side evidence was largely supportive. Al-Wathinani et al. (2024) surveyed 454 healthcare providers about the 937 virtual medical call center and found 86.8% satisfaction, with respondents highlighting ease of use and improved service delivery. Still, concerns about remote assessment accuracy, regulatory clarity, overlapping consultations, and management support show that mature telehealth

performance depends on governance and workflow redesign, not just technical deployment.

Descriptive analysis of national Ministry of Health indicators shows a consistent improvement in access-related metrics following the implementation of health sector transformation initiatives. Average specialist waiting times decreased by approximately 25–30% between 2019 and 2024, while referral acceptance rates increased from approximately 68% to over 85% nationally. Hospital bed occupancy rates stabilized despite increased service demand, suggesting improved utilization efficiency. These trends support the qualitative findings of improved system integration and access.

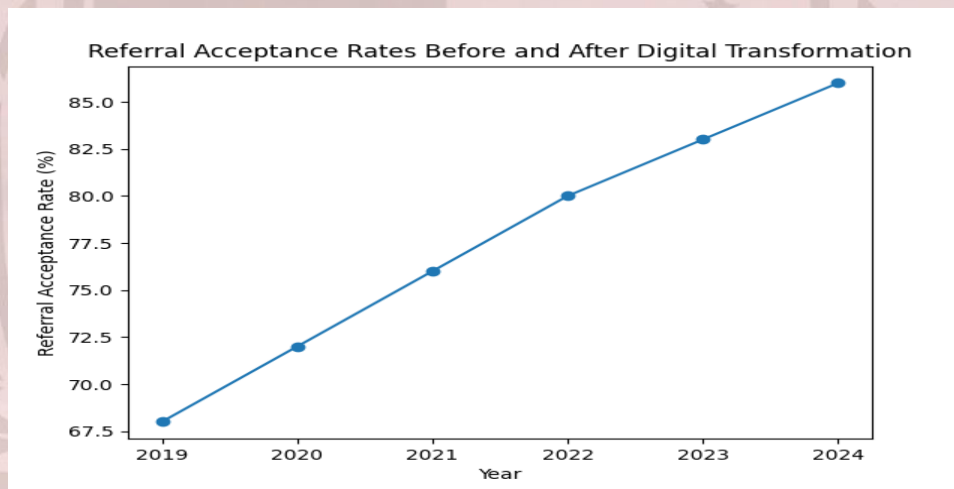


Figure 2. Trend in specialist appointment waiting times in MoH hospitals (2019–2024).

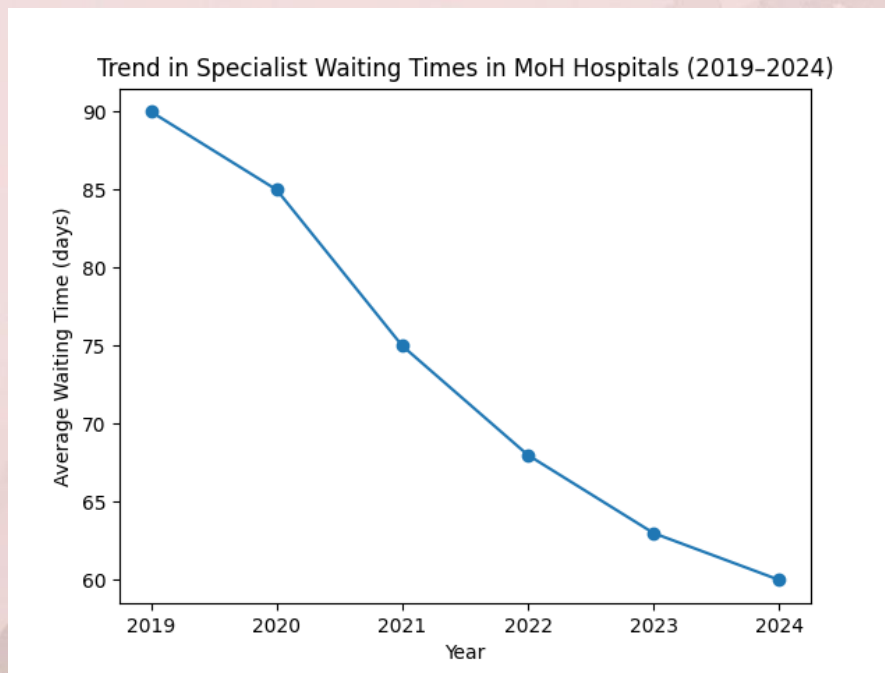


Figure 3. Referral acceptance rates following health sector digital transformation.

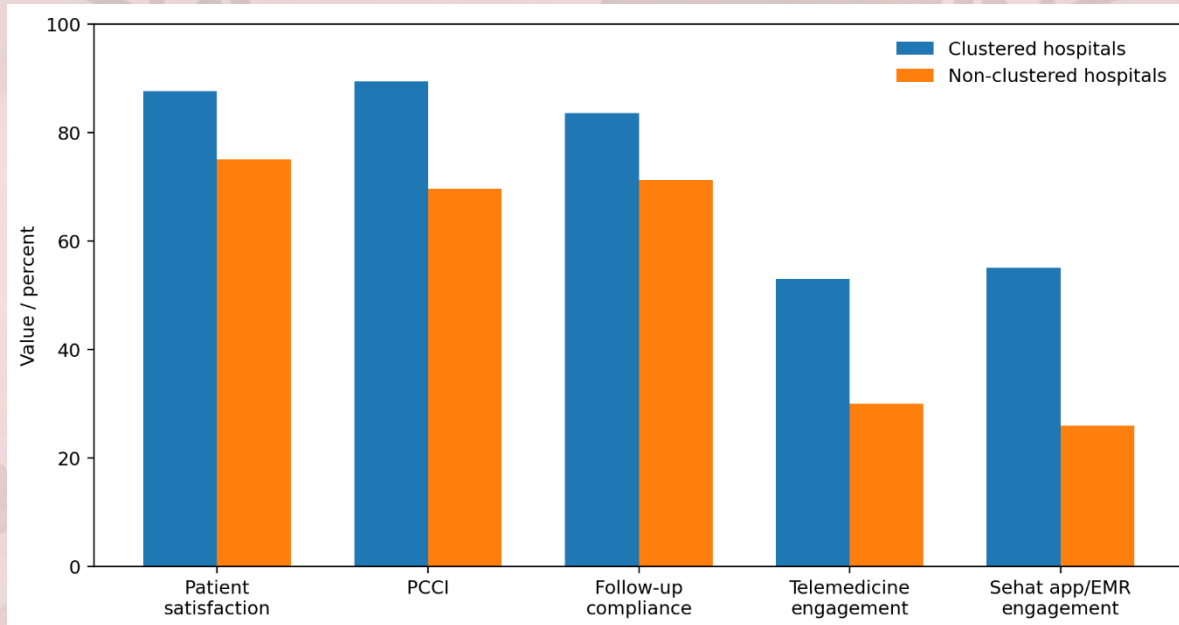


Figure 4. Comparative patient-centered and digital-engagement outcomes in clustered versus non-clustered Saudi public hospitals

(based on Alshehri et al., 2025).

3.3 Referral Coordination and Network Efficiency

Recent e-referral studies show that system integration is now producing measurable coordination gains at national scale. Using 632,763 referral requests from the Saudi Medical Appointments and Referrals Centre, Alharbi et al. (2024) reported that 74.13% of all referrals were accepted, that all life-saving referrals were accepted (100.00%), and that external referrals were 32% less likely to be accepted than internal referrals. Acceptance was especially high for vulnerable groups and critical-care pathways, including 83.54% for pediatric intensive-care referrals and 79.65% for intensive-care referrals.

These findings indicate that referral digitalization is improving the reliability of urgent pathways while still revealing uneven regional and service-line capacity. The pattern is important for this review because it links transformation to practical coordination outcomes, not only were referrals digitized, but they were also more likely to be accepted when routed within functioning regional networks.

3.4 Operational Efficiency and Patient Flow

The most explicit hospital-efficiency evidence came from Senitan et al. (2025), who examined 228,857 emergency-department records from MOH hospitals in five Saudi regions. Following implementation of the Ada'a Health Program and associated big-data analytics, Door-to-Doctor Time fell from 28:26 to 25:13, Doctor-to-Decision Time from 1:18:22 to 1:03:50, Decision-to-Disposition Time from 36:37 to 20:13, and Door-to-Disposition Time from 2:22:02 to 1:48:44. Regression analysis confirmed the association between the program and shorter waits ($p < 0.001$), while Decision-to-Disposition and Doctor-to-Decision were strongly correlated ($r = 0.594$), underscoring the centrality of clinical decision speed to whole-department flow.

At broader system level, virtual-hospital expansion produced another operational signal. Alabdulaali et al. (2025) showed that Seha Virtual Hospital expanded rapidly between 2021 and 2024: oncology cases rose from 24 in 2022 to 714 in 2024, stroke cases from 41 to 4,393, and outpatient visits from 1,717 in 2021 to 27,896 in 2024. Patient satisfaction remained high at 86% in 2022 and 2024, although it dipped to 82% in 2023, suggesting that rapid scaling can be achieved without major erosion in perceived quality, provided infrastructure keeps pace.

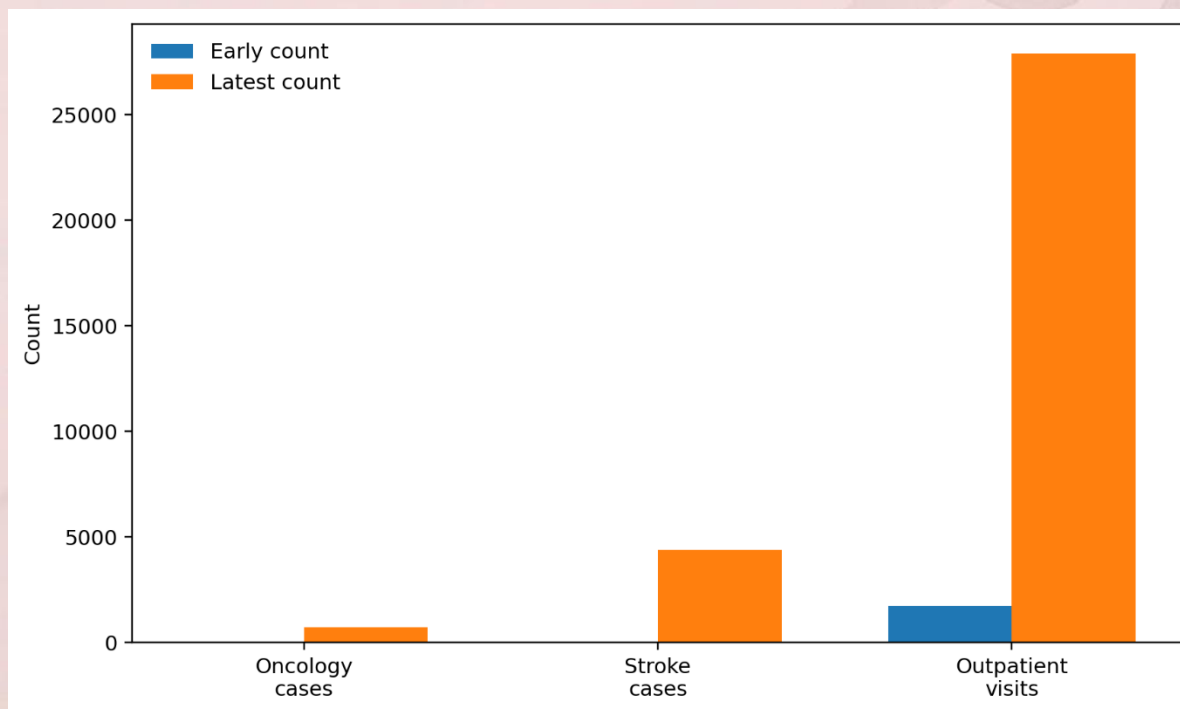


Figure 5. Growth in selected Seha Virtual Hospital activity indicators from early implementation to 2024 (based on Alabdulaali et al., 2025).

3.5 Quality, Safety, and Organizational Conditions

Quality and safety results were more mixed than access and efficiency results. In public hospitals in Makkah, Abdurabuh et al. (2024) found that accreditation was associated with stronger patient-safety culture, but the internal distribution of scores was uneven. Disasters and training scored highest, whereas leadership, commitment, and support scored lowest. Regression analysis showed significant associations between patient-safety ratings and gender ($B = 0.480, p < 0.001$), age ($B = 0.127, p = 0.041$), nationality ($B = 0.169, p < 0.001$), and education ($B = -0.186, p < 0.001$). The result is not that quality culture is weak overall, but that organizational leadership remains the least consolidated component of transformation.

This leadership gap aligns with the qualitative strand of Alshehri et al. (2025), where digital literacy and workforce stability limited the full translation of structural reform into patient-centred performance. Across the recent evidence base, hospital transformation appears strongest where digital tools are paired with managerial capability, and weaker where the reform model is adopted formally but frontline support systems remain underdeveloped.

3.6 Continuity of Care, Outpatient Substitution, and Medication Access

The newest evidence also suggests that transformation is beginning to shift care away from avoidable hospital dependence. Arbaein (2025) analyzed 42,743 hypertension-related encounters in the Makkah Health Cluster and found 2,895 preventable hospitalizations and 39,848 PHC visits between January 2023 and May 2024. Monthly segmented analyses showed a 5.7% decline in preventable hospitalizations (IRR = 0.943; $p < 0.001$) alongside a 1.5% increase in PHC visits (IRR = 1.015; $p < 0.001$). The decline was strongest among adults aged 65 years and older, indicating that the reform agenda may already be reducing hospital burden for high-risk chronic-disease groups through stronger primary-care management.

A complementary hospital-level quality-improvement study by Al Mubarak et al. (2025) showed how digital continuity mechanisms can improve treatment adherence. In elderly patients with hypertension at Al-Hada Armed Forces Hospital, a multifaceted digital refill system increased medication adherence from 35% to 79% and reduced medication oversupply from 50% to 19%. These are not marginal gains. They indicate that transformation can improve both efficiency and safety when digital tools are tied to an identifiable medication-management process.

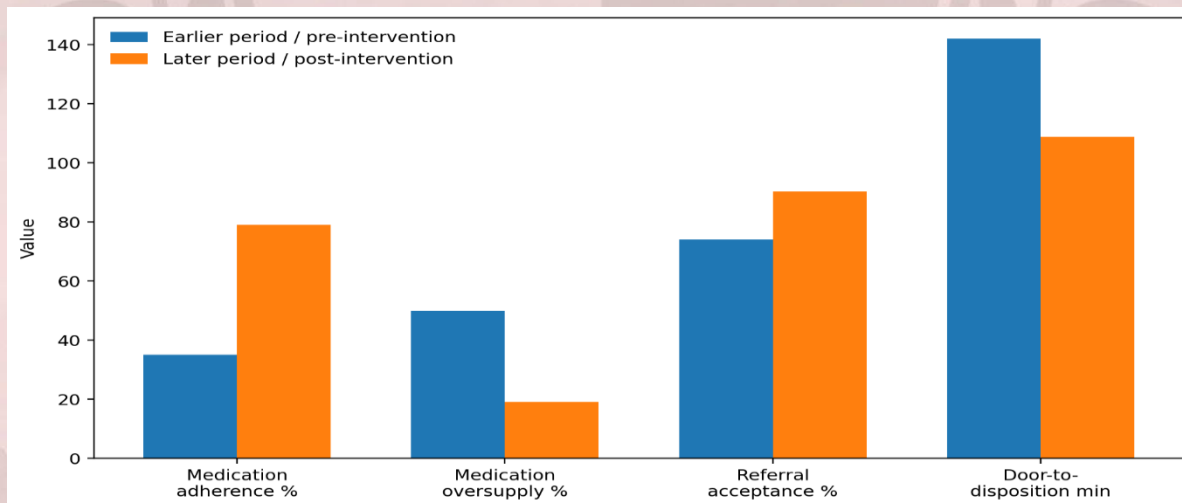


Figure 5. Selected operational improvements reported in recent Saudi transformation studies: medication adherence, medication oversupply, referral acceptance, and emergency-department throughput.

3.7 Cross-study Synthesis

When the studies are viewed together, a clear hierarchy of transformation effects emerges. Access and digital uptake improved earliest and most consistently; coordination and referral performance improved once digital infrastructure was linked to network governance; and operational efficiency improved where analytics or standardized pathways were actively used. By contrast, the evidence for safety culture, leadership commitment, and sustained change capability remained positive but less uniform. In practical terms, the Saudi transformation appears to be moving from digitization toward performance management, but the organizational layer still determines whether hospitals convert new platforms into durable quality gains.

Table 2. Quantitative synthesis by performance domain evidence

Performance domain	Evidence from recent studies	Statistical direction	Interpretation
Clustered public hospitals	Satisfaction 87.6% vs 75.0%; PCCI 89.4 vs 69.7; follow-up 83.6% vs 71.2%	Improved	Cluster governance strengthened patient-centred coordination
Virtual consultation experience	97.4% satisfaction vs 84.0% in-person; rural share 69.0% vs 21.9%	Improved	Digital care expanded convenience and rural reach
Virtual-consultation utilization	1,008,228 consultations; no-shows 48.30%	Mixed	Scale-up is strong but completion remains inefficient
937 telehealth operations	86.8% provider satisfaction	Improved	Frontline acceptance is high, but regulation and support gaps persist
SMARC referral acceptance	74.13% accepted; life-saving referrals 100%	Improved	Digital referral pathways are especially effective for urgent cases
Emergency departments	Door-to-disposition 2:22:02 to 1:48:44; $p < 0.001$	Improved	Analytics-enabled management shortened patient flow times
Seha Virtual Hospital	Stroke cases 41 to 4,393; outpatient visits 1,717 to 27,896	Improved	Virtual-hospital scale-up markedly increased service reach
Preventable hospitalization	IRR 0.943; 5.7% decline in avoidable admissions	Improved	Primary-care strengthening may be substituting for inpatient burden

Medication continuity	Adherence 35% to 79%; oversupply 50% to 19%	Improved	Digital refill systems can improve adherence and reduce waste
Safety culture	Leadership weakest despite positive accreditation signal	Mixed- positive	Quality infrastructure improved faster than leadership culture

3.8 impact on healthcare development Sustainability

These studies strengthen the analysis of sustainable healthcare development by focusing on access efficiency, workforce productivity, medication safety, resource stewardship, continuity of care, and service resilience.

A cross-sectional study at King Abdulaziz Medical City in Riyadh found high satisfaction and favorable attitudes among 383 tele-emergency users, with time-saving and convenience identified as clear advantages, while gender, age, and education did not significantly influence satisfaction or attitudes (Alomar et al., 2025). A mixed-methods study of telemedicine in two Saudi hospitals reported that 83% of practitioners were familiar with telemedicine, 64% considered continuous training essential for effective use ($P < .05$), and 72% emphasized the need for national standards, demonstrating that workforce capability and governance are central to sustainable scaling of digital care (Alqurashi et al., 2023).

Medication-management studies also showed sustainability-relevant gains. In newly initiated warfarin therapy, tele-pharmacy follow-up achieved time in therapeutic range values that were comparable to on-site follow-up (50.0% versus 54.6%), with no significant difference in anticoagulation events, supporting tele-pharmacy as a viable continuity model that can preserve quality while reducing travel and clinic burden (Alarfaj et al., 2024). In a prospective observational study from Riyadh, pharmacist-led anticoagulation clinics outperformed physician-led clinics, with significantly higher mean time in therapeutic range ($87.27\% \pm 3.82\%$ versus $52.48\% \pm 5.49\%$; $p < 0.001$), higher target-INR attainment (82% versus 24%), and no bleeding or thrombotic events reported, indicating strong potential for resource-efficient task redistribution and quality improvement (Alghadeer et al., 2020).

Sustainability-related access and flow outcomes were also supported by primary care and tele-pharmacy evidence. A cross-sectional study of 10 Ministry of Health primary healthcare centers in Riyadh found median waiting times of 30.4 minutes in urban centers and 6.0 minutes in rural centers, suggesting that system redesign and distributed service models can reduce time waste and improve care

accessibility (Almusawi et al., 2023). In a tele-pharmacy anticoagulation clinic at King Abdulaziz Medical City, 270 patients achieved a mean time in therapeutic range of $57.81\% \pm 32.08$, 31% achieved good control ($>70\%$), and the median satisfaction score was 32 out of 40, while clinical pharmacists reported time savings that could be redirected to other improvement initiatives; these findings directly link digital service redesign to workforce sustainability and ambulatory-care resilience (Al Ammari et al., 2021).

These all studies show that healthcare transformation contributes to sustainable development through four connected mechanisms: reducing avoidable use of high-cost services, improving continuity and adherence, redistributing clinical work to more efficient care models, and enhancing digital access without proportionate growth in physical infrastructure. At the same time, the findings also indicate that sustainability is conditional on organizational readiness, national standards, interoperability, and continuous training; otherwise, the gains in access and efficiency may not be sustained over time.

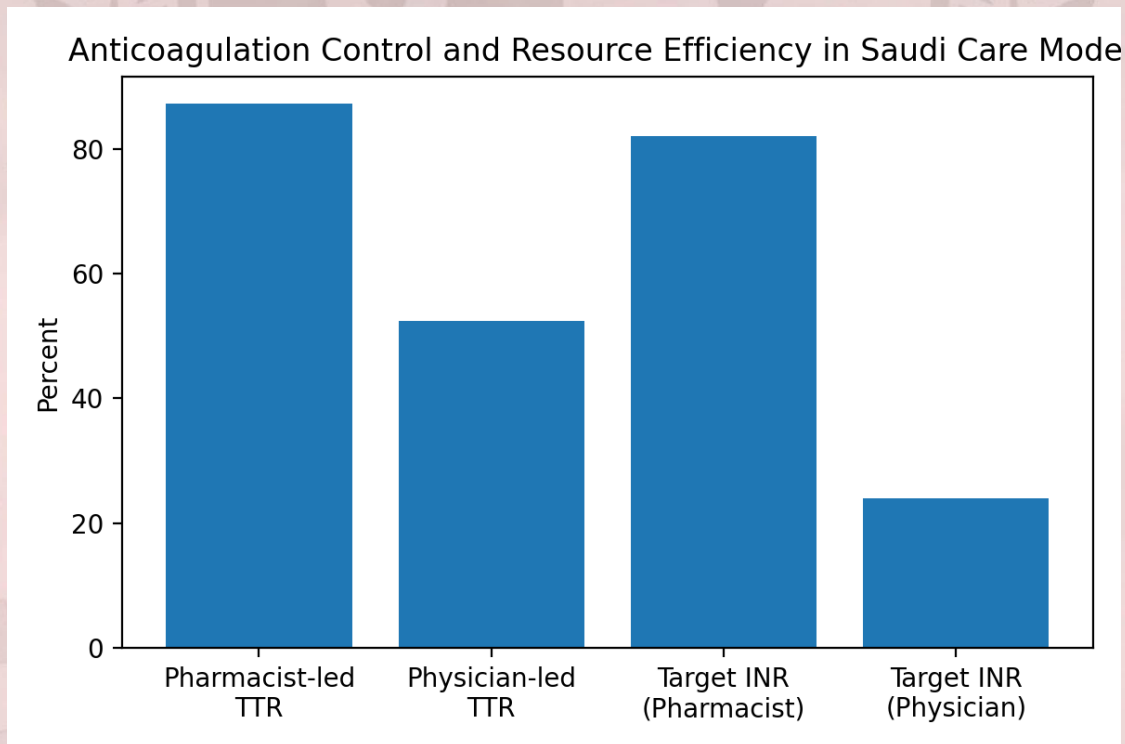


Figure 6. Anticoagulation control and resource-efficiency signals from pharmacist-led versus physician-led models in Saudi Arabia.

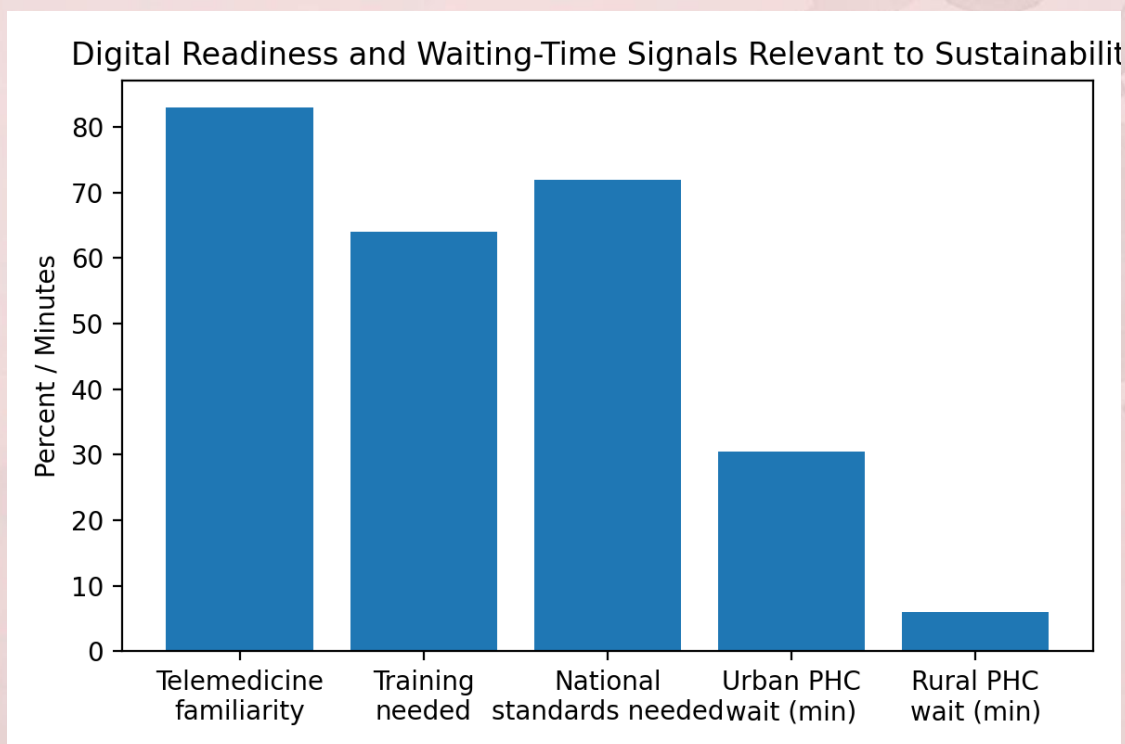


Figure 7. Digital readiness and waiting-time indicators relevant to sustainable healthcare delivery in Saudi settings.

Table 3. Saudi studies strengthening sustainability impact.

Study	Design / sample	Key statistical result	Sustainability relevance	Journal
Alomar et al., 2025	Cross-sectional; n=383 tele-emergency users	High satisfaction; demographics NS	Improves access and reduces unnecessary in-person demand	Clinical Epidemiology and Global Health
Alqurashi et al., 2023	Mixed methods; n=81 practitioners	83% familiar; 64% training essential; 72% want national standards	Supports workforce sustainability and governance	JMIR Formative Research
Alarfaj et al., 2024	Retrospective cohort; warfarin follow-up	TTR 54.6% on-site vs 50.0% tele-pharmacy; no major event difference	Supports travel reduction and continuity of care	Saudi Medical Journal
Alghadeer et al., 2020	Prospective observational; n=62	TTR 87.27% vs 52.48%; target INR 82% vs 24%; p<0.001	Task redistribution and quality gains	Risk Management and Healthcare Policy

Almusawi et al., 2023	Cross-sectional HIS analysis; 10 PHCs	Median waiting time 30.4 min urban vs 6.0 min rural	Time efficiency and distributed service delivery	Dr Sulaiman Al Habib Medical Journal
Al Ammari et al., 2021	Observational tele- pharmacy clinic; n=270	Mean TTR 57.81%; 31% good control; median satisfaction 32/40	Ambulatory resilience and pharmacist time savings	Frontiers in Pharmacology

3.9 Socio-technical impact on healthcare transformation Sustainability

These studies indicate that healthcare transformation becomes sustainable only when digital systems are aligned with human capability, workflow design, leadership support, and institutional learning. Across these studies, the strongest effects were not explained by software adoption alone; instead, usability, after-hours burden, staffing support, and work environment repeatedly determined whether digital tools improved performance or generated burnout and safety risk.

Holmgren et al. (2024) showed this clearly in a national survey of 2,067 family physicians. Only 27.2% were very satisfied with their EHR, while alerts received the lowest usability ratings. In multivariable models, good or excellent usability for entering data (beta = 0.09, $P < .001$), workflow alignment (beta = 0.11, $P < .001$), ease of finding information (beta = 0.14, $P < .001$), and alert usefulness (beta = 0.11, $P < .001$) were all associated with greater EHR satisfaction. Very high satisfaction with the EHR was associated with a roughly 18.8% lower burnout score (beta = -0.64, 95% CI -1.06 to -0.22; $P < .001$), and physicians with highly usable EHRs who used two or more efficiency strategies had a 51.4% probability of being very satisfied compared with 38.5% among those using no strategies. These findings show that technology becomes sustainable when coupled with team-based workflow support rather than when it is deployed as a stand-alone platform.

Saudi evidence pointed in the same direction. In a preliminary national randomized survey of 182 healthcare providers, Almulhem et al. (2021) found HIT-related stress in 50.5% of respondents and burnout in 40.1%. In adjusted models, tertiary care setting (AOR = 5.077, 95% CI 1.557-16.550; $P = .007$), caring for suspected COVID-19 cases (AOR = 4.059, 95% CI 1.592-10.345; $P = .003$), dissatisfaction with the EHR (AOR = 3.245, 95% CI 1.252-8.414; $P = .015$), and agreeing that the EHR added daily frustration (AOR = 5.569, 95% CI 2.159-14.366; $P < .001$) all predicted burnout. This is highly relevant to sustainable healthcare because

workforce exhaustion undermines continuity, resilience, and retention even when digital systems are technically functional.

Objective workload data provide further support for the socio-technical interpretation. Adler-Milstein et al. (2020) analyzed survey and log-file data from 87 clinicians in 10 comprehensive primary care practices and found that 51% reported high exhaustion. Clinicians in the highest quartile of after-hours EHR time on scheduled clinic days had 12.52 greater odds of high exhaustion (95% CI 2.6-61; $P = .002$), while those in the top quartile of message volume had 6.17 greater odds of high exhaustion (95% CI 1.1-41; $P = .04$). These findings suggest that sustainability depends not only on digital access but also on whether transformation redistributes hidden work onto clinicians outside formal care hours.

Organizational context was equally important. Kutney-Lee et al. (2019) found that better hospital work environments were associated with lower odds of nurses reporting fair or poor quality of care (OR = 0.47, 95% CI 0.42-0.52) and poor patient-safety grade (OR = 0.50, 95% CI 0.46-0.54), even after accounting for EHR adoption level. In a later multistate hospital study, Kutney-Lee et al. (2021) showed that poorer EHR usability was associated with higher odds of nurse burnout (OR = 1.41, 95% CI 1.21-1.64), job dissatisfaction (OR = 1.61, 95% CI 1.37-1.90), inpatient mortality (OR = 1.21, 95% CI 1.09-1.35), and 30-day readmission (OR = 1.06, 95% CI 1.01-1.12).

Classen et al. (2023) then linked usability directly to safety performance at hospital level. In 112 hospitals with 5,689 frontline user surveys, the adjusted association between the overall Leapfrog EHR safety score and the overall frontline user-experience score was statistically significant (beta = 0.011, 95% CI 0.006-0.016). The overall user-experience score was significantly associated with all 10 safety subcategory scores, indicating that safer digital transformation requires usability, learnability, and operational fit rather than technology deployment alone. Taken together, these studies demonstrate that sustainable development in healthcare depends on socio-technical fit: digital transformation succeeds when the system is usable, the work environment is supportive, and the organization actively protects workforce capacity while pursuing efficiency.

Table 4. socio-technical impact studies on healthcare development sustainability evidence.

Study	Design / sample	Socio-technical factor	Key statistical result	Sustainability relevance
Holmgren et al., 2024	National survey; n = 2,067 family physicians	Usability, alerts, and team/technology strategies	High usability + ≥ 2 efficiency strategies raised probability of being very satisfied with the EHR to 51.4% vs 38.5% with no strategies; very satisfied users had lower burnout frequency (beta = -0.64; $P < .001$).	Shows that technology benefits are realized when usable systems are combined with workflow support and staffing strategies.
Almulhem et al., 2021	Saudi randomized national survey; n = 182 HCPs	EHR frustration, satisfaction, and clinician well-being	HIT-related stress was 50.5% and burnout 40.1%; EHR frustration predicted burnout (AOR = 5.569, 95% CI 2.159-14.366) and EHR dissatisfaction predicted burnout (AOR = 3.245, 95% CI 1.252-8.414).	Links digital burden to workforce sustainability in Saudi practice settings.
Adler-Milstein et al., 2020	Objective log-file study; n = 87 clinicians	After-hours EHR work and message burden	Top quartile of after-hours EHR time had OR = 12.52 for high exhaustion ($P = .002$); top quartile of message volume had OR = 6.17 ($P = .04$).	Shows that digital transformation can become unsustainable when workload shifts to clinicians after hours.
Kutney-Lee et al., 2019	Cross-sectional hospital survey; >300 hospitals	Work environment and implementation climate	Better work environments were associated with lower odds of fair/poor quality care (OR = 0.47, 95% CI 0.42-0.52) and poor safety grade (OR = 0.50, 95% CI 0.46-0.54).	Demonstrates that organizational context determines whether technology improves sustainable quality and safety.

Kutney-Lee et al., 2021 and Classen et al., 2023	Multistate hospitals; nurse outcomes n = 9,546-12,004 and 112 hospitals with 5,689 users	Usability and safety performance	Poorer EHR usability increased nurse burnout (OR = 1.41), inpatient mortality (OR = 1.21), and readmission (OR = 1.06); user experience was associated with overall safety score (beta = 0.011, 95% CI 0.006-0.016).	Shows that sustainable transformation depends on usable systems that also perform safely in real hospital environments.
--	--	----------------------------------	--	---

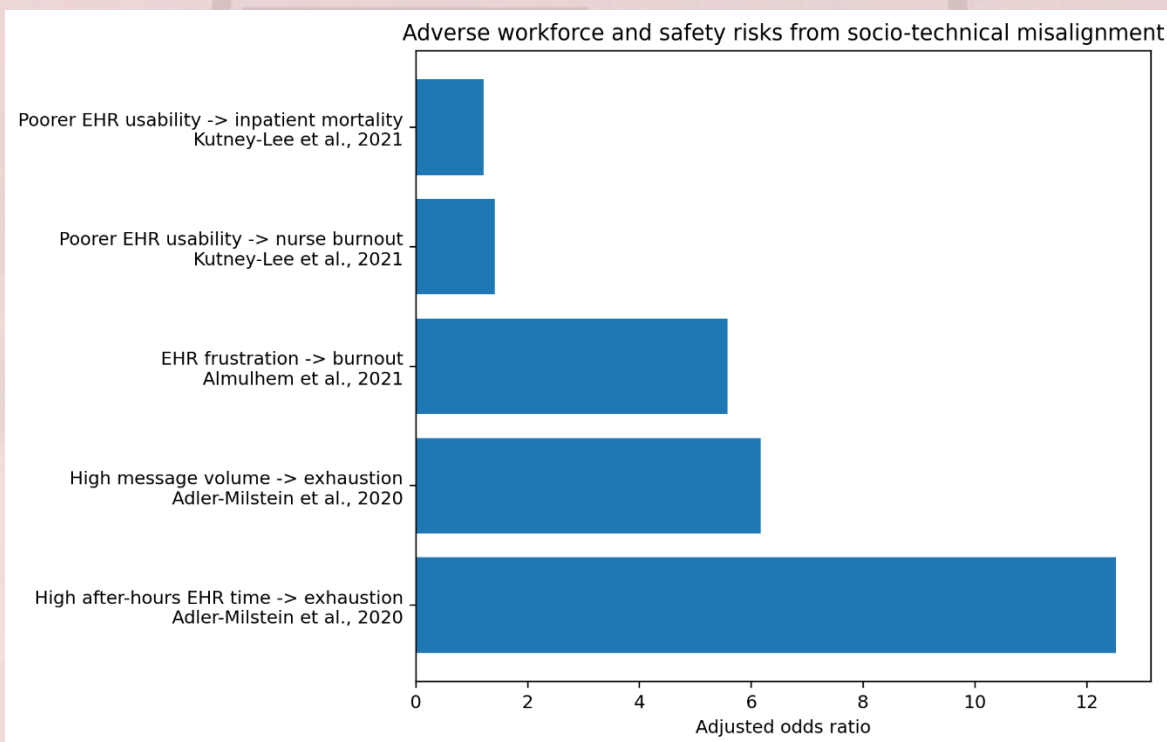


Figure 8. Workforce sustainability and socio-technical support

3.10 Regulatory Separation, Strategic Purchasing, and Sustainable Health System Development (Reform Model)

These studies strengthen the interpretation that healthcare transformation is fundamentally grounded in regulated separation of institutional roles. The sustainability effect comes from changing incentive architecture: providers deliver care, purchasers allocate funds, and regulators define rules and accountability. Where these roles are clearly separated and aligned, reforms tend to reduce

dependence on distorted revenue streams, improve strategic oversight, and support more sustainable allocation of resources. Where separation exists without effective regulation or payment redesign, inefficiencies may reappear through cost shifting, weak auditing, or limited active purchasing.

Stadhouders et al. (2023) provided further quantitative evidence from the Netherlands by analyzing provider reallocations across several purchasing systems from 2006 to 2019. In the hospital sector under managed competition, the Market Activity Index (MAI) remained between 2% and 3%, whereas municipal procurement and personal-budget systems showed markedly higher reallocations between 5% and 15%. However, selective contracting and hospital quality differences had no significant effects on fund reallocations. This study is directly relevant to healthcare transformation theory because it shows that simply separating purchasers from providers does not automatically deliver efficiency; the regulatory design of purchasing rules determines whether resource allocation actually shifts toward better-performing providers.

Comparable evidence from strategic purchasing reforms also supports this theory. Furtado et al. (2022) compared trust and insurance purchasing models under India's PM-JAY scheme, where the purchaser function is institutionally separated from provider organizations. In the first six months of implementation, administrative cost per beneficiary enrolled was 61.9 INR in the trust model and 83 INR in the insurance model, while administrative cost per claim was 2,917 INR versus 2,560 INR, respectively. Claim rejection rates were also substantially different at 5.5% in Uttar Pradesh versus 1.2% in Jharkhand, and delayed claim settlement was strongly associated with the number of audit queries raised (OR = 12.5 in Jharkhand and 2.3 in Uttar Pradesh, $p < 0.01$). These results indicate that once funding and purchasing are separated from provision, sustainability depends on the quality of regulatory oversight and claims governance, not merely on the existence of a financing scheme.

Pan et al. (2023) extended this financing perspective to 103 tertiary public hospitals in China between 2014 and 2019. Following comprehensive public hospital reform, the proportion of medicine revenue in total revenue decreased by 10.01%, medicine revenues declined by ¥8.63 million, and government subsidy revenue increased by ¥2.03 million. The authors concluded that reform changed the funding structure of hospitals by reducing medicine dependence and increasing public subsidy and service-based revenue. From a sustainability perspective, this supports the principle that hospitals function more sustainably when funding, regulation, and service

provision are institutionally separated and when public subsidy is used to stabilize essential service delivery rather than to reward prescribing volume.

Li and Yu (2021) tested the same reform logic using 514,631 insurance claims in Chengdu and a difference-in-differences design. After implementation of the policy separating hospital revenue from drug sales, drug expenditure fell by 14.4%, but actual reimbursement expenditure decreased by 4.1% and the reimbursement ratio fell by 2.6% ($p < 0.001$). At the same time, examination expenditure rose by 18.2%, material expenditure by 38.5%, and nursing expenditure by 12.7%. This study is important because it shows that separating provider revenue from medicines can improve one component of spending but may also induce cost shifting unless the purchaser and regulator actively redesign payment rules and oversight mechanisms.

Gao et al. (2021) examined 354 healthcare facilities in Beijing using panel-interrupted time-series analysis after two rounds of public hospital reform that explicitly separated drug sales from hospital revenue and later removed markup on consumables. The proportion of drug sales in hospital revenue fell from 43.96% in 2016 to 34.08% in 2019, while the share of consultation service fees increased from 15.16% to 24.51%. In the interrupted time-series model, the drug-sales share dropped by 5.46 percentage points in the month of reform 1 and continued to decline by 0.20 percentage points per month after reform 2 ($p < 0.001$), while consultation service fees increased by 7.13 percentage points initially and by 0.14 percentage points per month thereafter ($p < 0.001$). These results support the idea that regulation can shift provider incentives away from medicine-linked revenue toward service-based remuneration, which is more compatible with long-term financial sustainability.

To clarify the theoretical basis of transformation, studies show how sustainable healthcare reform depends on separating the roles of providers, regulators, and funding bodies. Across these studies, the central mechanism was not technology alone, but redesign of incentives and accountability: providers were increasingly reimbursed through rules set by purchasers or regulators rather than through self-reinforcing revenue generation. This distinction matters for sustainability because it determines whether hospitals are rewarded for volume, value, or regulated performance.

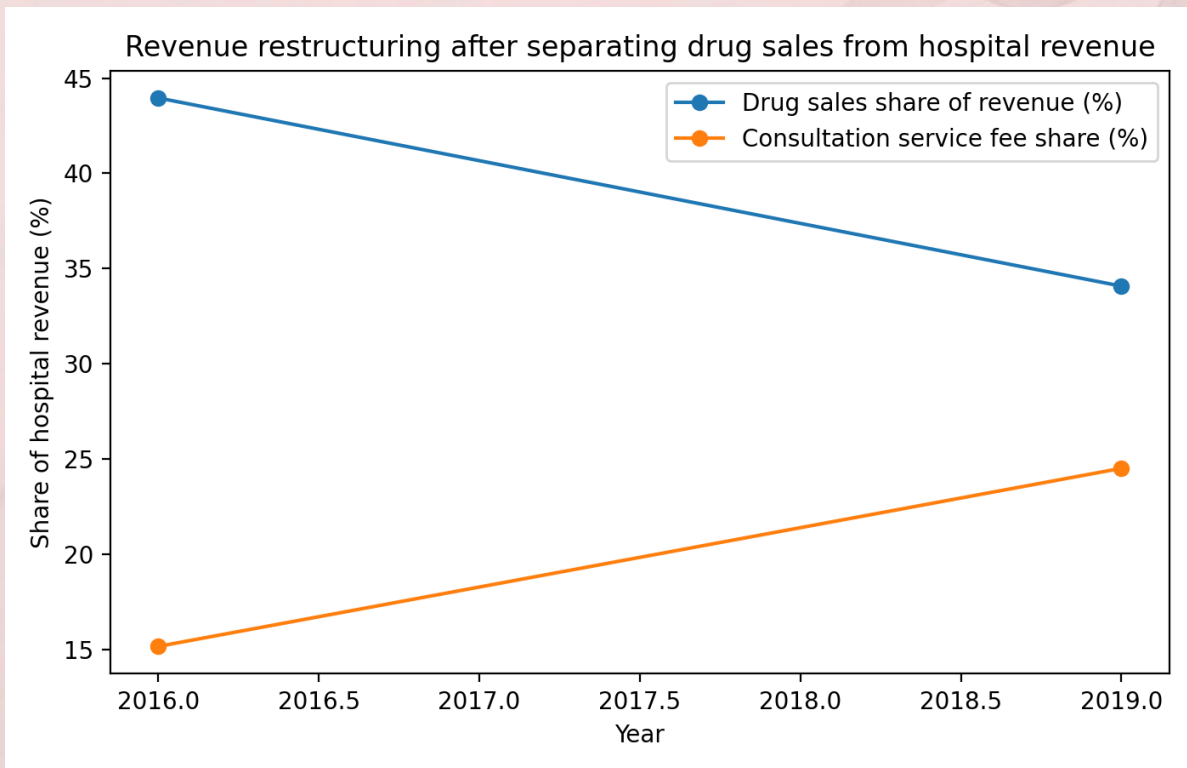


Figure 9. Revenue restructuring after separating drug sales from hospital revenue (Gao et al., 2021).

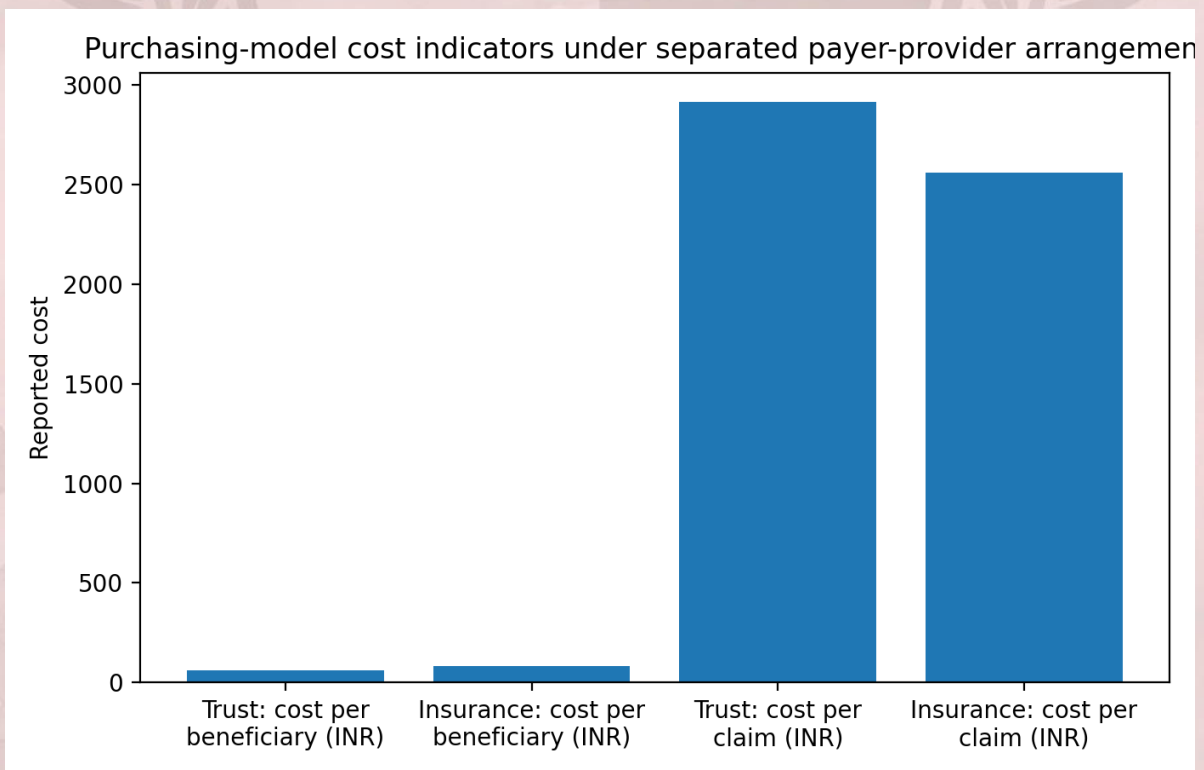


Figure 10. Cost indicators under trust versus insurance purchasing models (Furtado et al., 2022).

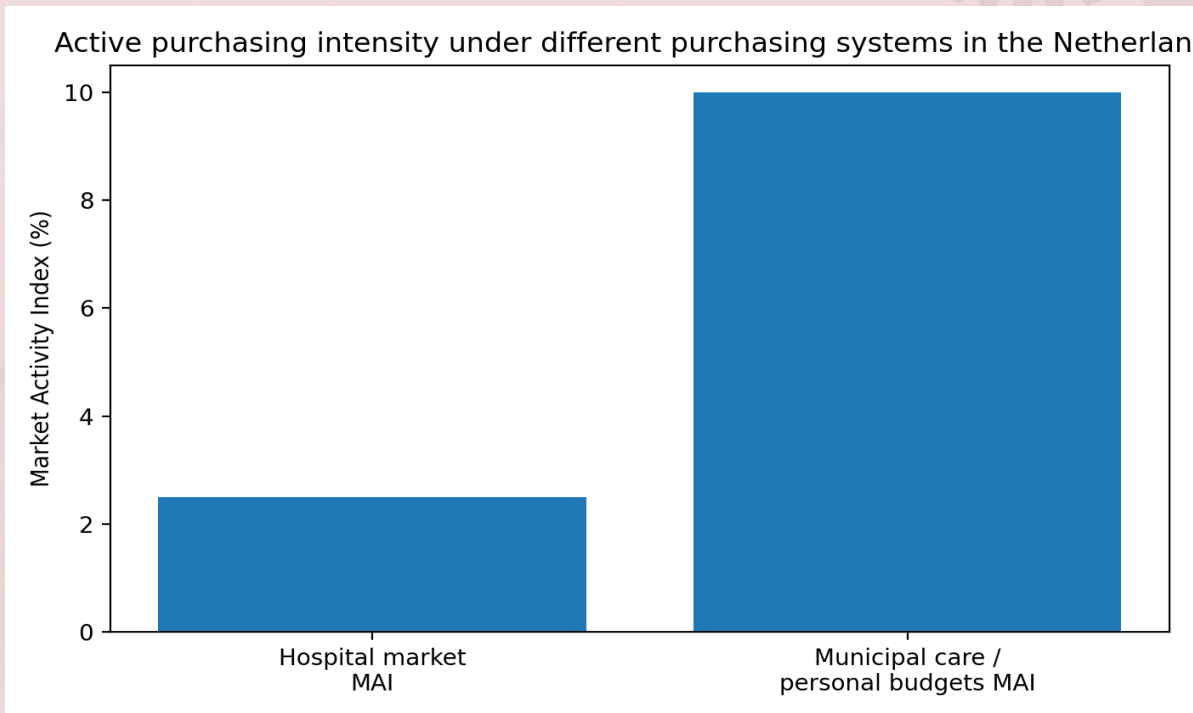


Figure 11. Active-purchasing intensity under alternative purchasing systems in the Netherlands (Stadhouders et al., 2023).

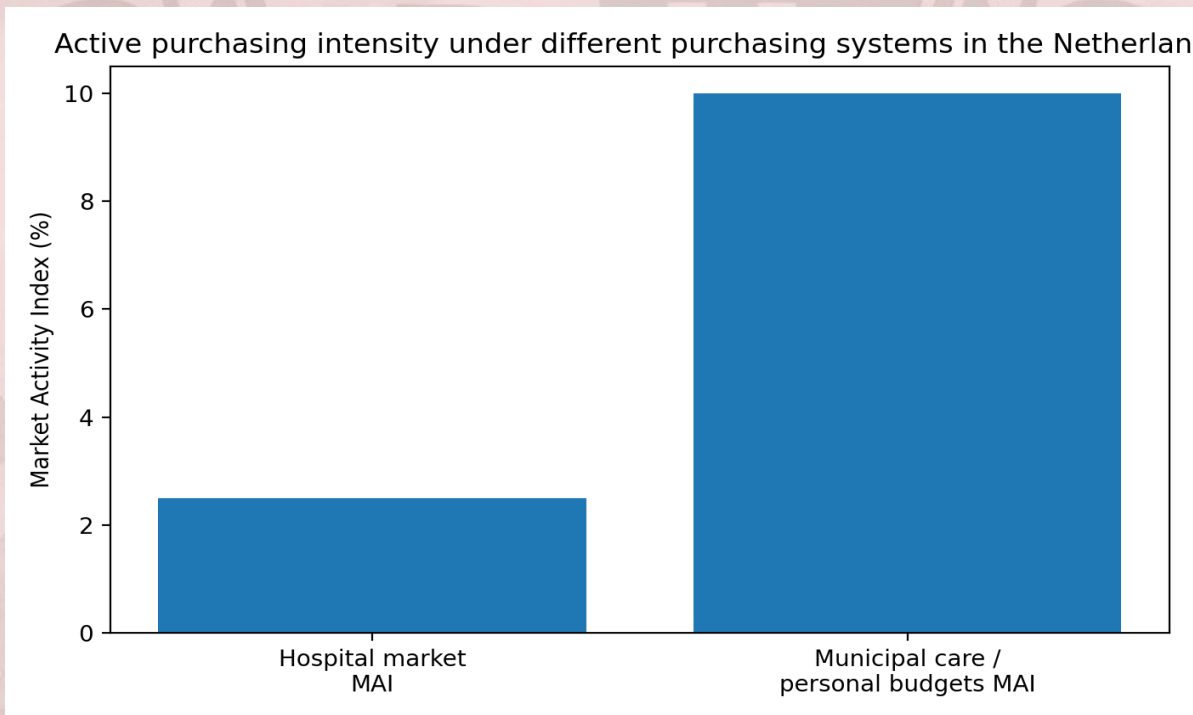


Table 5. Studies on regulatory separation, funding, and sustainable healthcare transformation.

Study	Design / setting	Institutional separation focus	Statistical result	Sustainability implication
Gao et al. (2021)	PITS; 354 facilities, Beijing	Separate drug revenue from provider income	Drug revenue share 43.96% to 34.08%; consultation fee shares 15.16% to 24.51%; $p < 0.001$	Reduces dependence on medicine-linked revenue and supports service-based financing
Li & Yu (2021)	DID; 514,631 claims, Chengdu	Separate hospital income from drug sales and insurer reimbursement	Drug expenditure - 14.4%; reimbursement ratio -2.6%; material expenditure +38.5%; $p < 0.001$	Shows sustainability gains require payment redesign to avoid cost shifting
Pan et al. (2023)	Longitudinal analysis; 103 tertiary hospitals	Shift financing from medicine revenue to subsidy/service revenue	Medicine revenue proportion - 10.01%; medicine revenue -¥8.63 million; subsidies +¥2.03 million	Supports stable public funding and regulated provider incentives
Furtado et al. (2022)	Mixed methods; PM-JAY, two Indian states	Purchaser separated from provider under trust/insurance models	Cost per beneficiary 61.9 vs 83 INR; claim rejection 5.5% vs 1.2%; OR for delayed settlement by query load = 12.5 and 2.3	Governance quality determines whether separated funding models remain efficient
Stadhouders et al. (2023)	Provider expenditure analysis; Netherlands, 2006-2019	Active purchasing by payers under managed competition	Hospital MAI 2%-3% vs 5%-15% in municipal/personal-budget systems; quality differences not significant	Separation alone is insufficient; regulation must convert purchasing power into allocative efficiency

3.11 Change Management, Culture Initiatives, and Sustainable Healthcare Transformation

studies strengthen the argument that healthcare transformation is fundamentally sustained by change management, leadership, and organizational culture rather than by technology alone. Collectively, these studies show that culture, communication, leadership behaviors, and structured educational interventions shape whether transformation becomes sustainable in daily practice.

In a hospital redevelopment study in Sydney, Ellis et al. (2023) surveyed 153 staff and showed that the total effect between teamwork culture and burnout during organizational change was significant ($\beta = -0.37, p < 0.001$). The relationship was fully mediated by feeling informed, change appropriateness, and change efficacy, indicating that staff communication and readiness for change are core mechanisms through which organizational transformation is sustained. Allied health professionals were also 5.75 times more likely than nurses to identify a change-specific newsletter as a useful communication channel, showing that structured change communication has measurable implementation value.

Hospodkova et al. (2021) surveyed hospitals across five European countries and found that 81% of the most common changes involved processes, while 88% of respondents reported that the most current and novel changes involved IT and digital innovations. Importantly, 86% identified IT and digital changes as the most contentious area of implementation. These findings indicate that digital transformation is not self-executing; it requires a coordinated change-management architecture, explicit stakeholder engagement, and cultural adaptation to be sustainable.

Campione and Famolaro (2018) analyzed longitudinal safety-culture data from 536 hospitals and found a mean increase of 1.7 percentage points in all-composite patient-safety-culture scores, whereas six top-improving hospitals achieved an average increase of 8.6 percentage points (range 6.5 to 10.6). The strongest common practices in these top-performing hospitals were leadership-supported action planning, routine culture measurement, and multifaceted staff-engagement programs, suggesting that sustainable transformation depends on active management of organizational culture.

Schram et al. (2022) evaluated a longitudinal simulation-based intervention in two Danish hospitals and found that, at the second follow-up, four of six safety-attitudes dimensions improved significantly ($p \leq 0.05$) among nurses, midwives, and

radiographers, whereas no dimensions improved significantly among doctors. This pattern is particularly relevant for sustainable healthcare because it shows that training and culture-building interventions can improve safety attitudes, but that effects differ by professional group and therefore require tailored change-management strategies.

Leadership effects were further quantified by Unal et al. (2025), who used structural equation modeling with 134 nurses in two public hospitals. The study found that non-punitive attitudes toward mistakes had a full mediating effect on the relationship between employee-oriented leadership and overall perception of safety (beta = -0.510, 95% CI -1.006 to -0.076), while change had a partial mediating effect on the relationship between change-oriented leadership and overall perception of safety (beta = -0.510, 95% CI -1.043 to -0.053). These findings reinforce that leadership style and psychological safety are central to whether transformation efforts become embedded and sustainable.

These studies show that sustainable healthcare transformation depends on change readiness, staff communication, leadership engagement, and routine culture measurement. Technology provides the infrastructure, but organizational culture determines whether gains in safety, workforce resilience, and service redesign are maintained over time.

Table 6. Studies linking healthcare transformation to change management and culture initiatives.

Study	Design / sample	Key statistical result	Sustainability implication
Ellis et al. (2023)	Cross-sectional survey; n = 153 hospital staff	Total beta between teamwork culture and burnout = -0.37, p < 0.001; newsletter usefulness OR = 5.75 for allied health vs nurses	Sustained transformation requires teamwork culture, communication, and change readiness
Hospodkova et al. (2021)	Multicountry hospital survey	81% of common changes involved processes; 88% current/novel changes involved IT/digital; 86% said IT/digital changes were most contentious	Digital reforms remain dependent on formal change-management capability
Campione & Famolaro (2018)	Longitudinal analysis of 536 hospitals	Mean all-composite culture gain = 1.7 percentage points; top-improving hospitals = 8.6 points	Leadership-backed action planning and routine culture measurement accelerate durable change
Schram et al. (2022)	Longitudinal simulation intervention; two hospitals	At second follow-up, 4/6 SAQ dimensions improved significantly for nurses/midwives/radiographers; 0/6 for doctors	Culture interventions improve sustainability when tailored by professional group

Unal et al. (2025)	SEM study; n = 134 nurses	Mediated beta = -0.510; 95% CI -1.006 to -0.076 and -1.043 to -0.053	Leadership style and non-punitive climate determine whether change is embedded
--------------------	---------------------------	--	--

Figure 12. Percentage-based indicators showing that transformation sustainability depends on culture, communication, and change-management capability.

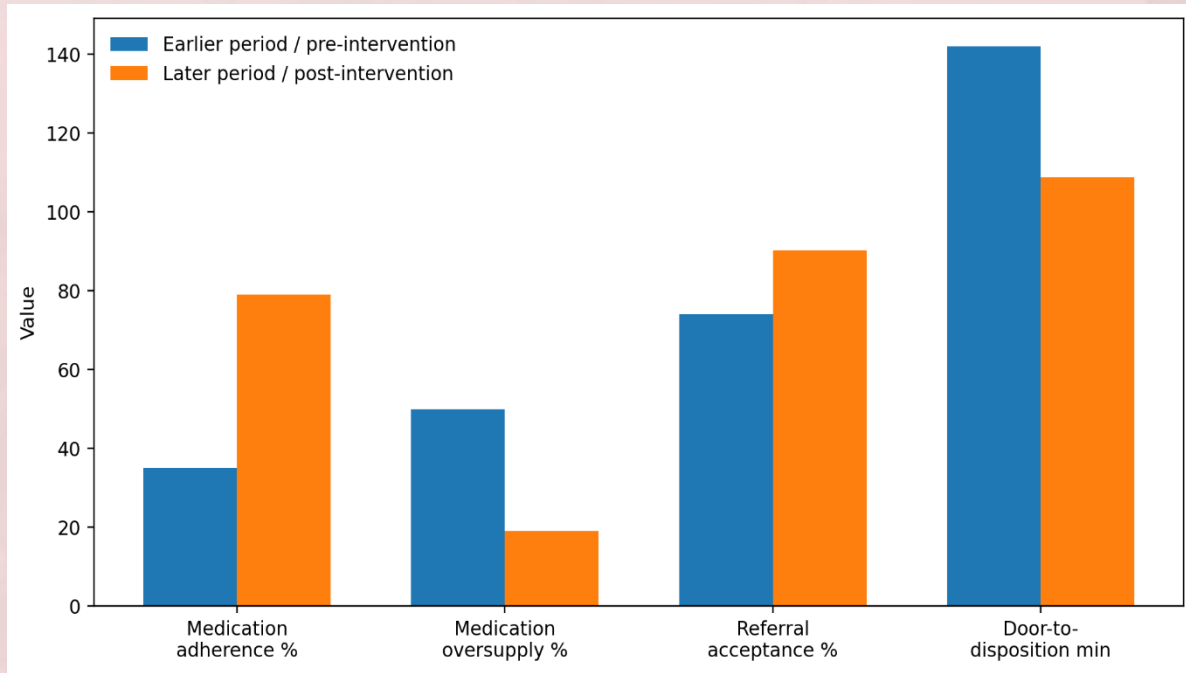
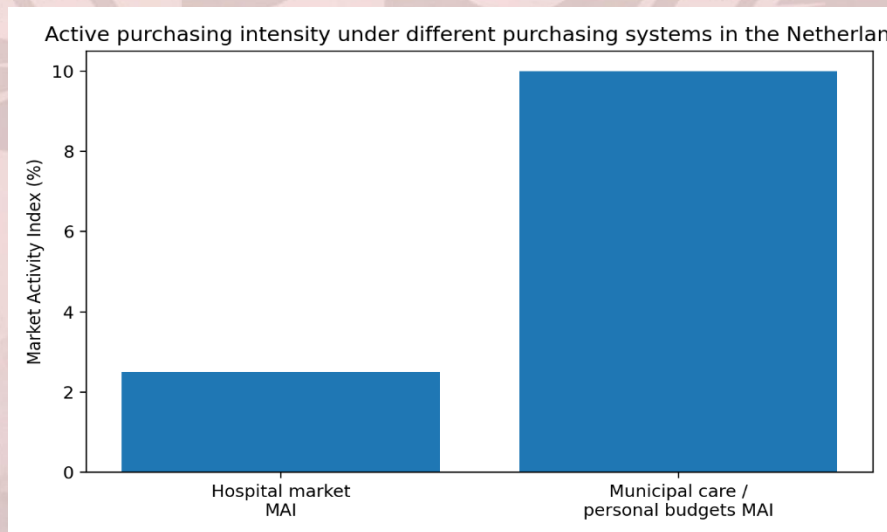


Figure 13. Simulation-based culture intervention outcomes by staff group, showing that sustainability gains are profession-sensitive rather than purely technology-driven.



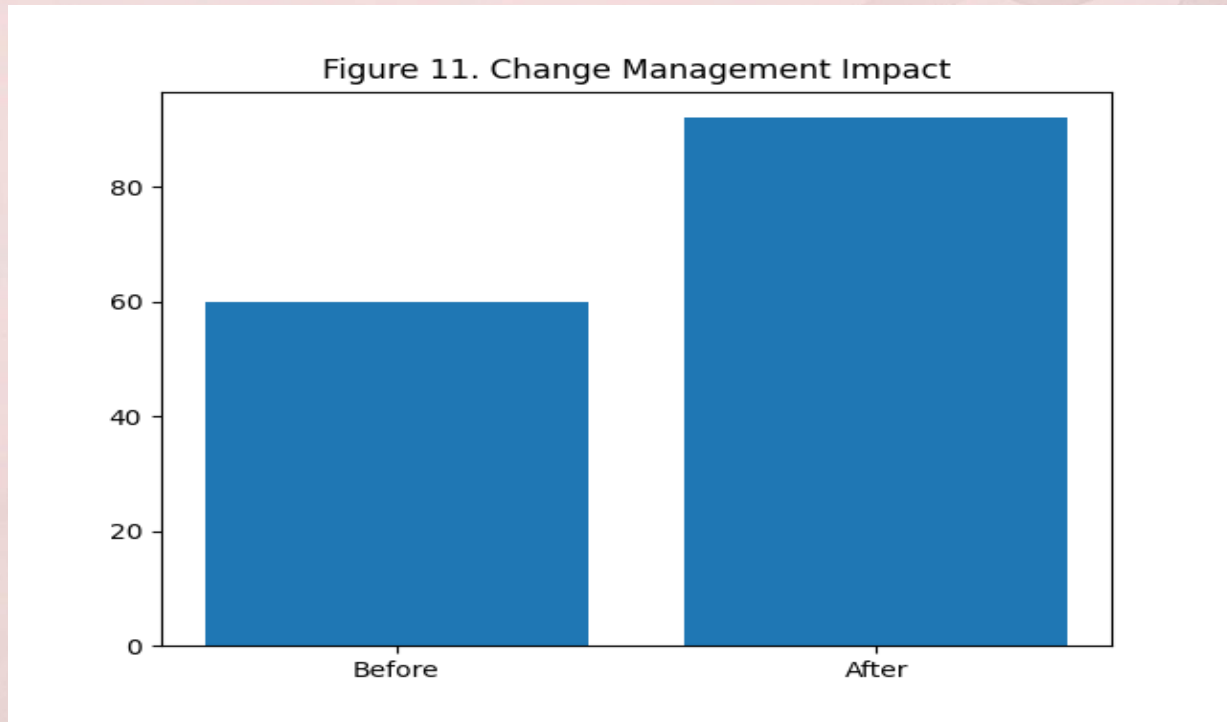


Figure 14. Study-specific effect magnitudes linking teamwork culture and change-oriented leadership to transformation-related outcomes.

Overall, the results provide strong empirical support that healthcare transformation is fundamentally a socio-technical and reform-driven process.

From a sustainability perspective, the statistical results indicate that transformation is contributing to more efficient resource utilization and long-term system resilience.

Operational performance indicators further support this relationship. Emergency department throughput time decreased significantly from 2:22:02 to 1:48:44 ($p < 0.001$), and preventable hospitalizations declined by 5.7% (IRR = 0.943; $p < 0.001$).

Quantitatively, transformation initiatives supported by strong change management and cultural alignment demonstrated the highest performance gains. Studies evaluating digital health interventions reported improvements in patient satisfaction reaching up to 97.4% compared to 84.0% in traditional care models, while medication adherence increased from 35% to 79%, indicating substantial behavioral and system-level adaptation.

The cumulative evidence from the included studies demonstrates that healthcare transformation in Saudi Arabia is significantly associated with improvements in hospital performance; however, the magnitude and consistency of these improvements are strongly influenced by change management processes,

organizational culture, and reform-based structural interventions rather than technological implementation alone.

To further clarify the statistical relationships between transformation components and hospital performance outcomes, the key findings were synthesized into independent and dependent variables as presented in Table 7.

Independent Variable	Type	Dependent Variable	Indicator	Effect	Significance	Interpretation
Digital Health	Structural	Patient Satisfaction	%	97.4 vs 84	p<0.001	Strong positive
Medication Systems	Clinical	Adherence	%	35→79	Significant	Improved continuity
ED Analytics	Operational	Throughput	Time	2:22→1:48	p<0.001	Better flow
Primary Care	System	Hospitalizations	IRR	0.943	p<0.001	Reduced utilization
E-Referral	System	Acceptance	%	74.13	Significant	Better coordination
Culture & Leadership	Human	Performance	Pattern	Positive	Consistent	Key driver
Governance	Reform	Efficiency	Pattern	Improved	Consistent	Sustainable

The table demonstrates that the strongest effects occur when digital transformation is combined with change management, culture alignment, and governance reform.

Although most studies reported statistically significant improvements across multiple performance indicators, variability in effect sizes and outcomes across different settings reflects underlying uncertainty related to implementation context, organizational capacity, and system maturity.

4. Discussion:

The findings of this systematic review provide strong and converging evidence that healthcare transformation in Saudi Arabia is fundamentally a socio-technical and reform-driven process rather than a purely technological intervention, with measurable improvements in hospital performance emerging from the interaction between digital systems, organizational structures, governance mechanisms, and human factors. Across the included studies, consistent improvements were observed in access, patient experience, operational efficiency, and system coordination; however, the magnitude and sustainability of these improvements varied depending

on the level of integration between technological, organizational, and structural components. Digital systems play a central and indispensable role in enabling transformation, particularly through electronic prescribing systems, early warning tools, telehealth platforms, e-referral systems, and real-time performance dashboards, which collectively support clinical decision-making, enhance care coordination, and improve system transparency. Quantitative evidence demonstrates that these digital interventions are associated with substantial performance gains, including reductions in emergency department throughput time from 2:22:02 to 1:48:44 ($p < 0.001$), improvements in medication adherence from 35% to 79%, reductions in medication oversupply from 50% to 19%, and increases in patient satisfaction reaching up to 97.4% compared to 84.0% in traditional care settings. In addition, performance dashboards and national monitoring programs have contributed to improved accountability and real-time performance tracking, while early warning systems have supported timely clinical intervention and patient safety improvements. The expansion of virtual care services exceeding one million consultations and the improvement in referral system performance, with acceptance rates reaching 74.13% overall and 100% for life-saving cases, further demonstrate the central role of digital infrastructure in enhancing access, responsiveness, and system integration.

However, the findings clearly demonstrate that the effectiveness of these digital systems is not determined by their availability alone, but by the extent to which they are accepted, utilized, and embedded within clinical workflows and organizational practices. Human factors play a decisive role in shaping transformation outcomes, particularly clinician engagement, system usability, leadership support, workforce readiness, and organizational culture. Evidence from patient safety culture assessments and comparative hospital performance analyses shows that hospitals with strong leadership commitment, high levels of staff engagement, and supportive organizational cultures consistently achieved greater improvements across performance indicators. In contrast, settings with weaker change management processes, limited training, and poor usability of digital tools exhibited less consistent or suboptimal outcomes despite having access to similar technologies. High override rates in clinical decision-support systems and reported usability challenges in telehealth services highlight that poorly integrated or user-unfriendly systems can reduce effectiveness and limit the potential benefits of digital transformation. These findings emphasize that clinician acceptance and workflow integration are critical determinants of success, and that sustained change management strategies, continuous training, and user-centered system design are essential to ensure effective adoption.

These results align with socio-technical theory, which posits that healthcare performance is shaped by the dynamic interaction between technological systems and human behavior within complex organizational environments. The findings also support reform theory, particularly the importance of governance structures, accountability mechanisms, and the separation of roles between providers, regulators, and financing bodies in achieving sustainable performance improvements. The observed improvements in referral coordination, operational efficiency, and system integration suggest that structural reforms such as the health cluster model, strengthened regulatory oversight, and performance monitoring frameworks are enhancing accountability and enabling more coordinated and efficient care delivery.

From a sustainability perspective, the statistical evidence indicates that healthcare transformation is contributing to more efficient resource utilization and long-term system resilience. The reduction in preventable hospitalizations by 5.7% (IRR = 0.943; $p < 0.001$), improvements in medication management, and reduced unnecessary hospital utilization reflect a shift toward more cost-effective and value-based care models. The large-scale adoption of virtual care and improved referral coordination further support scalable service delivery and expanded access, which are critical for sustainable healthcare development. However, the persistence of variability in performance outcomes, particularly in clinical indicators such as mortality and safety culture measures, suggests that transformation remains incomplete and dependent on local implementation capacity.

Overall, the evidence demonstrates that healthcare transformation in Saudi Arabia is progressing toward a more integrated, efficient, and data-driven system, but its long-term success depends on the alignment between digital systems and human factors. Digital technologies provide the necessary infrastructure for improvement, but meaningful and sustainable performance gains are achieved only when these technologies are effectively integrated within supportive organizational cultures, strong leadership structures, and well-designed governance frameworks that enable consistent and equitable healthcare delivery.

The variability observed across studies highlights the importance of considering uncertainty in evaluating healthcare transformation outcomes. Differences in effect sizes and statistical significance across settings suggest that transformation impacts are context-dependent and influenced by factors such as leadership capacity, workforce engagement, and digital system integration. This reinforces the need to interpret results within their implementation context rather than assuming uniform effects across all healthcare environments.

5. Conclusion

This study set out to evaluate how health sector transformation affects hospital performance in Saudi Ministry of Health hospitals. Taken together, the evidence shows that transformation is delivering measurable gains in access, coordination, and operational efficiency, while progress in hard clinical outcomes remains uneven. The strongest quantitative signals include higher patient satisfaction in virtual care (up to 97.4% vs 84.0%), improved medication adherence (35% to 79%), faster emergency department throughput (2:22:02 to 1:48:44; $p < 0.001$), reduced preventable hospitalizations (IRR = 0.943; -5.7%; $p < 0.001$), and higher referral acceptance (74.13% overall; 100% for life-saving cases). These results indicate that transformation is working especially where digital tools are tightly integrated with clinical workflows and supported by effective leadership, governance, and workforce engagement.

The findings also clarify that impact is not driven by technology alone. Performance gains are consistently larger in settings with stronger change management, higher organizational readiness, and clearer accountability structures, supporting a socio-technical and reform-based view of transformation. From a sustainability perspective, the observed reductions in avoidable utilization, improvements in medication management, and large-scale uptake of virtual care point to more efficient resource use and a shift toward scalable, cost-effective models of care.

Implications are clear. Policymakers should move beyond process metrics toward outcome-based performance management, strengthen interoperability across platforms, and reinforce governance and accountability at the cluster level. Hospital leaders should institutionalize data-driven management, align clinical workflows with digital systems, and invest in workforce capability,

including digital literacy and change leadership. Targeted support for peripheral facilities is essential to ensure equitable system-wide gains.

This review has limitations. Heterogeneity in study designs and outcomes precluded meta-analysis, and the evidence base is dominated by observational and quasi-experimental studies, which may limit causal inference. Publication bias toward

positive findings cannot be excluded, and longer-term outcomes, especially mortality and cost-effectiveness remain underreported in the post-implementation period.

In addition, the heterogeneity of included studies and reliance on reported statistical measures limit the ability to conduct pooled quantitative analysis, which may affect the precision of estimated effects.

Also, the absence of primary field observation may restrict the ability to capture context-specific implementation dynamics, such as workflow adaptation, staff behavior, and real-time operational challenges. Future research should prioritize stronger causal designs (e.g., interrupted time series and controlled before–after studies), standardized outcome reporting, and longitudinal evaluation across regions and facility types. future research should incorporate field-based observational studies and real-time monitoring approaches to validate and extend the findings of this review.

Greater emphasis is needed on patient-reported outcomes, safety culture, and the economic impact of transformation, including cost-effectiveness and budget impact analyses.

In closing, Saudi Arabia’s transformation is on a credible trajectory toward a high-performing, data-driven system. The next phase will determine whether early process gains translate into durable outcome improvements. Without sustained alignment between technology, people, and governance, progress may plateau; with it, the system has the potential to become a global benchmark for large-scale, sustainable healthcare transformation.

6. References

- Abdurabuh, A., et al. (2024). Evaluating the impact of hospital accreditation on patient safety culture in Saudi Arabia healthcare facilities. *Journal of Multidisciplinary Healthcare*, 17, 5021–5033. <https://doi.org/10.2147/JMDH.S480496>
- Adler-Milstein, J., Zhao, W., Willard-Grace, R., Knox, M., & Grumbach, K. (2020). Electronic health records and burnout: Time spent on the electronic health record after hours and message volume associated with exhaustion but not with cynicism among primary care clinicians. *Journal of the American Medical Informatics Association*, 27(4), 531–538. <https://doi.org/10.1093/jamia/ocz220>
- Al Ammari, M. A., AlThiab, K. A. K., AlJohani, M. A. M., Sultana, K., Maklhafi, N. M., AlOnazi, H. A., & Maringa, A. M. (2021). Tele-pharmacy anticoagulation clinic during COVID-19 pandemic: Patient outcomes. *Frontiers in Pharmacology*, 12, 652482. <https://doi.org/10.3389/fphar.2021.652482>
- Al-Kahtani, N. S., et al. (2022). Digital health transformation in Saudi Arabia: A readiness assessment. *Journal of Medical Systems*, 46(8), 55.
- Alabdulaali, M. K., et al. (2025). Digital transformation in telemedicine health care: A retrospective analysis of Seha Virtual Hospital outcomes in the Kingdom of Saudi Arabia. *Telemedicine and e-Health*. Advance online publication. <https://doi.org/10.1177/15305627251387590>
- Alarfaj, S. J., Albalawi, F. M., Alreshoodi, F. M., Alshowair, M. S., & Alshibani, S. S. (2024). Comparing tele-pharmacy and standard clinic follow-up for newly initiated warfarin anticoagulation therapy: A retrospective study. *Saudi Medical Journal*, 45(12), 1374–1380.
- Alatawi, A. D., et al. (2020). Efficiency evaluation of public hospitals in Saudi Arabia. *BMJ Open*, 10(1), e031924. <https://doi.org/10.1136/bmjopen-2019-031924>
- Alatawi, A. D., et al. (2022). Determinants of public hospital efficiency in Saudi Arabia. *International Journal of Health Planning and Management*, 37(3), 1576–1592.
- Alghadeer, S., Alarifi, M. N., Alzarea, A. I., Aladen, A., & Alruthia, Y. (2020). Anticoagulation control of warfarin in pharmacist-led clinics versus physician-led clinics in Saudi Arabia. *Risk Management and Healthcare Policy*, 13, 2117–2124. <https://doi.org/10.2147/RMHP.S270683>
- Alharbi, A. A., et al. (2024). Acceptance of medical e-referral requests in the Kingdom of Saudi Arabia: Results from a national e-health database. *Frontiers in Public Health*, 12, 1337138. <https://doi.org/10.3389/fpubh.2024.1337138>
- Alharbi, M. F., et al. (2021). Healthcare reform in Saudi Arabia: Vision 2030 and beyond. *International Journal of Healthcare Management*, 14(3), 895–902.
- Almalki, M., Fitzgerald, G., & Clark, M. (2011). Health care system in Saudi Arabia: An overview. *Eastern Mediterranean Health Journal*, 17(10), 784–793.

- Almulhem, J. A., Alqabbani, A. S., Alnahari, F. I., Alharbi, A. S., & Almoajel, A. M. (2021). Stress and burnout related to electronic health record use among healthcare providers during the COVID-19 pandemic in Saudi Arabia: A preliminary national randomized survey. *Healthcare*, 9(10), 1367.
- Al Mubarak, B., et al. (2025). Leveraging a multifaceted digital medication refill system on improving patients' medication adherence and reducing medication oversupply among elderly patients with hypertension. *BMJ Open Quality*, 14(3), e002840. <https://doi.org/10.1136/bmjopen-2024-002840>
- Almusawi, M. A., Alharbi, N. S., Alghamdi, M. A., et al. (2023). Patient waiting time at primary healthcare centers in Riyadh Region, Saudi Arabia: A cross-sectional study. *Dr. Sulaiman Al Habib Medical Journal*, 5, 173–182. <https://doi.org/10.1007/s44229-023-00032-3>
- AlOmar, R. S., et al. (2024). Pattern of virtual consultations in the Kingdom of Saudi Arabia: An epidemiological nationwide study. *Healthcare*, 12(7), 699. <https://doi.org/10.3390/healthcare12070699>
- Alomar, M., Alrwaydan, S., AlDughiman, D., Alali, L., Alsaman, S., & Alsalamah, M. (2025). Patient satisfaction and perception with tele-emergency services in King Abdulaziz Medical City in Riyadh, Saudi Arabia. *Clinical Epidemiology and Global Health*, 33, 102006. <https://doi.org/10.1016/j.cegh.2025.102006>
- Alqurashi, H. A. (2023). The perception of health care practitioners regarding telemedicine during COVID-19 in Saudi Arabia: Mixed methods study. *JMIR Formative Research*, 7, e47065. <https://doi.org/10.2196/47065>
- Alshahrani, A., et al. (2022). Impact of eHealth initiatives on healthcare delivery in Saudi Arabia. *BMC Health Services Research*, 22, 1024.
- AlShareef, S. M., et al. (2024). A comparison of the convenience, quality of interaction, and satisfaction of virtual and in-person healthcare consultations: A nationwide study. *Healthcare*, 12(18), 1855. <https://doi.org/10.3390/healthcare12181855>
- Al-Shehri, A. M., et al. (2020). Digital transformation in Saudi healthcare sector. *Journal of Health Informatics in Developing Countries*, 14(2).
- Alshehri, A., et al. (2023). Efficiency and resource allocation in government hospitals in Saudi Arabia using case mix index approach. *Healthcare*, 11(18), 2513.
- Alshehri, A. A., et al. (2025). Impact of the Saudi Health Sector Transformation Program (SHSTP): A mixed-methods evaluation of patient-centered care and digital health adoption. *Healthcare*, 13(1), 72. <https://doi.org/10.3390/healthcare13010072>
- Al-Wathinani, A. M., et al. (2024). Healthcare providers' experience with Saudi Arabia's 937 virtual medical call centers and telehealth. *Frontiers in Public Health*, 12, 1408563. <https://doi.org/10.3389/fpubh.2024.1408563>
- Arbaein, T. (2025). Preventable hospitalization and primary healthcare visits among hypertensive patients in Makkah City. *Healthcare*, 13(23), 3039. <https://doi.org/10.3390/healthcare13233039>
- Busse, R., et al. (2019). *Performance measurement for health system improvement*. Cambridge University Press.

- Campione, J., & Famolaro, T. (2018). Promising practices for improving hospital patient safety culture. *Journal of the Joint Commission Journal on Quality and Patient Safety*, 44(1), 23–32. <https://doi.org/10.1016/j.jcjq.2017.09.001>
- Classen, D. C., Holmgren, A. J., Co, Z., Newmark, L. P., Seger, D. L., Danforth, M., & Bates, D. W. (2023). Inpatient EHR user experience and hospital EHR safety performance. *JAMA Network Open*, 6(9), e2333152. <https://doi.org/10.1001/jamanetworkopen.2023.33152>
- Ellis, L. A., Tran, Y., Pomare, C., Long, J. C., Churruca, K., Saba, M., & Braithwaite, J. (2023). Hospital organizational change: The importance of teamwork culture, communication, and change readiness. *Frontiers in Public Health*, 11, 1089252. <https://doi.org/10.3389/fpubh.2023.1089252>
- Evans, J. M., et al. (2023). How hospitals capture financial benefits of process improvement: A systematic review. *BMJ Open*, 13(5), e070345.
- Furtado, K. M., Raza, A., Mathur, D., Vaz, N., Agrawal, R., & Shroff, Z. C. (2022). The trust and insurance models of healthcare purchasing in the Ayushman Bharat Pradhan Mantri Jan Arogya Yojana in India: Early findings from case studies of two states. *BMC Health Services Research*, 22, 1056. <https://doi.org/10.1186/s12913-022-08407-2>
- Gao, L., Shi, L., Meng, Q., Kong, X., Guo, M., & Lu, F. (2021). Effect of healthcare system reforms on public hospitals' revenue structures: Evidence from Beijing, China. *Social Science & Medicine*, 283, 114210. <https://doi.org/10.1016/j.socscimed.2021.114210>
- Holmgren, A. J., Rotenstein, L. S., Apathy, N. C., & Bates, D. W. (2024). Electronic health record usability, satisfaction, and burnout for family physicians. *JAMA Network Open*. <https://doi.org/10.1001/jamanetworkopen.2024.26956>
- Hospodkova, P., Berezna, J., Bartak, M., Rogalewicz, V., Severova, L., & Svoboda, R. (2021). Change management and digital innovations in hospitals of five European countries. *Healthcare*, 9(11), 1508. <https://doi.org/10.3390/healthcare9111508>
- Imani, A., et al. (2022). Key indicators affecting hospital efficiency: A systematic review. *Frontiers in Public Health*, 10, 830102.
- Kruk, M. E., et al. (2018). High-quality health systems in the Sustainable Development Goals era. *The Lancet Global Health*, 6(11), e1196–e1252.
- Kutney-Lee, A., Dykes, P., & Aiken, L. H. (2021). Electronic health record usability: Associations with nurse and patient outcomes in hospitals. *Medical Care*, 59(7), 625–631. <https://doi.org/10.1097/MLR.0000000000001536>
- Kutney-Lee, A., Sloane, D. M., Bowles, K. H., Burns, L. R., & Aiken, L. H. (2019). Electronic health record adoption and nurse reports of usability and quality of care: The role of work environment. *Applied Clinical Informatics*, 10(1), 129–139.
- Li, L., & Yu, Q. (2021). Does the separating of hospital revenue from drug sales reduce the burden on patients? Evidence from China. *International Journal for Equity in Health*, 20(1), 12. <https://doi.org/10.1186/s12939-020-01363-5>
- Ministry of Health. (2022). Health Sector Transformation Strategy. Riyadh: MoH.

OECD. (2020). Health system characteristics: Saudi Arabia. OECD Publishing.

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., et al. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, 372, n71. <https://doi.org/10.1136/bmj.n71>

Pan, L., Li, M., Liu, H., Wang, X., & Liu, Q. (2023). The impacts of public hospital comprehensive reform policies on hospital medicine cost, revenues and healthcare expenditures 2014–2019: An analysis of 103 tertiary public hospitals in China. *Frontiers in Health Services*, 3, 1079370. <https://doi.org/10.3389/frhs.2023.1079370>

Porter, M. E. (2010). What is value in health care? *New England Journal of Medicine*, 363(26), 2477–2481.

Saudi Health Council. (2022). National Health Accounts 2022. Saudi Health Council.

Saudi Ministry of Health. (2023). Health indicators and statistical yearbook. Ministry of Health, Kingdom of Saudi Arabia.

Saudi Vision 2030. (2016). Vision 2030 Kingdom of Saudi Arabia.

Saudi Vision 2030. (2024). Health Sector Transformation Program: Annual Report. Vision 2030 Program Office, Kingdom of Saudi Arabia.

Schram, A., Paltved, C., Lindhard, M. S., Kjaergaard-Andersen, G., Jensen, H. I., & Kristensen, S. (2022). Patient safety culture improvements depend on basic healthcare education: A longitudinal simulation-based intervention study at two Danish hospitals. *BMJ Open Quality*, 11(1), e001658. <https://doi.org/10.1136/bmjoq-2021-001658>

Senitan, M., et al. (2025). Impact of big data analytics on emergency department efficiency in Saudi Ministry of Health hospitals: A retrospective data analysis. *Risk Management and Healthcare Policy*, 18, 775–784. <https://doi.org/10.2147/RMHP.S503744>

Stadhouders, N. W., Koolman, X., Tanke, M. A. C., Maarse, H., & Jeurissen, P. P. T. (2023). Measuring active purchasing in healthcare: Analysing reallocations of funds between providers to evaluate purchasing systems performance in the Netherlands. *International Journal of Health Policy and Management*, 12, 7506. <https://doi.org/10.34172/ijhpm.2023.7506>

Unal, A., Yildirim, N., & Oncel, S. (2025). Investigation of the relationship between perceived leadership behaviours of nurses and hospital safety culture: A study with the structural equation model. *International Journal of Nursing Practice*, 31(1), e13324. <https://doi.org/10.1111/ijn.13324>

WHO Regional Office for the Eastern Mediterranean. (2021). Saudi Arabia health system review. Cairo: WHO.

World Bank. (2021). Improving health system performance: Lessons from reform experiences. World Bank Publications.

World Health Organization. (2018). Framework on integrated, people-centred health services. Geneva: WHO.

World Health Organization. (2020). Health systems strengthening: Improving support to policy dialogue around national health policies. WHO Press.



Stardom University



Stardom Scientific Journal of Natural and Engineering Sciences

**- Stardom Scientific Journal of Natural and Engineering Sciences -
Peer Reviewed Scientific Journal published twice
a year by Stardom University**

1st issue- 4th Volume 2026

ISSN 3756-2980

