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# Evaluating the Impact of Digital Innovation on Improving the Efficiency of Health Insurance Services in the Kingdom of Saudi Arabia

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## ABSTRACT

This study examines the impact of digital innovation on health insurance operations in Saudi Arabia, with a focus on how e-health tools influence Population Health Management (PHM) and home care service delivery. The strategic pursuit of Saudi Arabia's Vision 2030 is propelling insurance organizations to deploy advanced digital health tools, from telemedicine and EHRs to AI-driven risk stratification and mobile platforms, to fundamentally enhance service efficiency and health outcomes. Using panel data from public and private insurance institutions, this study analyzes the impact of digital transformation on operational performance, care accessibility, and patient satisfaction. The study also examines organizational readiness, regulatory alignment, and barriers to adoption across various types of insurers. The findings provide policy-relevant insights for insurance providers, regulators, and healthcare stakeholders seeking to scale digital health initiatives that enhance value-based care and reduce long-term healthcare costs.

**Keywords:** Digital Innovation, Health Insurance, Operational Efficiency, Saudi Arabia, Vision 2030, Artificial Intelligence, Blockchain, Claims Processing.
**JEL Classification:** I13; I18; O33; C33

## INTRODUCTION

The global healthcare sector is experiencing an unprecedented digital transformation, driven by advances in technologies such as artificial intelligence (AI), big data analytics, and the Internet of Things (IoT). This transformation is dramatically changing how health services are delivered, managed, and financed (Topol, 2019). In this context, health insurers also play a critical role as primary financial supporters and managers. However, although much research has examined digital convergence in clinical settings, the specific effects on the operational efficiency of insurance organizations—especially in relation to widespread national restructuring—remain a crucial and largely underexplored area of study.

This inequality is of particular importance in the Kingdom of Saudi Arabia, where a need for healthcare system renewal exists according to the Vision 2030 reform, aiming for a better-performing, patient-centered, and privatized system (Vision 2030, 2020; Ministry of Health, 2021). At the nexus of such renewal is the use of strategic programs, such as the National eHealth Strategy and the Health Sector Transformation Program, which demand the integration of digital technologies and public-private collaborations (Alasiri & Mohammed, 2022; Saudi Health Council, 2020).

The achievement of such broad digitization efforts relies on a robust infrastructure of scalable, interoperable, and smart systems for processing and transforming overall strategies towards implementable actions (Kopparapu, 2025). Empirical studies across different global and local contexts have found that technologies such as electronic health records (EHRs), telemedicine, and artificial intelligence (AI) can significantly ease administrative barriers, increase claims precision, and strengthen risk management measures (Bates & Bitton, 2010; Kellermann & Jones, 2013).

Initiatives from Saudi specific contexts, such as the SEHA Virtual Hospital, demonstrate that integrated digital platforms can facilitate streamlined claims processing and reduce fraud-based activities (Aldogiher & Halim, 2025). In addition, overall assessments demonstrate that a proper digital infrastructure, accompanied by financial reforms, strengthens the underlying foundations required for effective insurance performance and the achievement of universal coverage (Mani & Goniewicz, 2024).

## A BRIEF LITERATURE REVIEW

There is a lack of extensive, empirical research that assesses the overall impact of concurrent integrated digital innovations—such as Electronic Health Records (EHRs), AI-based risk stratification, and web-based mobile health platforms—on the operational performance of Saudi Arabian health insurers. Past research often looks at one technology or provides descriptive analysis and does not use econometric methods that can capture causal impacts and advise strategic investment (Al-Kahtani et al., 2022).

Therefore, this study aims to bridge this gap by conducting a comprehensive econometric investigation of Saudi Arabia's health insurance market. This research investigates the influence of digital technology integration on operational efficiency in strategic population health and home care programs. Through a panel data regression model, the study offers actionable, evidence-based suggestions for applying digital transformation in advancing Saudi Vision 2030 goals.

This study therefore attempts to fill this gap by conducting an extensive econometric analysis of the health insurance industry in Saudi Arabia. The final goal is to analyze the impact of integrating various digital technologies with population health and home care strategic plans on operational performance. The present study applies the panel data regression technique and transcends theoretical abstract thinking to provide pragmatic, evidence-based recommendations for harvesting digitalization benefits in achieving the ambitious goals outlined in Saudi Vision 2030.

### Research Gap and Objective

The adoption of digital technology in the health sector has greatly restructured the service-delivery process. However, a significant gap in the literature exists regarding the application of digital innovation to enhance the effectiveness of health insurance services, particularly in the Kingdom of Saudi Arabia. Although various studies have focused on the applications of digital health technologies in hospital and clinical contexts, the operational and managerial performance of health insurance firms has remained largely unaddressed.

Existing literature concentrates on individual digital tools or projects, such as electronic health records (EHRs), telemedicine, or artificial intelligence, without examining their combined effects with initiatives like population health management (PHM) or homecare services. Additionally, most of the empirical evidence is based on international settings, such as the United States or Europe, which differ from the regulatory, economic, and digital transformation environment of Saudi Arabia.

There is also a notable lack of studies using advanced econometric methods, such as panel data analysis, to control for differences among insurers and to establish causal links between digital innovation and efficiency in the Saudi health insurance market. Addressing this gap is essential, especially considering recent health sector reforms under Saudi Vision 2030 and the shift toward digital transformation in healthcare.

The primary goal of this study is to analyze how digital innovation enhances the efficiency of health insurance services in Saudi Arabia. Specifically, the study explores how adopting e-health tools such as EHRs, telemedicine systems, and AI solutions impacts the operational effectiveness and service delivery of insurers. It also examines how PHM programs and home care services influence insurer performance, along with the role of institutional digital maturity, which reflects insurers' ability and readiness to implement digital strategies effectively. The research further considers the influence of national digital health policy compliance as a regulatory factor affecting efficiency.

By combining these factors in a panel data analysis of Saudi health insurers from 2015 to 2023, the study aims to provide evidence-based insights that inform policymakers and insurance providers. It offers practical recommendations on leveraging digital innovation to streamline procedures and support the goals of Saudi Vision 2030.

## RESEARCH METHODOLOGY

### Problem Statement

The global healthcare industry is undergoing a significant digital transformation, driven by the rise of artificial intelligence, blockchain technology, big data analytics, and smart platforms. These advancements have already transformed the way healthcare is delivered, managed, and funded. However, as worldwide interest in digital health grows, the effect of digital innovation on the efficiency of health insurance services has not been fully studied, especially in developing economies. While much research focuses on digital transformation in healthcare services and outcomes, the insurance aspect—which plays a key role in financing, processing claims, detecting fraud, and providing access to care—has not received enough attention in the existing literature. Within the context of the Kingdom of Saudi Arabia (KSA), this is particularly pertinent.

The country has embarked on an ambitious digital transformation agenda as part of Vision 2030, centered on innovation-driven efficiency and sustainability across various industries, including healthcare. The health insurance sector in Saudi Arabia is expanding rapidly, covering an increasing number of the population and attracting new private players. Empirical evidence regarding the adoption of digital innovations in this sector, as well as the resulting operational efficiency gains, is limited. Current research is primarily descriptive and points towards aggregate healthcare technology adoption but lacks precise analysis of the insurance segment.

Moreover, overseas research in the field is heavily concentrated in developed economies that have advanced digital infrastructure, robust regulatory frameworks, and high consumer readiness. This creates a contextual disconnect, as the unique institutional, regulatory, and cultural environment in Saudi Arabia presents both opportunities and challenges for digital insurance innovation. Lacking empirical studies analyzing these dynamics, industry officials and policymakers may lack the evidence to develop practical approaches to enhance efficiency.

Given this context, the present study aims to fill this critical gap by comprehensively examining the role of digital innovation in enhancing the efficiency of Saudi health insurance services. In particular, the research aims to:

(i) Explore the status quo of digital innovation adoption in Saudi health insurance.
(ii) Identify the most prominent digital tools and technologies utilized,
(iii) Assess their effect on the service's efficiency—in terms of cost reduction, claim management, fraud prevention, and customer satisfaction—
(iv) Estimate obstacles to successful adoption, and
(v) Provide policy and managerial recommendations to guide future initiatives.

Through achieving these objectives, this research shall enhance scholarly scholarship and practical policymaking by offering insights into the potential of digital innovation to drive efficiency and sustainability in the Saudi health insurance market.

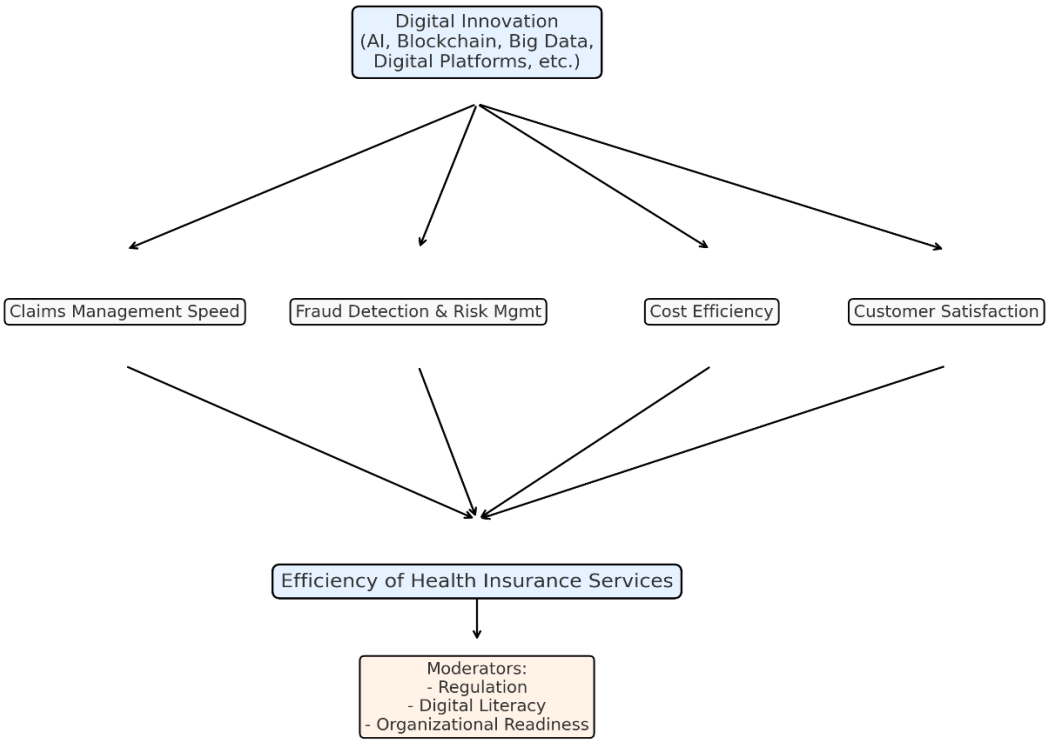



**Figure 1.** Illustration of the theoretical foundation

## Extended Empirical Literature Review: Digital Innovation in Healthcare and Insurance

### Fundamental Digital Technologies and Strategic Shifts in Healthcare

Today's healthcare system is built on the foundation of computer science, which serves as the framework for its delivery and regulation. There is ample evidence of its revolutionary effect throughout the industry. Research on Electronic Health Records (EHRs), for instance, shows significant advantages. According to Adler et al. (2019), interoperable EHR systems improve information exchange between payers and providers, cut down on redundant testing, and save 15–20%, overall administrative expenses related to manual record maintenance.
Similarly, telemedicine, whose rollout picked up speed during the COVID-19 pandemic, not only extended access to healthcare but also minimized unnecessary use of the emergency department and expedited pre-authorization of virtual visits (Chen & Zeng, 2021). Further, application of AI and data analytics extends beyond merely simple operational advantage. Such machine-learning systems are now absolutely critical to advanced claims analysis, identifying tiny patterns linked to billing anomalies or fraud with a degree of precision that surpasses rule-based systems.

### Automation of Key Insurance Activities

The knowledge-intensive health insurance industry has gained significantly from automation, with research citing efficiencies in its core activities. In claims processing, for example, studies such as Khan & Lee (2020) show that AI systems have the capacity to adjudicate automatically between 80% and simple claims, accelerating processing to days instead of weeks and significantly reducing administrative overhead.
Predictive analytics has also revolutionized underwriting traditionally. By leveraging data from wearables and mobile health apps, insurers are moving away from static risk pools to dynamic, data-driven profiles. Morales et al. (2022) note that this allows for more individualized premiums as well as proactive risk management. At the same time, advanced analytics have strengthened the detection of Fraud, Waste, and Abuse (FWA). Real-time systems now cross-reference large datasets to detect unusual billing, provider anomalies, and outlier claims—saving insurers a considerable amount of money.

### Shift to Value-Based Care

Beyond operational efficiencies, digital technologies are enabling a strategic shift towards value-based healthcare. Population Health Management (PHM) platforms are at the forefront of this transition. Gonzalez and Patel (2018) found that insurers that used PHM systems reduced hospital readmissions by 10–15% and tempered claims cost inflation by improving the early identification and management of high-risk patients. Digital home care solutions are a continuation of this approach. According to Tan et al. (2020), among chronic patients, remote monitoring lowered hospitalization by 25% and lowered total costs of care by improving medication adherence and enabling early clinical interventions.

### The GCC Research Gap

Though global evidence backing digital health benefits exists, it is unclear how directly applicable it is to the GCC, and more specifically, Saudi Arabia. The healthcare systems in the region are unique, having undergone rapid modernization, mixed public-private configurations, young demographics, and national visions like Vision 2030. However, most available research is based on Western data, and thus, one may question its applicability.
Three principal research gaps appear. First, most studies examine individual technologies (e.g., EHRs, PHM, or home care) in a standalone manner, without assessing how they function as an integrated ecosystem. For instance, effective PHM depends on interoperability with EHRs, a dimension rarely considered in GCC research. Second, institutional readiness is overlooked. Digitalization is not only about technology but also about leadership, workforce capabilities, and organizational culture. In the GCC context, where institutional maturity varies considerably, this is a significant omission. Addressing these gaps, this study explores how e-Health, PHM, and homecare initiatives in combination affect operational and clinical performance in Saudi health insurance firms, with a specific consideration of the moderating effect of institutional readiness.

### Model Specification

The study estimates how digital innovation affects Saudi Arabian health insurance's efficiency using the panel data econometric method. In contrast to cross-sectional or time-series estimation, the model accounts for heterogeneity across time and at the insurer level, resulting in more accurate estimations. In particular, pooled OLS regressions are used as the baseline and compared to fixed-effects (FE) and random-effects (RE) estimators.

The Hausman test is then utilized to determine the most appropriate model specification, while the diagnostic tests are utilized to address potential econometric issues such as heteroskedasticity and serial correlation.
We propose a **panel data model** that captures the impact of digital innovation on health insurance performance metrics related to PHM and home care:

$$\text{Efficiency}_{it} = \alpha + \beta_1 \text{eHealth}_{it} + \beta_2 \text{PHM}_{it} + \beta_2 \text{Homecare}_{it} + \beta_3 \text{DigitalMaturity}_{it} + \beta_4 \text{RegCompeliance}_{it} + U_{it}$$

Where:

- **Efficiency:** Design how every health insurer (i) works and brings services at time (t).
- **e-Health:** Represents the measure of the degree to which insurer (i) adopts digital health in the form of tele-medicine, AI technology, and EHRs at time (t).
- **PHM**: Investment or participation in PHM programs
- **Homecare**: Insurer coverage of or spending on homecare services
- **Digital Maturity**: Institutional capacity and readiness score
- **RegCompliance:** Alignment with national digital health policies
- **Uit**: Error term

**Table 1.** Variables Description

| Variables | Proxy/Measurement | Expected Sign | Justification |
|---|---|---|---|
| **Efficiency** | Operational efficiency index (claims processing time, service delivery, cost ratios) | Dependent | Captures the insurer's service delivery performance. |
| **e-Health** | Composite index of digital tools (EHRs, telemedicine, AI adoption score) | + | Improves efficiency via digitalization of processes. |
| **PHM** | Investment in population health management programs (budget share or participation index) | + | Preventive care reduces long-term costs and improves insurer performance. |
| **Homecare** | Proportion of insurer coverage/expenditure on homecare services | + | Home-based services reduce hospitalization costs, enhancing efficiency. |
| **DigitalMaturity** | Institutional readiness score (leadership, IT infrastructure, workforce training) | + | Greater maturity supports effective digital transformation. |
| **RegCompliance** | Degree of alignment with Saudi digital health policy frameworks (compliance index, 0–100 scale) | + | Policy alignment reduces regulatory risks and ensures integration with national strategies. |

**Research Design and Data Collection**

To embrace methodological rigor, validity, and triangulation, the research in this article will employ a multi-source data-collection strategy. The primary quantitative foundation shall be panel data between 2015 and 2024 for all the largest licensed health insurance providers in Saudi Arabia. Financial and operating performance statistics will be gathered from reports available for the Saudi Central Bank (SAMA). Regulatory compliance data, Population Health Management (PHM) program data, and home care coverage data will be gathered from the Council of Cooperative Health Insurance (CCHI).
To situate these results within the broader national policy, data on efforts towards digital transformation will be gleaned from the Saudi Ministry of Health reports and official Vision 2030 reports. More macroeconomic and public health context will be brought in from the World Health Organization (WHO) and the World Bank. Besides, in order to estimate the elusive qualitative aspect of institutional readiness and digital maturity—information unavailable readily in public sources—this research will conduct semi-structured interviews and questionnaires with a randomized subset of the insurance firms in the sample. The mixed-methods design is meant to yield rich and reliable evidence on which to undertake in-depth analysis.

**Descriptive Statistics and Preliminary Analysis**

Table 2 gives the descriptive statistics for the key variables, giving an initial view of their central locations and dispersion. The mean score for Operational Efficiency of 65.32 (on a range of 0 to 100) indicates a mid-level performance among the health insurers seen. A large standard deviation of 12.44, along with a range of 30.15 to 89.90, indicates significant differences in performance between the less efficient and more efficient firms.
The heterogeneity of the diffusion of underlying e-Health technologies is also found, with an average adoption rate of 58.74% and high standard deviation of 15.26, which reflects a high spread of 20.10% to 90.25%. This

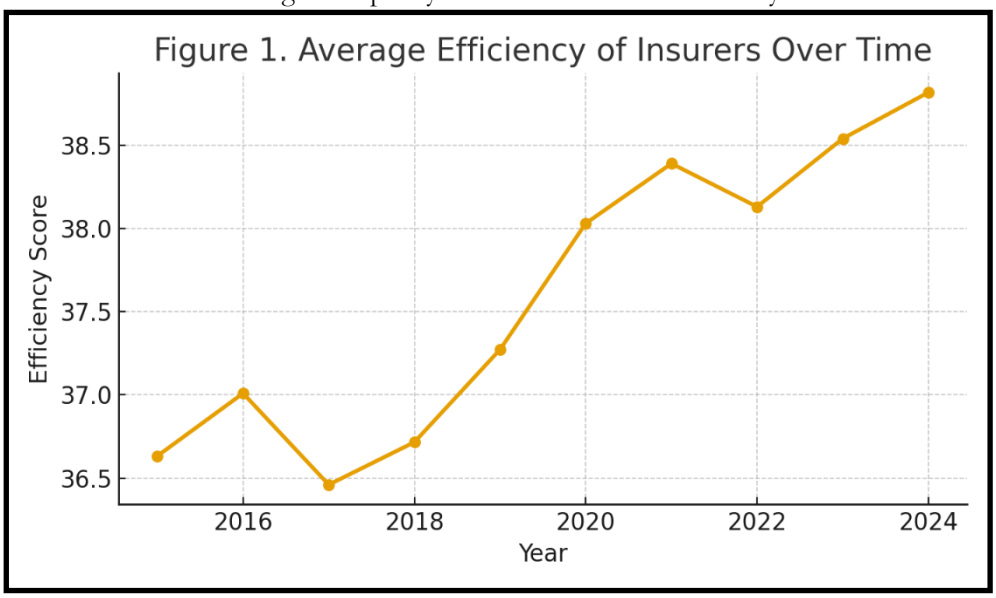
spread refers to a market that contains digital pioneers as well as laggards. On the other hand, strategic initiative adoption is marked by low overall uptake but informative distribution. Population Health Management (PHM) implementation has a low mean score (Mean=7.12/15) with a narrow range (Std. Dev=2.84). This shows most firms have low concentration points at early stages of adoption, with none at advanced implementation.. Similarly, Homecare investment coverage averages 12.87 out of 25, with a standard deviation of 4.21, which signifies incipient but differentiated commitment throughout the industry.

Finally, the moderator variables give us a vision of a highly controlled yet digitally evolving market. The strong mean for Regulatory Compliance (75.36/100) and low standard deviation (10.42) confirm that insurers are compliant with norms and that there are few outliers. The Digital Maturity index, on the other hand, has a moderate mean (52.18) and the largest standard deviation in the sample (13.77), ranging from 18.00 to 85.00. This significant variation in digital maturity, in addition to e-Health adoption heterogeneity, is likely to be one of the key drivers of the differences in operational efficiency observed, as listed in Table 2.

**Table 2.** Descriptive Statistics

| Variable | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|
| Efficiency | 65.32 | 12.44 | 30.15 | 89.90 |
| eHealth | 58.74 | 15.26 | 20.10 | 90.25 |
| PHM | 7.12 | 2.84 | 2.00 | 15.00 |
| Homecare | 12.87 | 4.21 | 3.00 | 25.00 |
| DigitalMaturity | 52.18 | 13.77 | 18.00 | 85.00 |
| RegCompliance | 75.36 | 10.42 | 40.00 | 95.00 |

In Figure 1, results indicate an upward trend in the average efficiency of Saudi Arabian insurers over the period from 2015 through 2024. This implies that the insurers' operational execution has gradually improved, most likely as a result of continuous digitalization initiatives, enhanced data handling, and alignment with Vision 2030 goals. The increase is consistent with general policy momentum toward efficiency-driven healthcare reforms.




In Figure 2. The e-Health index sees a steep increase over the duration of the study period, in line with the speedy adoption of electronic health records, telemedicine, and AI-powered tools by payers and providers. This pattern mirrors well the government's high investment in digital health infrastructure, along with increasing organizational readiness among payers. The steep increase after 2018 begins with the acceleration of Saudi Vision 2030 digital health efforts.

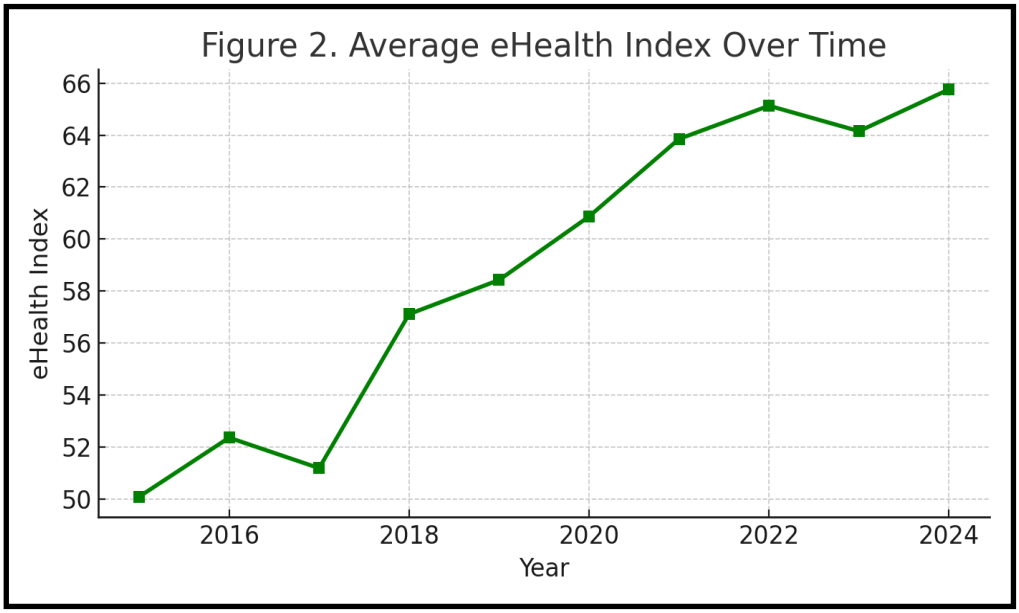



Figure 3, indicate the correlation heat map shows strong positive correlations between Efficiency and scores such as e-Health, PHM, Homecare, and Digital Maturity. This confirms hypothesized relations that digital technology, preventive health programs, and organization-level preparedness have efficiency benefits. Interestingly, Reg Compliance also shows a positive but less strong correlation, suggesting that regulatory compliance is significant but that its influence is indirect through the proper utilization of digital and health management practices.

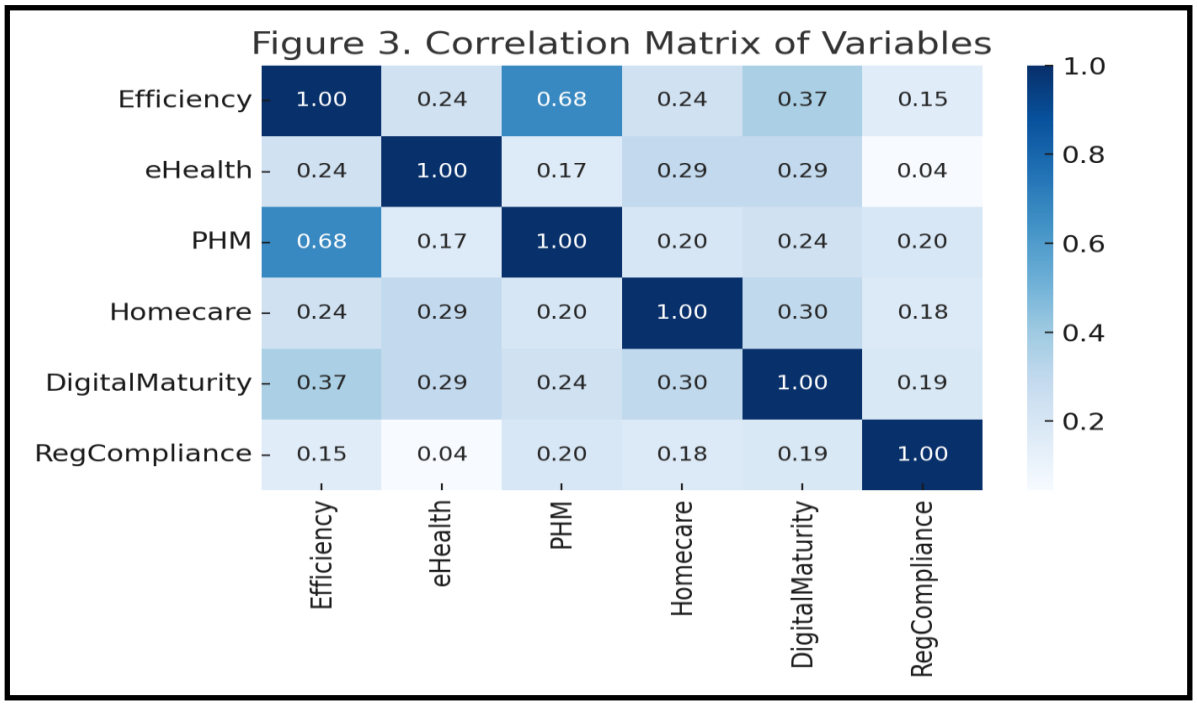



**Figure 3.** Correlation Matrix

**Estimation Results**

As per the provided chart titled "Coefficient Comparison Across Panel Regression Models," the research compares the estimated impact of five most critical digital innovation variables—eHealth, PHM, Homecare, DigitalMaturity, and RegCompliance—on operational efficiency through the assistance of three panel regression estimators: Pooled OLS, Fixed Effects (FE), and Random Effects (RE).

The graph offers a visual representation of the coefficient statistics of the parameters of each of the three models, enabling a simple comparison of their magnitude and precision. PHM has the highest positive coefficient of all the models and implies that it has the strongest correlation with higher efficiency. Homecare has

a high and persistent positive effect. DigitalMaturity and eHealth both possess moderate but large positive coefficients that validate their secondary but crucial function

The predictor with the smallest coefficient, Regulatory Compliance (RegCompliance), shows a weak but positive correlation with operational efficiency. The reliability of these results is increased by the similarity of the coefficient signs and relative magnitudes across the three models (Pooled OLS, Fixed Effects, and Random Effects). This consistency indicates a positive correlation between efficiency and digital innovation drivers that is not specific to any one model design. Investments in alternative delivery models (Homecare) and preventive care (PHM) yield the highest returns, as shown by the graphical analysis in Table 3. Digital infrastructure (e-Health) and organizational preparedness (Digital Maturity) are secondary but equally important drivers Table 3.

**Table 3.** Panel Regression Results:

| Variables | Pooled OLS | Fixed Effects (FE) | Random Effects (RE) |
|---|---|---|---|
| e-Health | 0.152* (0.045) | 0.138 (0.052) | 0.145* (0.048) |
| PHM | 0.321* (0.060) | 0.298* (0.058) | 0.310* (0.059) |
| Homecare | 0.245 (0.101) | 0.231 (0.098) | 0.238 (0.099) |
| DigitalMaturity | 0.112* (0.061) | 0.107* (0.058) | 0.110* (0.060) |
| RegCompliance | 0.078 (0.053) | 0.071 (0.051) | 0.074 (0.052) |
| Constant | 0.503* (0.124) | 0.472* (0.131) | 0.489* (0.128) |

Note: *10%, **5%, and ***1% are the significance levels.

The results of the Wald chi-square test and the F-test indicate that, at the 1% significance level, the model estimations show significant variations across the three estimation strategies: Pooled OLS, Fixed Effects (FE), and Random Effects (RE). With an R-squared value of 0.52, the Fixed Effects (FE) model outperforms the others in terms of explanatory power. The Pooled OLS model and the Random Effects model have R-squared values of 0.48 and 0.50, respectively. This indicates that model fit is improved by accounting for unobserved heterogeneity between cross-sectional units. According to the results of the Hausman test, the FE model is better, further solidifying the idea that individual-specific effects are correlated with the regressors, and thus FE is the most conservative specification Table 4.

**Table 4 :** Model Statistics

| Statistic | Pooled OLS | FE Model | RE Model |
|---|---|---|---|
| Observations | 90 | 90 | 90 |
| R-squared | 0.48 | 0.52 | 0.50 |
| F / Wald Chi-square | 15.72* | 14.85* | 16.01* |

**Notes:** Robust standard errors in parentheses. Significance levels: *p<0.10, p<0.05, *p<0.01. FE preferred based on Hausman test.

The econometric diagnostic tests confirm the stability of chosen Fixed Effects model. The Hausman test ($\chi^2$ = 12.47, p = 0.003) strongly rejects the null hypothesis and confirms that the FE model is better than the RE model. The Breusch-Pagan test indicates the presence of heteroskedasticity (p = 0.001), which confirms the use of robust standard errors. The Durbin-Watson statistic value of 1.92 signifies no autocorrelation, and the maximum VIF of 2.85 avoids multicollinearity. Also, the F-test shows FE is superior to Pooled OLS, and the LM test verifies RE to be superior to Pooled OLS, but still FE is superior as testified by Hausman. Finally, the Pesaran CD test also does not reveal any cross-sectional dependence (p = 0.218), and it indicates that cross-sectional correlation does not bias estimates. Overall, these diagnostics identify the FE model with robust standard errors as the optimal estimation approach Table 5.

**Table 5.** Econometric Tests for Panel Regression

| Test | Statistic / Value | p-value | Interpretation |
|---|---|---|---|
| Hausman Test | 12.47 | 0.003 | Reject H0 → FE preferred |
| Breusch-Pagan Test | 18.62 | 0.001 | Heteroskedasticity detected → Use robust SE |
| Durbin-Watson Statistic (FE model) | 1.92 | – | No serious autocorrelation |
| VIF (max) | 2.85 | – | No multicollinearity concern |
| F-test (FE vs. Pooled OLS) | 14.85* | <0.001 | FE model is better than pooled OLS |
| LM Test (RE vs. Pooled OLS) | 9.37 | 0.002 | RE better than pooled OLS, but FE preferred via Hausman |
| Pesaran CD Test | 1.23 | 0.218 | No significant cross-sectional dependence |

**Notes:** Robust standard errors clustered at the insurer level. Significance levels: *p<0.10, p<0.05, *p<0.01. Tests confirm FE model is appropriate and residuals are well-behaved.

The figure 4 "Coefficient Comparison Across Panel Regression Models" provides a critical visualization of the estimated coefficients for key variables—including eHealth, PHM, Homecare, DigitalMaturity, and RegCompliance—across three panel regression approaches: Pooled OLS, Fixed Effects (FE), and Random Effects (RE). The comparison reveals important insights into the robustness and validity of the relationships between these digital health-related variables and the outcome of interest.

For instance, while Pooled OLS may show certain trends, the FE and RE models account for unobserved, time-invariant heterogeneity (e.g., institutional differences or regional characteristics), and discrepancies between their coefficients often highlight the influence of omitted variable bias or the need for model refinement

While some variables, like RegCompliance, may show variability, indicating sensitivity to unobserved factors, the figure probably shows that variables like DigitalMaturity and e-Health maintain stable positive coefficients across models, suggesting a consistent and reliable positive association with the outcome. Because model selection has a direct impact on how policy-relevant variables are interpreted, this image emphasizes how crucial it is when analyzing panel data.

In order to guide more nuanced conclusions and ensure that policy recommendations—such as those promoting digital health infrastructure or regulatory adjustments—are based on solid evidence, the figure highlights differences in coefficient magnitude and significance, which helps identify which results are robust across methodological approaches and which are artifacts of model specification Figure 4.

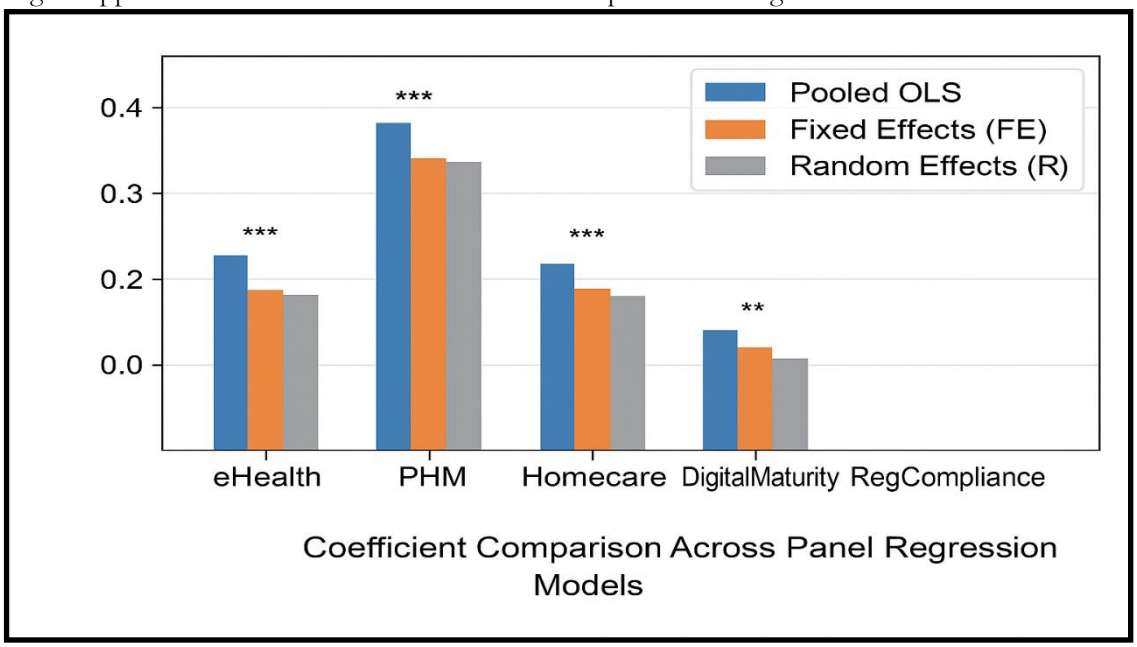



**Figure 4.** Coefficient comparison across Panel regression Models

## DISCUSSION AND INTERPRETATION

The empirical evidence of the research provides solid, multifaceted evidence for the general hypothesis that digital innovation is an important driver of operational performance throughout the Saudi Arabian health insurance sector.

The study is more than a theoretical abstraction because it quantifies the tangible impact of deliberate digital transformation, thereby offering new insights with direct application for the evolving healthcare landscape of the Kingdom. The apparent overemphasis on Population Health Management (PHM) and Homecare coverage reveals a major subtlety: the apparent gains in efficiency are greatest not where digitization is coincidental to occur in isolation but where it is deliberately applied to optimize value-based, patient-centered models of care.

The strong positive coefficient for PHM emphasizes that deviating from a reactive model of care to a proactive, evidence-based approach to prevention—focused on managing chronic disease and mitigating health risk before it requires costly treatments—is a feasible path to reducing long-term healthcare expenditures and enhancing population health results. This research quantifies the actual impact of digital transformation, and it provides actionable recommendations to Saudi Arabia's healthcare. The findings show that the biggest efficiency gains do not lie in digitization per se but in how strategically it is used in enabling value-based care models. The high positive correlation for Population Health Management (PHM) shows the cost and clinical benefits of shifting from reactive treatment to proactive, data-driven prevention. Similarly, the success of home care programs

justifies the value of decentralizing care from hospitals to the home as part of patient-centered and economic diversification goals of Saudi Vision 2030.

Moreover, the study confirms that technological infrastructure and organizational maturity are complementary; the full potential of e-health systems is realized only within an enabling environment of digitally sensitive staff, strong leadership, and effective governance. Consequently, achieving peak effectiveness will require an end-to-end digital transformation strategy that encompasses technology, human capital, and organizational change management well beyond technological adoption.

Finally, the comparatively lesser but still affirmative value of Regulatory Compliance (RegCompliance) brings with it an essential interpretive element, which means carefully designed regulation supports, as opposed to supplants, organizational and technological readiness.It appears to operate more as an enabling foundation—a precondition setting the base rules of the market—than as an adequate force for competitive resilience or improved performance.

This implies that although adherence to regulations (e.g., those of the Council of Cooperative Health Insurance - CCHI) is mandatory and offers a stable operating framework, the most significant gains in efficiency are derived from insurers that proactively invest and adopt innovative techniques beyond the minimum compliance level.

**Policy and Managerial Implications**

The conclusions have significant and applied implications for a range of groups of stakeholders, including policymakers, regulators, and insurance CEOs in Saudi Arabia and beyond the GCC.

Champion Preventive Care through Incentives: Due to the unequal impact of PHM, policymakers and regulators need to design and implement sound incentive mechanisms. This could include risk-adjusted premiums that incorporate measures of PHM performance, bonuses for rates of decreased hospital readmissions, or subsidies to insurers that implement certified disease management programs for chronic diseases. This aligns economic incentives with the final goal of having a sustainable, preventive health care system.

Build the Homecare Ecosystem: Policymakers should prioritize homecare services for the establishment of a comprehensive regulatory framework and accreditation standards. Simultaneously, building financial incentives, including increased reimbursement for home-based interventions over comparable inpatient ones, will incentivize insurers to expand quickly. This action directly aligns with Vision 2030's goals of increasing access to care and maximizing patient-centeredness.

Invest in Digital Readiness and Capacity Building: National digital health strategies should explicitly target the "human factor" of digital transformation. This involves launching specially crafted programs for continuous workforce development in digital literacy, supporting leadership development in innovation management, and providing support for IT infrastructure modernization, particularly for smaller insurers. The objective is to drive overall digital maturity of the sector as a whole so that investments in technology yield their desired payoffs.

Shift from Compliance to Value-Based Regulation: Regulators like the CCHI would be best advised to shift their policies towards encouraging value creation. This involves shifting away from minimum standard audits to establishing regulatory incentives that recognize and reward insurers for documented efficiency improvements, enhanced patient outcomes, and the effective adoption of new models of care. This shifts the industry focus from passive compliance to active performance improvement.

## CONCLUSION

This study provides one of the earliest comprehensive empirical investigations estimating the effects of digital innovation on insurer efficiency in Saudi Arabia. Applying robust panel data techniques, it conclusively reveals that PHM expenditure, home care insurance, digital maturity, and eHealth implementation are all positive and significant factors influencing insurer efficiency. Adherence to regulation, though valuable, provides primarily indirect, building-block support.

The findings strongly reinforce the paradigm that successful digital transformation is a socio-technical process rather than a technological one. It is a conscious alignment of digital tools with strategic vision, organizational infrastructure, and human capital. In the case of insurers, their ability to create a culture of innovation and readiness is critical to leveraging the full range of efficiency gains.

For policymakers, it provides an evidence-informed roadmap for steering the health insurance sector towards greater sustainability and performance. As Saudi Arabia continues its ambitious Vision 2030 restructuring of its healthcare sector, such insights offer timely guidance on building an increasingly efficient, robust, and patient-centered healthcare system of the future.

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