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Technology Innovation and Healthcare Performance among Healthcare Organizations in Saudi Arabia: A Structural Equation Model Analysis

Yusuf O. Akinwale [1,*] and Hoda M. AboAlsamh [2]

[1] Economics Department, College of Business Administration, Imam Abdulrahman Bin Faisal University, Dammam 31441, Saudi Arabia
[2] Department of Management, College of Business Administration, Imam Abdulrahman Bin Faisal University, Dammam 31441, Saudi Arabia
* Correspondence: yemiiakinwale@yahoo.com or yoakinwale@iau.edu.sa

Abstract: The number of people in need of healthcare is increasing over time despite the limited resources available in each country; hence, access to healthcare, quality of healthcare, and cost of healthcare remain contemporary global issues. The limitations of travel and access to healthcare during the global pandemic (COVID-19) have triggered the further search for improved and sustainable healthcare services through technology innovation and digital transformation in the healthcare sector. This study examines the impact of technology innovation on healthcare performance among 241 healthcare organizations in Saudi Arabia. The study utilizes the structural equation model (SEM) method to unravel the nature of technology innovation and its influence on healthcare performance. The results of SEM reveal that innovation efforts, in terms of R&D, training, and the acquisition of new software and acquisition of new medical machinery/equipment, have a significant influence on technology innovation and healthcare performance. Furthermore, the results further indicate that technology innovations measured by mobile technology, digitalization of health records, telehealth/telemedicine and artificial intelligence have great likelihood and significant influence on healthcare performance among the healthcare organizations surveyed. This implies that continuous innovative efforts and spending on various technology innovations would further improve the efficiency and quality of healthcare service which give a competitive advantage to healthcare organizations in Saudi Arabia. Hence, innovation which encompasses all stakeholders should be continuously reinforced in Saudi Arabia's health policy as this would further strengthen healthcare performance.

Keywords: healthcare performance; technology innovation; innovation efforts; healthcare organizations; structural equation model; Saudi Arabia

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1. Introduction

The fatality in terms of health and economics that resulted from COVID-19 cannot be fully estimated at both micro and macroeconomics levels. The COVID-19 pandemic caught the world by surprise, leading to the loss of lives and the collapse of businesses in both developed and developing countries. The healthcare systems in various countries, including the most developed countries such as the USA and the UK, among others, were stretched beyond their capacities during the peak of COVID-19. When such happened, then a lot of rationing and allocation strategies were deployed [1,2]. Apart from coronavirus, there are so many diseases that have claimed the lives of people, and many are still claiming people's lives, including heart attacks, diabetes, malaria, Ebola, and strokes, among others. This indicates that coronavirus will not be the last disease to disrupt the world if much more attention is not devoted to healthcare sector. The economic consequence of the pandemic ensued in unprecedented unemployment levels, which significantly impaired the mental wellbeing of people [3,4]. However, the COVID-19 pandemic has also brought forth technological advancement to all spheres of life in dramatic ways which were never thought of in the last few decades. The advantages of some of the recently developed technology innovations have cut across nearly all aspects of human life. Technology innovation has also lowered the carbon emission associated with physical travel by roads, rail, or air, resulting in a sustainable environment, as the carbon footprint is greatly reduced [5]. Hence, the healthcare sector is one of the sectors that is undoubtedly affected by the pace of growth in technological innovations. Although the extent of adoption of information technology growth was slower, as some medical practitioners believed that this could affect their closeness to patients, cause a loss of their autonomy, and possibly be too high-cost relative to the benefit [6,7], the period of COVID-19 has changed the perception of some of these medical practitioners.

Technology innovation could play a vital role in periods of major economic and health crises [8]. Innovations in healthcare could arise from providing new products/services or improving existing healthcare products/services through new technologies [9]. It is anticipated that this technological innovation would result in better health outcomes, higher quality of care, and enhanced efficiency which would be favorable to both the patients and the healthcare organizations [10]. In periods of health crises such as COVID-19, health institutions utilize different methods to precisely evaluate the event and take action to contain it [11]. A good example is BeiDou, which is a technological application used in China to track COVID-19 patients and affected areas, hence reducing the spread of the virus. This is also similar to the Tawakalna application used in Saudi Arabia to detect, track, and analyze coronavirus diseases among the residents. These are offshoots of digital transformation and innovation, which further signaled that digital transformation in health is no longer debatable like other sectors, though its adoption and utilization have not been seamless [12]. These technological innovations include location detection technologies, blockchain, artificial intelligence, big data analytics, Information and Communication Technology (ICT), Internet of Things (IoT), and autonomous robots, among others, which improve the productivity and performance of an organization [13]. The application of these technological innovations is not limited to the information technology industry or universities but cuts across various sectors of the economy, including the health sector [14]. The permeation of technology innovation into healthcare continues to impact the role of physicians', nurses', and healthcare practitioners' efficiency in healthcare delivery [15,16]. Effective technology innovation is required for the success of healthcare organizations in the current dynamic environment; however, it has some associated costs attached to it. Moreso, there has been a huge rise in healthcare costs, medical staff burnout due to labor shortages, and long hospital stays for patients awaiting treatment [17]. The current focus on cost-reduction of healthcare while maintaining the quality of the healthcare remains the main goal for technology innovation in the healthcare sector [18]. The aim of this study is to assess the nature of technology innovation that is being implemented among healthcare organizations in Saudi Arabia, as well as the effects on healthcare performance.

There is a myriad of studies on innovation and healthcare performance in developed countries [19–22], but there is a dearth of research study that reveals the relationship between innovation efforts, technology innovation, and healthcare performance in the Gulf countries and specifically in Saudi Arabia. The study administered a survey instrument on senior health practitioners across 241 healthcare organizations between July 2021 and March 2022. This study hypothesized that:

Hypothesis 1. *Innovation effort has a direct significant influence on technology innovation.*

Hypothesis 2. *Innovation effort has a direct and significant influence on healthcare performance.*

Hypothesis 3. *Technology innovation has a direct and significant influence on healthcare performance.*

Hypothesis 4. *Innovation effort has an indirect and significant influence on healthcare performance through technology innovation.*

Hypothesis 5. *Innovation effort has a significant total influence on healthcare performance.*

The Structural Equation Model (SEM) was adopted in analyzing the results so as to unravel the relationship between innovation and healthcare performance in Saudi Arabia; hence, appropriate managerial and policy implications as well as recommendations are made. The manuscript is divided into five sections as follows: Sections 1–3 discuss the introduction, literature, and methodology, and Sections 4 and 5 present the results and conclusion of the study.

2. Literature Review

This section presents a brief of healthcare sector in Saudi Arabia, the theoretical framework for the study, the empirical review of technology innovation and organizational performance in general and in particular to the health sector.

2.1. Brief Overview of the Healthcare Sector in Saudi Arabia

Similar to some other high-income countries, Saudi Arabia is experiencing a growing and aging population and increasing life expectancy that seems to expand healthcare needs and definitely increase healthcare costs [23]. In addition to this, there is an increase in a range of chronic non-communicable lifestyle-related diseases, such as diabetes, hypertension, and cardiovascular disease, in the country, which made the Saudi government include healthy lifestyles and a sustainable environment in the country's Vision 2030. In light of the global health systems' development, the health transformation program launched in Saudi Arabia in 2021 focuses on improving the quality and efficiency of health services through concentration on digitizing the health sector and initiating various technology innovation applications [24].

Health and social development accounted for the third-largest government expenditure by sector in the Saudi Arabia budget in the last five years, and the current budget expenditure for health in 2021 is 175 billion riyal (approximately 46.7 billion US dollars) as against 167 billion riyal (approximately 44.5 billion US dollars) in 2020 [25]. The total number of hospital and hospital beds has increased gradually over the years and stood at 504 and 78,596, respectively, as of 2020. Meanwhile, the total number of healthcare centers run by the Ministry of Health and private dispensaries stood at 5262 in 2020 compared to 4952 in 2015 [25]. Furthermore, the total number of physicians, nursing staff, and pharmacists stood at 114,958, 196,701, and 27,529 respectively in 2020 compared to 70,337, 137,364, and 21,492 in 2015, respectively. The increased budget expenditure on health and social development is not only for increasing the number of hospitals, physicians, nurses, and other health practitioners but also for increasing research and technology innovations that could improve healthcare performance. Much more attention is being given to the adoption of innovations in the Saudi health sector in the recent period [8]. Moreover, proper deployment of technology innovation is expected to improve patient care, staff productivity, and operational efficiency.

2.2. Theoretical and Empirical Literature

The Resource-based view (RBV) theory which is the underpinning theory of this research lays an emphasis on the importance of the resources which an organization possesses and the impact on its performance [26,27]. The RBV theory avers that both the physical and intangible resources of an organization provide such an organization with dynamic capabilities that enable it to achieve a competitive advantage, resulting in superior long-term performance [28–31]. Dynamic capability is a central pathway through which organizations utilize their resources to enable them to survive in any turbulent and competitive environments. The organizational resources include all assets owned by the organization, including the processes, dynamic capabilities, attributes, information, and knowledge that the organization uses to conceive ideas and implement its strategies in order to bolster its efficiency and performance [32]. There is a correlation between the

RBV, technological innovation, and effective performance of an organization [2,33–35]. The role that technological innovation capability has played as one of the core resources of an organization in fostering performance cannot be underestimated. Technology innovation continues to occupy a central position in developing the quality of healthcare and reduction of costs by enabling efficiency and competitiveness in healthcare organizations [9]. Developing innovation capabilities within healthcare organizations ensures the sustainability of the healthcare systems, which has ripple effects in the health sector [19,36,37].

There are some empirical studies that have shown the impact of technology innovation on performance. For instance, Sinha et al. [38] found, in their research carried out in India among large, medium, and small organizations, that technology innovation has a great influence on organizational performance, though it has a greater influence on larger ones than smaller ones. The outcome of the study [39] also revealed the impact of technology innovation among the SMEs in Kenya. Cahn et al. [40], in their study carried out among the manufacturing organization in Vietnam, further confirmed the significant influence of technology innovation on performance. Other studies also affirmed the impact of technology innovation on organizational performance in differing sectors, such as manufacturing, service, food and beverage, insurance, automobile, and information technology, among others [33,41–47]. However, there are few other studies that could not establish a significant impact of technology innovation on performance [48,49].

Specifically, in the health sector, a few other related studies have also been conducted on the relationship between technology innovation and performance. A study conducted among 184 Lithuanian and Spanish physicians revealed a positive and significant indirect effect of open innovation on clinical service and economic valuation [50]. Additionally, research conducted in Italy found that technology innovation, human resources, and work organizations significantly contribute to the diffusion of telemedicine services which improve health service delivery [36]. Another study was conducted in Italy using a Triple Helix Model in the Italian innovation ecosystem, and the results revealed that technological capability propels the use of artificial intelligence among General Practitioners (GPs) in the health sector, which then improves their healthcare service delivery [19]. Bellucci [17] also highlighted the significant impact of disruptive innovation (artificial intelligence and clinical decision support system) on patients' health information. Meanwhile, the study noted the challenges of implementing disruptive innovation, which include the high cost of implementation and the risk of data breaches/cybersecurity, and these could be resolved by implementing sound government regulations in health care and extensively training medical practitioners and other healthcare staff on new technologies. The review conducted in the United States by Ref. [22] indicates that technology innovation has the long-term positive effects of reducing healthcare costs and improving healthcare services. Dias et al. [2] conducted a study on big data utilization and healthcare performance in Malaysian government hospitals. The results revealed that virtually all the variables that measured big data have a significant impact on hospital performance. A study [51] explored the relationship between supply chain innovation (proxied by technology innovation and process innovation) and healthcare performance in Malaysia using structural equation modeling. The result revealed that technology and process innovations have a direct and significant influence on healthcare performance. This indicates that supply chain innovation would provide a competitive advantage for the hospital through an improved information system, quality improvement, and value addition, leading to better hospital performance in the healthcare industry in Malaysia. Studies conducted in India also reflected that supply chain innovation [52] and artificial intelligent-enabled systems [53] have improved the healthcare performance of healthcare firms.

Similarly, Lee et al. [54], in their study conducted in the Korean healthcare industry, found that supply chain innovation has a positive influence on hospital performance. Another study [9] assessed the influence of the acquisition of relevant medical technology and information technology on the efficiency of hospital wards in Dubai. The results, using regression analysis, revealed that the acquisition of medical technology and information technology have a positive influence on hospital performance, though moderated by few other organizational and managerial factors. However, there are other studies that have also established the negative influence of technology innovation on healthcare service delivery, such as the threat to patients' data privacy, adverse impacts on patients' care, medical liability concerns, and lack of adequate infrastructure and training, among others [6,7,55–58]. While there are studies that recorded the positive influence of technology innovation on healthcare organization performance, few other studies could not establish any positive influence, and some even found a negative influence of technology innovation on performance in healthcare organizations [59,60].

There are differing results across countries from past studies, which indicate the inconclusiveness of research outcomes on this topic, so it would be wrong to assume a positive relationship between technology innovation and healthcare performance in all countries, as posited by the theory. This is because the empirical findings from the real-world study could differ from the theory due to the peculiarities of each country. Furthermore, empirical studies on this topic in the health sector are underexplored in Saudi Arabia. Hence, this study assesses the impact of innovation efforts and technology innovation on healthcare performance in Saudi Arabia.

3. Methodology

This section provides information relating to the variables, their measurements and the technique used for analyzing this research study. The study is based on the conceptual framework in Figure 1. It is believed from the literature that innovation efforts of health organization could lead to technology innovation. Afterwards, technology innovation could foster the healthcare performance in such healthcare organization. In addition to this, there is a possibility that innovation efforts could directly influence organizational performance.

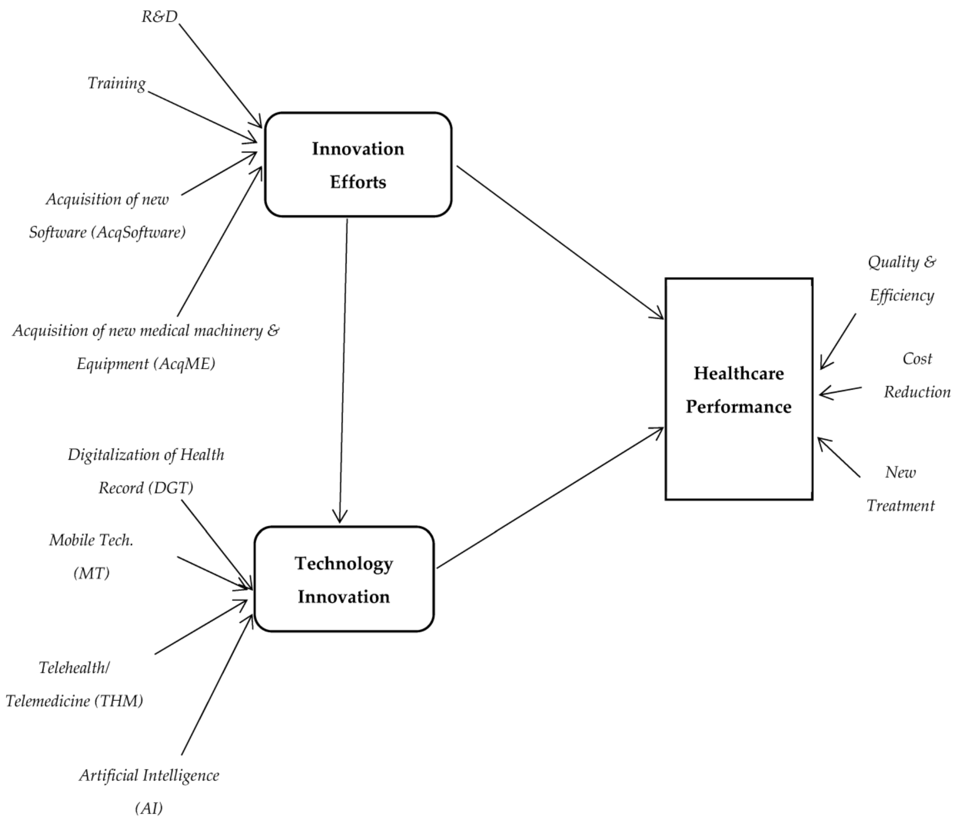

Figure 1. Conceptual Framework of Health Technology Innovation and Healthcare Performance.

The study was conducted among the health practitioners at both public and private health organizations (hospitals, clinics, physicians, dentists, optometrists, school health clinics and any organizations that provide clinical care) in Saudi Arabia through their online email contacts, contacts of an employee in such organizations, and some referrals from contact in Ministry of Health. A questionnaire was developed in line with a standardized questionnaire for technology innovation [61]. This was validated through a pilot survey by sending three copies of questionnaire each to academics in colleges of health sciences and business, as well medical practitioners. This is to ensure that the questions are measuring what they are supposed to measure and that they are properly written to avoid misinterpretation. After incorporating the necessary suggestions from the pilot study, a set of questionnaires was distributed to the health practitioners through an online platform and emails using a simple random sampling technique. The questionnaire elicits information relating to the innovation efforts in the respondents' departments/units, information relating to technology innovation used since the beginning of COVID-19 until date of the survey and the healthcare performance in the respondents' organizations. The survey spanned from the third quarter of 2021 to the first quarter of 2022. The number of observations expected for the unknown population size is based on Cochran [62] with 95% confidence level, amounting to 385, but only 241 healthcare organizations responded, resulting in a response rate of 62.5%.

3.1. Variable Measurements

The measurement of the variables is classified into three factors, viz: innovation efforts, technology innovation, and healthcare performance.

3.1.1. Innovation Efforts

Innovation efforts are the activities and actions embarked upon to generate technology innovation. Accordingly, innovation efforts in healthcare organizations surveyed are proxied by four main variables, namely internal research and development (*R&D*), training received by the health employees (*TR*), acquisition of new software (*AcqSoft*), and acquisition of new medical machinery and equipment (*AcqME*). The research instrument required the health practitioners to rate the extent to which their departments and/or organization engage in any of the aforementioned innovation activities since the beginning of COVID-19. The response is ranked on 5-Likert scale from 1 (very low extent/rarely) to 5 (very high extent/very often).

3.1.2. Technology Innovation

Technology innovation in this study relates to providing new healthcare services and/or products through new ways of using information technologies or improving the existing ones rather than core medical technologies use during drug production or surgery. In this study, technology innovation in healthcare is proxied by four variables, namely digitalization of patients' health records (*DGT*), utilization of telehealth/telemedicine such as video consultation (*THM*), utilization of mobile technology in the delivery of healthcare products to patients (*MT*), and utilization of artificial intelligence-powered systems/tools to perform precision medicine and detection of disease (*AI*). The questionnaire enquired from the health practitioners on the extent to which they utilize the aforementioned technology innovations in their organizations since the beginning of COVID-19. Their responses are also categorized into 5-Likert scale with 1 being the lowest and 5 being the highest.

3.1.3. Healthcare Performance

The organizational performance, otherwise known as healthcare performance (*HP*) in this case, refers to the efficiency and quality of healthcare for the patients (*E/Q*), development of new treatment/drug for the patients (*NTD*), and the cost reduction (*Cost_R*) for the healthcare [9]. The survey instrument probed the respondents on the extent to which their organizations were able to improve the efficiency and quality of healthcare provided to their patients, the extent of developing new treatments/drugs for the patients, as well as the extent to which they reduced costs due to technology innovation since the beginning of COVID-19. These are also measured on 5-Likert scale from 1 (rarely) to 5 (very often).

3.2. Method

The study deploys quantitative method of analysis with the use of correlation technique and structural equation model (SEM). Correlation technique depicts the direction and strength of relationship between innovation efforts, technology innovation, and healthcare performance using SPSS statistical package. The relationship between each of these variables could be negative or positive in direction, as it has a range between −1 and +1, and the value of 0 signifies no relationship. Additionally, the probability value of less than 1% indicates that the relationship between any two variables is considered significant at 1% level. Before conducting SEM, there is a need to examine the validity and reliability of the data. The variables and data are valid, provided that the factor loadings of values are greater than 0.5; average variance extracted (AVE) from each construct is greater than 0.5; and the square roots of the AVE for each construct are greater than the corresponding correlation between the constructs [63]. Meanwhile, the reliability of the data is evaluated using Cronbach's Alpha (α) and the Composite Reliability (CR), and the values are expected to be 0.7 and above for the data to be considered as being reliable [63]. If the data passed validity and reliability tests, then the variables are subjected to SEM in order to determine the structural causality and impact of innovation efforts and technology innovation on healthcare performance.

The study utilizes Structural Equation Modeling (SEM), specifically Partial Least Square method (SMARTPLS 3) program, to examine the relationship between innovation effort, technology innovation, and healthcare performance among healthcare organizations. This method has been described in various other studies [63,64]. This method is applicable to this study, as it presents a structural model that explains the direct, indirect, and total effects of the exogenous variables on the endogenous variables. Meanwhile, a particular endogenous latent variable in one situation could at the same time serve as exogenous variable in another instance in the same model, which differentiates it from regression analysis. This method is also appropriate for a study with relatively small sample size of less than 250 and can resolve non-normality issues in data [65,66].

4. Results and Discussion

The section presents the results of both the descriptive and inferential statistics, as well as a discussion of the results. The total number of responses that were found useful for the purpose of analysis is 241.

4.1. Descriptive Analysis

Table 1 shows that the majority (56%) of the healthcare organizations sampled started operating more than 10 years ago, whereas the least of them (2.9%) started operating within the last two years. This indicates that most of the sampled healthcare organizations are expected to have a full integrated healthcare system since they have been operating for a reasonable length of time. Furthermore, the majority of the healthcare practitioners who responded to the survey are between the ages of 25 and 44 years (78%). This is expected, as the majority of medical staff below 25 years of age are relatively new in the industry, while the majority of those above 60 years old are retired, leaving those between these two age brackets in charge of hospital/clinic management. Table 1 also shows the respondents' perception about the healthcare performance in their organizations in the last two years, including healthcare performance in terms of improvement of the efficiency and quality of care for the patients (EQ), reduction of costs due to technology (Cost-R), and development of new treatment/drug for patients (NTD). While 66% of the respondents assert that quality of care for patients improved on a high level in their healthcare organizations, 61% claim that there was a cost reduction, and 48% of the respondents aver that there was development of new treatment/drug in their healthcare organizations in the last two years.

Table 1. Characteristics of the Healthcare Organizations and Respondents.

Respondent's Characteristics	Freq.	%
Age of the Healthcare Organization (Number of years of establishment)		
Less than 2 years	7	2.9
Between 2 and 5 years	48	19.9
Between 5 and 10 years	51	21.2
Between 10 and 20 years	67	27.8
Above 20 years	68	28.2
Age of the Healthcare Practitioners		
Less than 25 years	24	10.0
25–34 years	113	46.9
35–44 years	76	31.5
45–60 years	24	10.0
Above 60 years	4	1.7
Healthcare Performance		
Efficiency and quality of care for the patients (EQ)	159	66.0
Reduction of cost due to technology (CostR)	148	61.4
Development of new treatment/drug for patients (NTD)	116	48.1

The correlations between healthcare performance, technology innovation, and innovation efforts are presented in Table 2. The correlation matrix shows that there is a positive and significant relationship between healthcare performance and technology innovation (0.43). Additionally, a positive correlation is also established between healthcare performance and the variables measuring innovation efforts, viz: R&D (0.42), training (0.39), acquisition of software (0.42), and acquisition of medical machinery and equipment (0.46). The correlational relationships established between healthcare and all these aforementioned factors are significant at a 1% level. Furthermore, technology innovation is also positively related with all the innovation efforts of the healthcare organizations. However, the correlation between the healthcare performance and age of the organization (−0.06) is negative, very small, and not significant. The same is also observed between age of the organization and technology innovation. This indicates that relatively new healthcare organizations seem to utilize health technology for service delivery better than the old ones.

Table 2. Correlation Analysis.

S/No	Variables	1	2	3	4	5	6	7
1	Healthcare Performance	1						
2	Technology Innovation	0.43 ***	1					
3	Age of Organization	−0.06	−0.02	1				
4	R&D	0.42 ***	0.56 ***	−0.09	1			
5	Training	0.39 ***	0.59 ***	−0.05	0.62 ***	1		
6	Acquisition of Software	0.42 ***	0.63 ***	−0.01	0.60 ***	0.58 ***	1	
7	Acquisition of Machinery & Equipment	0.46 ***	0.63 ***	−0.07	0.61 ***	0.72 ***	0.62 ***	1

*** signifies significant at 1% level.

Since the correlation analysis only reveals the direction of relationship between the variables and does not depict the impact of one variable on the other one, there is a need to conduct a structural model to examine the nature and impact of independent variable (s) on the dependent variable(s).

4.2. Technology Innovation, Innovation Efforts, and Healthcare Performance: SEM Analysis

The results of the structural relationships between innovation efforts (IE), technology innovation (TI), and healthcare performance (HP) using the Partial Least Square (SMART-PLS 3) program are presented and discussed in this section.

The factor loadings, reliability, and validity of the constructs are subjected to tests using different statistics so as to determine the fitness of the data for analysis. Table 3 shows that while one factor (AI) has a load of 0.62, which is termed moderately strong, the remaining 10 factors each have a loading above 0.8 which is termed very strong [67,68]. Since each of these factors is well loaded above 0.5, then there is no need to eliminate any of them, as they pass one of the criteria for convergent validity. Variance Inflation Factor (VIF) is also conducted to ensure that the factors are free from a multicollinearity issue whereby two or more factors are highly related in predicting a construct suggesting the existence of redundant factors [63]. The VIF values below 5.0 and above 0.20 indicate that the factor is not suffering from multicollinearity. Table 3 shows the result of VIF ranges between 1.33 and 2.45, which is below 5.0 and greater than 0.2, signifying the absence of multicollinearity in the model.

Table 3. Factor loadings, Convergent Validity, and Reliability Results.

Factors	Loadings	VIF	AVE	Cronbach Alpha	Composite Reliability
Technology Innovation (TI)			0.615	0.788	0.863
Artificial Intelligence (AI)	0.623	1.33			
Digitalization of Health Record (DGT)	0.819	1.75			
Mobile Technology (MT)	0.834	1.95			
Telehealth/Telemedicine (THM)	0.840	1.93			
Innovation Efforts			0.720	0.870	0.911
Acquisition of new medical machinery and equipment (AcqME)	0.871	2.45			
Acquisition of new Software (AcqSoft)	0.836	1.93			
Research and Development expense (R&D)	0.833	1.98			
Training (TR)	0.853	2.36			
Healthcare Performance			0.715	0.801	0.882
Reduction of cost due to technology (Cost-R)	0.870	2.01			
Efficiency and quality of care for the patients (EQ)	0.811	1.65			
Development of new treatment/drug for patients (NTD)	0.854	1.67			

Furthermore, the convergent validity also requires the average variance extracted from each construct to be above 0.50, and the results in Table 3 indicate that all the constructs have values between 0.62 and 0.72, which surpassed the required threshold of 0.5. In addition to this, the reliability test, which reflects the internal consistency among the factors measuring each construct, requires Cronbach's Alpha (α) and the Composite Reliability (CR) to be above 0.70 to be reliable. The outcomes as shown in Table 3 reveal that Cronbach's Alpha ranges from 0.79 to 0.87 and composite reliability values range from 0.86 to 0.91 for the three constructs in the model. These results indicate that both the factors and the constructs have met the conditions of reliability and convergent validity of the model.

Furthermore, Table 4 presents the outcome of the discriminant validity, which requires the square roots of the AVE for each construct to be greater than the corresponding correlation between the constructs [69,70]. The outcome reflects that the diagonal values (0.845, 0.849, and 0.784), which are the square roots of AVE and are greater than the inter-constructs correlations. This also confirms the presence of discriminant validity.

Table 4. Fornell-Larcker Criterion Discriminant Validity.

Constructs	HP	IE	TI
Healthcare Performance (HP)	**0.845**		
Innovation Efforts (IE)	0.510	**0.849**	
Technology Innovation (TI)	0.483	0.739	**0.784**

Since the data passed reliability and validity tests and are also free from multicollinearity issues, then the structural equation model is further analyzed by evaluating the structural path between the latent variables in the equation as depicted in Figure 2. Hypothesis

1 examined the influence of innovation efforts (IE) on technology innovation (TI) in healthcare organizations. The results show that IE has positive and significant effects on TI with a weight of 0.739 at the 1% level of significance. Hypothesis 2 also reveals that IE has a direct positive influence on healthcare performance (HP) with a coefficient value of 0.34 at a 1% level of significance. This implies that if innovation effort increases by 1 unit, it would lead to the healthcare performance being improved by 0.34 units. Figure 2 also shows the result of hypothesis 3, which reflects a direct positive effect of technology innovation (TI) on HP with a weight of 0.23 at a 5% level of significance. On the other hand, regarding indirect effects, innovation efforts through technology innovation positively impact healthcare performance with a weight of 0.17 at a 5% level of significance. The total (direct and indirect) effect of IE on HP is 0.51 at a 1% level of significance, as shown in Table 5. The coefficients of determination (R^2), which measure the proportion of variations in the endogenous variable explained by the exogenous variables, are 0.547 and 0.285 for TI and HP, respectively, as shown in Figure 2. R^2 values that are greater than 0.26 are considered as substantial, and those above 0.13 but below 0.26 are considered as moderate in SEM [71].

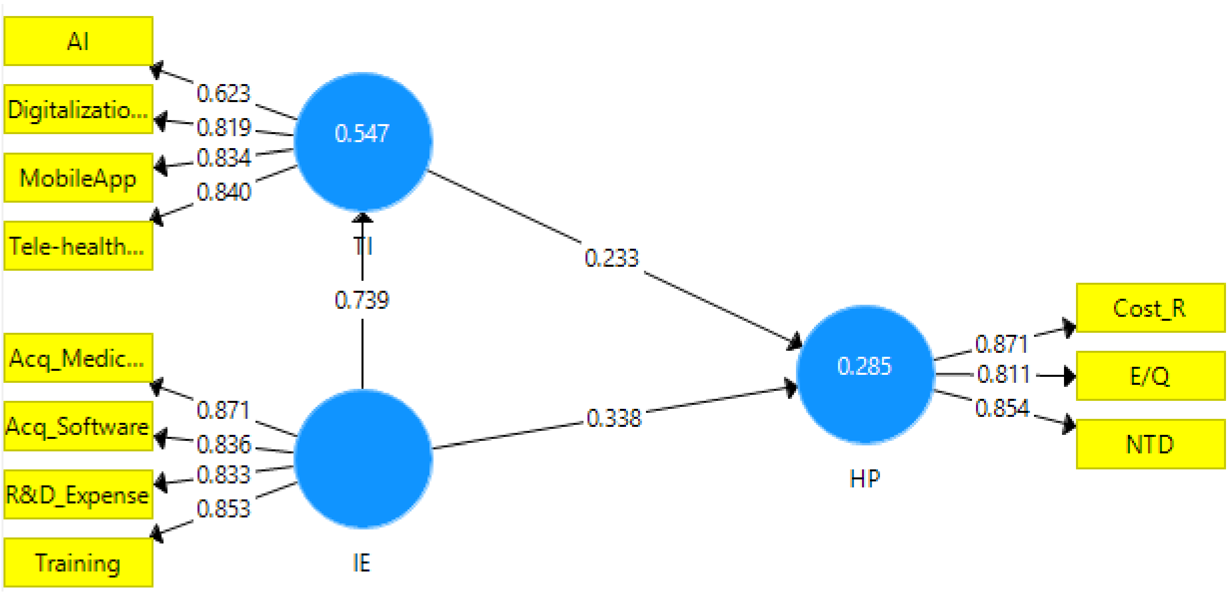

Figure 2. Results of the SEM Path Analysis.

Table 5. Summary of Hypotheses' Results.

Hypotheses	Path Weight	*p*-Value	Path Direction	Decision
H1	0.739	0.0000	Direct	Supported
H2	0.338	0.0002	Direct	Supported
H3	0.233	0.0130	Direct	Supported
H4	0.172	0.0190	Indirect	Supported
H5	0.510	0.0000	Total	Supported

4.3. Discussion and Implications of the Study

Technology innovation has disrupted the way things are being done effectively in many sectors, including the health sector. There has been some level of resistance to technology innovation on the part of some physicians and medical staff in the past due to some areas of medical concerns [55,56]. However, there was a surge in the deployment of telemedicine, mobile applications, and a few other technology innovations in healthcare service delivery since the COVID-19 pandemic in 2020 [6,36]. It is crucial to find out the factors contributing to technology innovation in healthcare service delivery and more importantly to assess the impact of technology innovation on healthcare performance. This study, conducted in Saudi Arabia, provides the empirical outcome of the proposition of a resource-based view (RBV) theory that firm performance depends on the tangible and intangible resources that an organization possesses. The results of the correlation analysis in this study show the positive relationships between each of the variables of innovation efforts, technology innovation, and healthcare performance. This implies that innovation effort, technology innovation, and healthcare performance move in the same direction. For instance, an increase in innovation efforts indicates an increase in technology innovation and healthcare performance and vice versa. The results are similar to the outcomes of related studies [9,10,13]. Meanwhile, the age of the healthcare organization is not significantly related to technology innovation and healthcare performance, implying that new healthcare organizations could deploy technologies to aid healthcare delivery faster than the old ones.

Additionally, the summary of the structural equation model as revealed in Table 5 shows that innovation efforts (R&D, training, acquisition of software, acquisition of medical machinery, and equipment) among healthcare organizations play a significant role in influencing technology innovation and healthcare service delivery, as confirmed by hypotheses 1 (*direct effect on TI*), 2 (*direct effect on HP*), 4 (*indirect effect on HP*), and 5 (*total effect on HP*). While the innovation efforts resulted in 0.73 units of increase in technology innovation, it actually yielded a total effect of more than half of the innovation efforts on healthcare performance. The results indicate that the more resources healthcare organizations devote to R&D, software and medical equipment acquisition, and training of employees in their medical facilities, the more they are able to develop new technologies and improve the existing ones. This improves technology innovation and performance among healthcare organizations in Saudi Arabia. These findings are consistent with related studies [2,17,72–74]. Meanwhile, hypothesis 3 is also supported, indicating that technology innovation positively and significantly influenced healthcare performance among the healthcare organizations surveyed. This gives credence to the critical role of technology innovations, namely MobileApp technology (MT), the digitalization of patients' health records (DGT), telehealth/telemedicine (THM), and artificial intelligence (AI), on healthcare performance. The results affirmed the results of similar studies in the literature [2,9,17,19,22,36,63]. The outcomes of this study are not farfetched from the deliberate actions of the government to foster health service delivery through various health policies, which are supported by the provision of a necessary enabling environment for private health practitioners in Saudi Arabia and increased funding toward health transformations in line with Vision 2030 [24]. More funds have been appropriated to the health sector in the recent budget of the Saudi government, which has led to the development of various technological innovations [25]. This assists in conducting healthcare-related research, developing various healthcare applications and equipment, digitalizing healthcare records through big data and blockchain, and enhancing artificial intelligence, which improves precision in health diagnosis and treatment of patients.

The implication of this study suggests that both public and private healthcare practitioners should intensify their efforts on continuous improvement in research, the training of healthcare employees, and the acquisition of software and medical equipment. The results of this study have clearly shown the positive impact of innovation efforts and technology innovation on healthcare performance in Saudi Arabia. Specifically, the application of modern technology innovations, such as the digitalization of health records, telehealth/telemedicine, and artificial intelligence contribute to the improvement in efficiency and quality of healthcare service delivery, reduction of cost and development of new treatments. This would result into achieving sustainable development goals of improved good health and reduced carbon emission [5,75]. The policy makers in the health sector should further create an enabling- and sustainable environment whereby technology innovations could be supported and fostered through policies such as tax rebate for the private health organization which engages in technology innovation, reduction of tariffs on imported healthcare machinery and equipment and reduction of excise duties for the indigenous firms which produce healthcare products/services using new technology innovation among others. Furthermore, higher academic institutions should be encouraged through proper funding to conduct applied/developmental research that would result into developing new technology innovation such as new healthcare applications which improve efficiency and reduce cost of healthcare in the health sector.

5. Conclusions

Technology innovation has been playing a great role in transitioning various sectors from traditional systems to digital systems, including in the health sector. Artificial intelligence, Internet of Things (IoT), blockchain, and mobile applications, among others, have been recorded as technology innovations driving efficiency, quality, and cost of healthcare delivery in healthcare organizations. The empirical investigation of the impact of technology innovation on healthcare performance is less explored in developing countries like Saudi Arabia. It cannot be assumed that these technology innovations have contributed to healthcare performance in all countries, as many countries have peculiar characteristics that support or inhibit their application in their environment. Thus, this study assessed the structural relationship between innovation efforts, technology innovation, and healthcare performance among healthcare organizations in Saudi Arabia from the third quarter of 2021 to the first quarter of 2022.

The results of the correlation matrix show that healthcare performance is positively related to technology innovation and innovation efforts. Meanwhile, the age of the healthcare organization is not significantly related to the healthcare performance, implying that new healthcare organizations could deploy technologies to aid healthcare delivery faster than the old ones. Furthermore, partial least square reveals the structural path among the latent variables in the SEM. The results indicate that innovation efforts among healthcare organizations (R&D, training, acquisition of software, acquisition of medical machinery and equipment) significantly influence technology innovation and healthcare performance. While the innovation efforts resulted in a 0.73 unit increase in technology innovation, it caused a total effect of 0.51 on healthcare performance. Meanwhile, technology innovations (artificial intelligence, mobile technology, digitalization of health records, and telemedicine) also have a positive and significant influence on healthcare performance, with a regression weight of 0.23. Hence, health technology innovations have generally reflected their positive and significant impacts on healthcare performance among healthcare organizations in Saudi Arabia. This results in better health outcomes, higher quality of care, and enhanced efficiency, which is favorable to both patients and healthcare organizations. Furthermore, the effect of this technology innovation would spill over to a sustainable low-carbon environment when there is less physical travel for hospital appointment and less utilization of papers, reducing carbon emissions and e-material wastes, which end up in landfill sites. There is a need to further strengthen both the recently established and old private and public health organizations by increasing healthcare funding and creating an enabling environment to enable them to continually improve healthcare performance through differing technology innovations in this era of digital transformation. The outcomes of this study provide more information on healthcare technology innovation and healthcare performance and also contribute to the empirical findings on the related research. These results could be applicable in any resource-rich developing countries and others that have similar characteristics as Saudi Arabia.

One of the limitations of the study is that it does not cover core medical technologies use during drug production or surgery. Another limitation is the sample size, which can be increased in a future study. Furthermore, there is a need for future research to conduct a longitudinal study that covers the technology innovation among the healthcare practitioners over a relatively long period so as to understand the changes that could happen over a period rather than a point in time.

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References

1. Shahzad, A.; Hassan, R.; Aremu, A.; Hussain, A.; Lodhi, R. Effects of COVID-19 in E-learning on higher education institution students: The group comparison between male and female. *Qual. Quant.* **2021**, *55*, 805–826. [CrossRef]
2. Dias, M.N.; Hassan, S.; Shahzad, A. The Impact of Big Data Utilization on Malaysian Government Hospital Healthcare Performance. *Int. J. eBus. eGov. Stud.* **2021**, *13*, 50–77.
3. Posel, D.; Oyenubi, A.; Kollamparambil, U. Job loss and mental health during the COVID-19 lockdown: Evidence from South Africa. *PLoS ONE* **2021**, *16*, e0249352. [CrossRef]
4. Blustein, D.; Duffy, R.; Ferreira, J.; Cohen-Scali, V.; Cinamon, R.; Allan, B. Unemployment in the time of COVID-19: A research agenda. *J. Vacat. Behav.* **2020**, *119*, 103436. [CrossRef] [PubMed]
5. Dias, R.; Montalvo, R. Digital Transformation as an Enabler to Become More Efficient in Sustainability: Evidence from Five Leading Companies in the Mexican Market. *Sustainability* **2022**, *14*, 15436.
6. Zweifel, P. Innovation in health care through information technology (IT): The role of incentives. *Soc. Sci. Med.* **2021**, *289*, 114441. [CrossRef]
7. Brauns, H. Presidential Address to DGTelmed's Tenth Anniversary. 2015. Available online: https://www.dgtelemed.de/downloads/10-Jahre-dgtelemed-web.pdf (accessed on 5 December 2021).
8. Akinwale, Y. Health Expenditure, Economic Growth and Life Expectancy at Birth in Resource Rich Developing Countries: A case of Saudi Arabia and Nigeria. *J. Econ. Coop. Dev.* **2021**, *42*, 13–36.
9. Ancarani, A.; Mauro, C.; Gitto, S.; Mancuso, P.; Ayach, A. Technology acquisition and efficiency in Dubai hospitals. *Technol. Forecast. Soc. Change* **2016**, *113*, 475–485. [CrossRef]
10. Länsisalmi, H.; Kivimäki, M.; Aalto, P.; Ruoranen, R. Innovation in healthcare: A systematic review of recent research. *Nurs. Sci. Q.* **2006**, *19*, 66–72. [CrossRef] [PubMed]
11. Dhingra, C. How Technology Innovation is Boosting Healthcare Systems. 2020. Available online: https://www.geospatialworld.net/blogs/how-technology-innovation-is-boosting-healthcare-systems/ (accessed on 28 October 2021).
12. Iyanna, S.; Kaur, P.; Ractham, P.; Talwar, S.; Islam, A. Digital transformation of healthcare sector. What is impeding adoption and continued usage of technology-driven innovations by end-users? *J. Bus. Res.* **2022**, *153*, 150–161. [CrossRef]
13. Looy, A. A quantitative and qualitative study of the link between business process management and digital innovation. *Inf. Manag.* **2021**, *58*, 103413. [CrossRef]
14. Akinwale, Y.; Surujlal, J. The Nexus between R&D, Innovation and Economic Growth Revisit: The Case of South Africa and Saudi Arabia. *Int. J. Innov. Creat. Change* **2021**, *15*, 69–85.
15. Aloini, D.; Benevento, E.; Stefanini, A.; Zerbino, P. Transforming healthcare ecosystems through blockchain: Opportunities and capabilities for business process innovation. *Technovation* **2023**, *119*, 102557. [CrossRef]
16. Flessa, S.; Huebner, C. Innovations in Health Care—A Conceptual Framework. *Int. J. Environ. Res. Public Health* **2021**, *18*, 10026. [CrossRef]
17. Bellucci, N. Disruptive Innovation and Technological Influences on Healthcare. *J. Radiol. Nurs.* **2022**, *41*, 98–101. [CrossRef]
18. Kesavan, P.; Dy, C. Impact of healthcare reform on technology and innovation. *Hand Clin.* **2020**, *36*, 255–262. [CrossRef]
19. Lepore, D.; Frontoni, E.; Micozzi, A.; Moccia, S.; Romeo, L.; Spigarelli, F. Uncovering the potential of innovation ecosystems in the healthcare sector after the COVID-19 crisis. *Health Policy* **2023**, *127*, 80–86. [CrossRef]
20. Tsymbal, O. Healthcare Technology Trends and Digital Innovations in 2023. Available online: https://mobidev.biz/blog/technology-trends-healthcare-digital-transformation (accessed on 15 January 2023).
21. Bagot, K.; Moloczij, N.; Barclay-Moss, K.; Vu, M.; Bladin, C.; Cadilhac, D. Sustainable implementation of innovative, technology-based health care practices: A qualitative case study from stroke telemedicine. *J. Telemed. Telecare* **2020**, *26*, 79–91. [CrossRef] [PubMed]
22. Gottlieb, S.; Makower, J. A Role for Entrepreneurs: An Observation on Lowering Healthcare Costs via Technology Innovation. *Am. J. Prev. Med.* **2013**, *44*, S43–S47. [CrossRef]
23. Miller, W. Harnessing Technology-Driven Innovation to Help Meet Saudi Arabia's Growing Healthcare Needs. Arab Health 2017, Issue 3. Available online: https://www.arabhealthonline.com/magazine/en/latest-issue/3/harnessing-technology-driven-innovation-to-help-meet-Saudi-Arabia-growing-healthcare-need.html (accessed on 12 December 2021).

24. Saudi Vision 2030 Document. Health Sector Transformation Program. 2021. Available online: https://www.vision2030.gov.sa/v2030/vrps/hstp/ (accessed on 11 November 2021).
25. Saudi Arabia Monetary Authority. Yearly Statistics: Other Miscellaneous Statistics. 2021. Available online: https://www.sama.gov.sa/en-US/EconomicReports/Pages/YearlyStatistics.aspx (accessed on 11 November 2021).
26. Barney, J. Firm resources and sustained competitive advantage. *J. Manag.* **1991**, *17*, 99–120. [CrossRef]
27. Wernerfelt, B. A resource-based view of the firm. *Strateg. Manag. J.* **1984**, *5*, 171–180. [CrossRef]
28. Andersén, J. Resource orchestration of firm-specific human capital and firm performance-the role of collaborative human resource management and entrepreneurial orientation. *Int. J. Hum. Resour. Manag.* **2021**, *32*, 2091–2123. [CrossRef]
29. Akinwale, Y. Descriptive analysis of building indigenous low-carbon innovation capability in Nigeria. *Afr. J. Sci. Technol. Innov. Dev.* **2018**, *10*, 601–614. [CrossRef]
30. Makadok, R. Toward a synthesis of the resource-based and dynamic-capability views of rent creation. *Strateg. Manag. J.* **2001**, *22*, 387–401. [CrossRef]
31. Grant, R. The resource-based theory of competitive advantage: Implications for strategy formulation. *Calif. Manag. Rev.* **1991**, *33*, 114–135. [CrossRef]
32. Barney, J. Is the Resource-Based View a Useful Perspective for Strategic Management Research? *Acad. Manag. Rev.* **2001**, *26*, 41–56.
33. Akinwale, Y.O. Technology innovation and financial performance of MSMEs during Covid-19 lockdown in Dammam area of Saudi Arabia: A case of food and beverage sector. *Int. J. Technol. Learn. Innov. Dev.* **2020**, *12*, 136–152. [CrossRef]
34. Gupta, M.; George, J. Toward the development of a big data analytics capability. *Inf. Manag.* **2016**, *53*, 1049–1064. [CrossRef]
35. Fullerton, R.; Wempe, W. Lean manufacturing, non-financial performance measures and financial performance. *Int. J. Oper. Prod. Manag.* **2009**, *29*, 214–240. [CrossRef]
36. Cannavacciuolo, L.; Capaldo, G.; Ponsiglione, C. Digital innovation and organizational changes in the healthcare sector: Multiple case studies of telemedicine project implementation. *Technovation* **2023**, *120*, 102550. [CrossRef]
37. Ciani, O.; Armeni, P.; Boscolo, P.; Cavazza, M.; Jommi, C.; Tarricone, R. De innovatione: The concept of innovation for medical technologies and its implications for healthcare policy-making. *Health Policy Technol.* **2016**, *5*, 47–64. [CrossRef]
38. Sinha, A.; Mishra, A.; Patel, Y. Firm size, R&D expenditure, and international orientation: An empirical analysis of performance of Indian firms. *Int. J. Technol. Learn. Innov. Dev.* **2019**, *11*, 311–336.
39. Chege, S.; Wang, D.; Suntu, S. Impact of information technology innovation on firm performance in Kenya. *Inf. Technol. Dev.* **2020**, *26*, 316–345. [CrossRef]
40. Canh, N.; Liem, N.; Thu, P.; Khuong, N. The impact of innovation on the firm performance and corporate social responsibility of Vietnamese manufacturing firms. *Sustainability* **2019**, *11*, 3666. [CrossRef]
41. Fard, M.; Amiri, N. The effect of entrepreneurial marketing on halal food SMEs performance. *J. Islam. Mark.* **2018**, *9*, 598–620. [CrossRef]
42. Rajapathirana, R.; Hui, Y. Relationship between innovation capability, innovation type, and firm performance. *J. Innov. Knowl.* **2018**, *3*, 44–55. [CrossRef]
43. Akinwale, Y. Empirical analysis of inbound open innovation and small and medium-sized enterprises' performance: Evidence from oil and gas industry. *S. Afr. J. Econ. Manag. Sci.* **2018**, *21*, e1–e9. [CrossRef]
44. Soto-Acosta, P.; Popa, S.; Palacios-Marqués, D. E-business, organizational innovation and firm performance in manufacturing SMEs: An empirical study in Spain. *Technol. Econ. Dev. Econ.* **2016**, *22*, 885–904. [CrossRef]
45. Olomu, M.; Akinwale, Y.; Adepoju, A. Harnessing technological and non-technological innovations for SMEs profitability in the Nigerian manufacturing sector. *Am. J. Bus.* **2016**, *4*, 75–88.
46. Adeyeye, A.; Jegede, O.; Akinwale, Y. The impact of technology innovation and R&D on firms' performance: An empirical analysis of Nigeria's service sector. *Int. J. Technol. Learn. Innov. Dev.* **2013**, *6*, 374–395.
47. Hall, B.; Lotti, F.; Mairesse, J. Innovation and productivity in SMEs—Empirical evidence for Italy. *Small Bus. Econ.* **2009**, *33*, 13–33. [CrossRef]
48. Saliba de Oliveira, J.; Cruz Basso, L.; Kimura, H.; Sobreiro, V. Innovation and financial performance of companies doing business in Brazil. *Int. J. Innov. Stud.* **2018**, *2*, 153–164. [CrossRef]
49. Santos, D.; Basso, L.; Kimura, H.; Kayo, E. Innovation efforts and performances of Brazilian firms. *J. Bus. Res.* **2014**, *67*, 527–535. [CrossRef]
50. Pundziene, A.; Sermontyte-Baniule, R.; Rialp-Criado, J.; Chesbrough, H. Indirect effect of open innovation on clinical and economic value creation in digital healthcare: A comparative study of European countries. *J. Bus. Res.* **2023**, *159*, 113701. [CrossRef]
51. Habidin, N.; Shazali, N.; Salleh, M.; Zainol, Z.; Hudin, N.; Mustaffa, W. A review of supply chain innovation and healthcare performance in healthcare industry. *Int. J. Pharm. Sci. Rev. Res.* **2015**, *35*, 195–200.
52. Pal, S.; Baral, M.; Mukherjee, S.; Venkataiah, C.; Jana, B. Analyzing the impact of supply chain innovation as a mediator for healthcare firms' performance. *Mater. Today Proc.* **2022**, *56*, 2880–2887. [CrossRef]
53. Kumar, P.; Sharma, S.; Dutot, V. Artificial intelligence (AI)-enabled CRM capability in healthcare: The impact on service innovation. *Int. J. Inf. Manag.* **2023**, *69*, 102598. [CrossRef]
54. Lee, S.; Lee, D.; Schniederjans, M. Supply chain innovation and organizational performance in the healthcare industry. *Int. J. Oper. Prod. Manag.* **2011**, *31*, 1193–1214. [CrossRef]

55. Sarradon-Eck, A.; Bouchez, T.; Auroy, L.; Schuers, M.; Darmon, D. Attitudes of General Practitioners Toward Prescription of Mobile Health Apps: Qualitative Study. *JMIR mHealth uHealth* **2021**, *9*, 21795. [CrossRef]
56. Heath, M.; Porter, T. Change management overlooked: Physician perspectives on EHR implementation. *Am. J. Bus.* **2019**, *34*, 19–36. [CrossRef]
57. Caffery, L.; Taylor, M.; North, J.; Smith, A. Tele-orthopaedics: A snapshot of services in Australia. *J. Telemed. Telecare* **2017**, *23*, 835–841. [CrossRef]
58. Bilal, W.; Qamar, K.; Siddiqui, A.; Kumar, P.; Essar, M. Digital health and telemedicine in Pakistan: Improving maternal healthcare. *Ann. Med. Surg.* **2022**, *81*, 104425. [CrossRef]
59. Smelcer, J.B.; Jacobs-Miller, H.; Kantrovich, L. Usability of electronic medical records. *J. Usability Stud.* **2009**, *4*, 70–84.
60. Zhivan, N.; Diana, M. US hospital efficiency and adoption of health information technology. *Health Care Manag. Sci.* **2012**, *15*, 37–47. [CrossRef] [PubMed]
61. Organisation for Economic Co-Operation and Development. *Oslo Manual 2005*; OECD: Paris, France, 2005.
62. Cochran, W. *Sampling Techniques*, 2nd ed.; John Wiley and Sons, Incorporation: New York, NY, USA, 1963.
63. Hair, J.; Risher, J.; Sarstedt, M.; Ringle, C. The Results of PLS-SEM Article Information. *Eur. Bus. Rev.* **2019**, *31*, 2–24. [CrossRef]
64. Wang, Y.; Kung, L.; Byrd, T. Big data analytics: Understanding its capabilities and potential benefits for healthcare organizations. *Technol. Forecast. Soc. Change* **2018**, *126*, 3–13. [CrossRef]
65. Reinartz, W.; Haenlein, M.; Henseler, J. An empirical comparison of the efficacy of covariance-based and variance-based SEM. *Int. J. Res. Mark.* **2009**, *26*, 332–344. [CrossRef]
66. Hair, J.; Hult, G.; Ringle, C.; Sarstedt, M. *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*, 2nd ed.; Sage Publications: Thousand Oaks, CA, USA, 2017.
67. Krause, F.; Gathmann, S.; Gorschewsky, O. The use of intramedullary helix wire for the treatment of proximal humerus fractures. *J. Orthop. Trauma* **2008**, *22*, 96–101. [CrossRef]
68. Chan, Y. Biostatistics 104: Correlational Analysis. *Singap. Med. J.* **2003**, *44*, 614–619.
69. Hair, F.; Sarstedt, M.; Hopkins, L.; Kuppelwiesr, V. Partial Least Squares Structural Equation Modeling (PLS-SEM). *Eur. Bus. Rev.* **2014**, *26*, 106–121. [CrossRef]
70. Fornell, C.; Larcker, D. Structural equation models with unobservable variables and measurement error: Algebra and statistics. *J. Mark. Res.* **1981**, *18*, 382–388. [CrossRef]
71. Tehseen, S.; Ahmed, F.; Qureshi, Z.; Uddin, M.; Ramayah, T. Entrepreneurial competencies and SMEs' growth: The mediating role of network competence. *Asia-Pac. J. Bus. Adm.* **2019**, *11*, 2–29. [CrossRef]
72. Akenroye, T. Factors Influencing Innovation in Healthcare: A conceptual synthesis. *Innov. J.* **2012**, *17*, 21.
73. Thakur, R.; Hsu, S.; Fontenot, G. Innovation in healthcare: Issues and future trends. *J. Bus. Res.* **2012**, *65*, 562–569. [CrossRef]
74. Figuiredo, J.; Eiriz, V. Analysis of the impact of technological innovation on healthcare services. *Int. J. Behav. Healthc. Res.* **2009**, *1*, 235–246. [CrossRef]
75. THE 17 GOALS | Sustainable Development. Available online: https://sdgs.un.org/goals. (accessed on 29 December 2022).