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Impact of Artificial Intelligence Auditing, Natural Language Processing, and IT Technologies on the Sustainable Performance

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ABSTRACT

Ensuring sustainable performance in healthcare management requires accurate data governance, regulatory compliance, and efficient decision-making. This study examines the impact of real-time artificial intelligence auditing, natural language processing integration, and IT technologies on the sustainable performance. Real-time AI auditing automates compliance monitoring, detects anomalies, and minimizes manual oversight, ensuring regulatory adherence. Natural language processing enhances data extraction and interpretation, enabling more informed decision-making and optimizing workflow automation. Additionally, IT technologies, including cloud-based compliance systems, blockchain for secure data management, and AI-powered analytics, contribute to data security, interoperability, and process automation. Using a quantitative research approach, this study collected data from 300 respondents through a structured questionnaire. The findings indicate that AI-driven auditing significantly improves regulatory compliance and operational efficiency, while NLP integration enhances data processing accuracy and decision-making. Moreover, IT technologies strengthen data security and streamline processes, leading to better resource management in healthcare organizations.

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1.0 Introduction

With ever increasing amount of integration of Advanced Technologies like Artificial Intelligence (AI), Natural Language Processing (NLP) and Information Technology (IT) in the Healthcare Industry, there have been inevitable transformations. Over the past years, on the healthcare sector, there is increasing pressure to improve efficiency, save in costs and increase patient outcomes (Tatomir, 2024). The requirement to manage increasingly limited resources and meet rising patient expectations, regulatory trends, and determine the effectiveness of investments in healthcare in the future, has resulted in the global push for healthcare management to achieve sustainable performance; all of which necessitate using cutting edge technologies. The use of AI, NLP and IT technologies has become vital tools to cope up with these problems by streamlining healthcare operations, better decision making, and providing resource optimization. Apart from revolutionizing healthcare practices, these technologies can also help to make the healthcare systems sustainable, enabling continuous viability in the long run even as they are expected to meet future demands (Javaid et al., 2024).

The use of AI algorithms in auditing processes, practices and decisions in the healthcare sector has become more popular as AI auditing. AI auditing allows healthcare organizations to review large quantities of data, make inferences, and take data driven decisions that helps improve operational efficiency and performance (Badmus et al., 2024). AI can be applied in areas like patient care, resource allocation, financial management, by detecting inefficiencies, eliminating errors and compliance with regulation standards using AI auditing. For example, AI for auditing systems can detect for medical procedure audits and billing practices to ensure that medical providers follow best practices and stay away from fraud. In addition, AI auditing can enhance the quality of healthcare services by spotting gaps in the care delivery, suggesting evidence based interventions as well as optimizing a patient's outcome. As such, the effects of AI auditing on sustainable healthcare performance are twofold: by improving the accuracy and reliability of healthcare processes, it saves both cost and environment from its inevitable waste (Shaikh et al., 2025).

Natural Language Processing (NLP) is another crucial technology that can greatly increase the performance of healthcare management. NLP is a subset of AI that makes it possible for computers to understand, interpret and generate human language (Iorliam & Ingio, 2024). NLP technologies are being used more and more in healthcare to analyze unstructured data such as clinical notes, patient records, and medical literature for the sake of extracting useful insights and improving decision making. Therefore, NLP helps to process and categorize huge amounts of data automatically which can be used to streamline administrative tasks like coding and documentation (Necula et al., 2024). Additionally, NLP can help enhance patient care by improving communication between healthcare providers and patients, refining the diagnosis quality, and recognizing potential health risks based on analysis of the patient's

language patterns. Automating these processes with NLP helps ease the burden from healthcare professionals and lets them focus on more important matters and thus improve efficiency and reduce errors in the process. NLP in healthcare management integrates for sustainability of performance by improving workflows, data driven decision making, and supporting evidence based practice (Rawas et al., 2024).

Other than AI auditing and NLP, IT technology has a critical role to play in shaping sustainable performance of healthcare management. This article provides information on IT technologies adopted that includes electronic health records (EHR), telemedicine, as well as data analytics that have revolutionized the way healthcare services are delivered and managed (Baporikar, 2024). For example, EHR systems have enabled the easy and accurate access to patient's information that assists healthcare providers to provide more personalized and coordinated care. The use of IT technologies to support telemedicine has helped increase access to health services in remote and underserved areas and reduced the need for physical health facility and travel. Additionally, health care organizations use data analytics employing advanced IT systems to analyze patients' data, detect trends and determine future requirements for health care (Šajnović et al., 2024). Therefore, the integration of IT technologies in healthcare management results in enhancing the operational efficiency, improvement of the patient outcomes, and reduction of the environmental and financial costs associated with the sustainable performance. Therefore, the combination of AI auditing, NLP, and IT is a whole answer to the sustainability issues of healthcare organizations (Suboyin et al., 2024).

There are, however, some research gaps that hinders the widespread use of AI auditing, NLP, and IT technologies in improving healthcare management. The need is unfulfilled by the lack of empirical evidence on the long term impact of such technologies on the sustainability of healthcare systems (Vasileiou et al., 2024). Although many studies on the short term effects of AI, NLP and IT applicability in healthcare exist, there are very few studies on how these technologies affect sustainable performance over time. Besides, more research is required on the ethical aspects of adopting AI and NLP to healthcare, for example, in relation to patient privacy and data security; and algorithmic bias. In addition, there are factors, such as resistance to change, the lack of technical expertise, as well the high implementation costs, which obstruct adoption of these technologies. Overcoming these barriers will enable full use of the power of AI auditing, NLP and IT technologies for healthcare management (Nair et al., 2024).

A second research gap is the lack of knowledge of the relation between AI auditing, NLP, IT technologies and the sustainable performance of healthcare management. Although studies do exist about the individual impact of these technologies on healthcare sustainability, there is little literature about their impacts when they work together (Liu et al., 2021). It is important to understand how these technologies interrelate and to the existing healthcare systems for development of integrated solutions to meet the challenges of healthcare management.

Additionally, research about how organizational culture, leadership, and governance can help healthcare organizations to adopt and integrate AI, NLP, and IT technologies is also needed. Research gaps in this area are identified by addressing these research gaps scholars and practitioners can develop more effective strategies to leverage these technologies to achieve sustainable healthcare performance (Babawarun et al., 2024).

This study deals with the research problem of few comprehensive understanding of how AI auditing, NLP, and IT technologies influence sustainable performance of the healthcare management. Although these technologies have been recognized as having a great potential for improving healthcare operations, to date limited research on the long term impact of these technologies on sustainability has been conducted. To fill this gap, this study aims to study the relation between AI auditing, NLP, IT technologies, and sustainable healthcare performance. The study specially focuses on the way in which these technologies can increase the operational efficiency, decrease the cost, and increase the patient outcome but, reduce the negative environmental impact. This study contributes to the literature on the role of technology in sustainable healthcare management through an exploration of AI auditing, NLP, and other IT technologies in synergy.

This study has significance because it could provide important implications on how healthcare organizations can make use of AI auditing, NLP and IT technologies to be sustainably performed. In recent years healthcare systems across the world have become under increasing pressure to cut costs, improve quality, and deal with the impact of an ageing population, and need for innovative solutions has therefore never been so great. Practical recommendations are offered by this study to the healthcare leaders and policymakers on how by utilizing advanced technologies, the potential of healthcare management can be maximized and most importantly, make it long term sustainable. Additionally, the results of this study are generally applicable to other industries that aim for sustainable performance with the integration of AI, NLP, and IT technologies. The contribution of this study to the discussion of technological technology and sustainability is achieved by showcasing the potential of this technology to make a difference towards sustainability on other industries.

In general, the capability of the integration of AI auditing, NLP, and IT technologies can contribute greatly to the sustainable performance of healthcare management. As these technologies are innovative, they come up with the solutions to the complex challenges that healthcare organizations are facing currently, such as enhancing patient outcomes and decreasing the operational efficiency and costs. Nevertheless, there are still open research questions, more specifically about the long-term sustainability effects of these technologies and the ethical issues of their application. This research fills these gaps by investigating the relationship between AI auditing, NLP, IT technologies, and performance of sustainable healthcare. The results of this study will be useful for healthcare leaders, policymakers and

scholars to build sustainable healthcare systems, which meet healthcare needs of future generations.

2.0 Literature Review

Artificial intelligence (AI) auditing, Natural Language Processing (NLP), and Information technology (IT) have significant impact on healthcare management which requires theoretical foundations for understanding. The Resource-Based View (RBV) of the firm is one of the central theories that informs this understanding and is characterized by the competitive advantage an organization will have if it successfully exploits valuable, rare, and inimitable resources (Crews Jr, 2024). In the healthcare context, technologies such as AI, NLP, and IT systems are strategic assets in which the effective use can improve operational performance, decrease costs, and improve patient outcomes. By integrating these technologies, RBV shows that the improvement in resource allocation, decision making, and management process is conducive to a sustainable organizational advantage. The second theory used to highlight the situation of incorporating IT advancements in health care institutions stems from the Diffusion of Innovation theory which understands the process in which health care institutions adopt these advanced technologies (Zhang et al., 2015). In accordance with this theory, the adoption of innovations such as AI and NLP in healthcare practice is impacted by several variables and contains perceived relative advantage, compatibility with prevailing systems, complexity, trial ability as well as observability. The use of these theoretical perspectives provides a way of conceptualizing how technological advancements are strategically important in bringing about improvements in healthcare sustainability (Martínez-Peláez et al., 2023).

Recently there is a gradually increased body of empirical studies on the impact of AI, NLP and IT technologies on healthcare management. According to a study on this subject examined how AI algorithms enhance the healthcare process including automation of diagnostic, patient management, and predictive analytics (Fatima, 2024). The researchers in their research report have learned that the AI applications especially that are powered by the machine learning and a deep learning model can significantly increase the accuracy of medical diagnoses, lessen human errors and help in the decision making. Further noted that AI had the capability to analyze a massive amount of information in the field of medicine to personalize treatment plans (Shiwlani et al., 2023). These are AI based systems that use medical histories of the patients and predict patient outcomes to suggest the treatment option, which can also promote the efficiency of the health care delivery. As an extension of AI, NLP has been studied as well in its contribution to process and interpret unstructured data such as clinical notes and patient histories. Conducted a study which states that the nlp technologies have transformed the way the healthcare professionals can extract valuable insights from the large amounts of data of patients and can help them make more informed decisions in regards to the patient care (Subrahmanya et al., 2022).

It is equally well documented that IT technologies can contribute to healthcare management. The healthcare organizations have been able to streamline their operations, make data easily accessible, and make it easier for communication among healthcare professionals through the use of IT infrastructure including electronic health records (EHRs), telemedicine, and data analytics (Adeniyi et al., 2024). With the help of IT technologies, telemedicine has widened the healthcare access to underserved populations whose patients can consult with the healthcare providers on remote, thereby removing the need for physical visits and reducing health care cost (Krawchenko, 2024). Additionally, data ana lytics tools included in the healthcare system has assisted healthcare providers to analyses trends, monitor population health and anticipate future healthcare needs. The growth of this empirical evidence reflects the disrupting potential of AI, NLP, and IT technologies in health care management (Ogunseye et al., 2025).

Despite the progress made in this area, however, there are still some research gaps concerning the combined effect of AI auditing, NLP and IT technologies on sustainable healthcare performance. However there is little research, focused on the collective impact of these technologies on healthcare system (Alami et al., 2024). For example, it is well documented that the use of AI for improving diagnostic accuracy has benefits, but not very well understood how using AI auditors can improve healthcare efficiency through compliance and operational efficiency monitoring. It is a well-known fact that NLP has been extensively researched for its use in the context of extracting insights from unstructured data, but NLP's ability to automate mundane administrative tasks like coding and billing, in conjunction with AI and IT infrastructure, is not extensively explored yet. Moreover, most studies on IT technologies in healthcare have concentrated on the operations improvement achieved by EHR and telemedicine, with little empirical evidence on how these technologies play in the long run sustainability. From this, it can be inferred that there is a need for more research in how AI, NLP, and IT technologies can be integrated to produce a more sustainable healthcare system (Bekbolatova et al., 2024).

In addition, the relationship between the above-mentioned advanced technologies and healthcare sustainability has not been fully understood. As well as quantitative benefit, studies showed that AI and NLP enhance operational efficiency and patient care; nevertheless, they reported lack of empirical evidence regarding long term impact of these technologies on healthcare system sustainability (Moro Visconti & Morea, 2020). For one, the use of AI auditing systems to find where efficiency can be lost and compliance with regulatory standards abided to could save the firm large amounts of money, but the environmental impact of these technologies has not been thoroughly investigated. For instance, although IT systems such as EHRs and telemedicine have eliminated the necessity for physical infrastructure and travel, there is secondary research that aimed at studying their contribution towards environmental sustainability through the reduction of the carbon footprint of the healthcare sector. However,

to fully capitalize on how these technologies can contribute toward making healthcare sustainability, these gaps should be addressed (Shalaby, 2024).

As a result of fast technological innovation, on the other hand, it is equally important to consider the ethical implications of utilization of AI, NLP and IT technologies in management of healthcare. All these are critical issues that would need to be addressed to make sure that these technologies are being used responsibly (Poszler et al., 2024). Researchers found that healthcare decision making AI algorithms could inadvertently maintain the same partial racial biases that humans begin with if they are not appropriately developed and tested. Like this, the spread of IT technologies in the healthcare also leads to the fear of the loss of patient data due to the spread of cyber-attacks on the healthcare institutions. While the ethical considerations of AI, NLP, and IT technologies in healthcare systems need to be carefully balanced, the implementation of these technologies can hold significant potential benefit if they will further the sustainability as well as equity of healthcare systems (Hoagland & Kipping, 2024).

This study proposes several hypotheses based on existing literature and identified research gaps to drive further research on the effects of AI auditing, NLP, and IT technologies towards sustainable healthcare performance. Second, it is hypothesized that the role of AI auditing in healthcare sustainability is positive through achievement of operational efficiency and conformity to general regulatory standards. The reason behind this hypothesis is based on the RBV theory that an organization with the usage of advanced technologies creates the competitive advantage. Second, it is hypothesized that the use of NLP in the healthcare realm leads to administrative process efficiency and data driven decision making towards sustainability. The empirical evidence on NLP's ability to process unstructured data and alleviate healthcare professional's workload supports this hypothesis. Finally, it is hypothesized that the integration of such IT technologies as EHRs, telemedicine, and data analytics has a positive effect on the sustainability of healthcare systems since they increase the availability of data and decrease the costs of healthcare while also reducing their environmental impact. The hypothesis is built on the growing body of literature about operational and environmental benefits of IT systems in healthcare.

Finally, the combination of AI audit, NLP, and IT is expected to yield significant improvement in sustainable performance of healthcare management. So too, these technologies present innovative solutions to the tough problems confronting the healthcare organization ranging from optimizing the operational efficiency, to minimizing the cost, and transforming the patient outcomes. Nonetheless, there are still some research gaps regarding long-term impacts of these technologies on healthcare sustainability and ethical issues of their use. To overcome these gaps, this study investigates the association between AI auditing, NLP, IT technologies, and sustainable healthcare performance. Future research can help to further test the proposed hypotheses to the development of more sustainable healthcare systems that will meet the needs of future generations as well as to better address ethical concerns.

3.0 Methodology

For this study, a quantitative research design was chosen since it was deemed suitable in investigating the relationships between artificial intelligence (AI) auditing and natural language processing (NLP), IT technologies and sustainable healthcare performance. The philosophy of the study was positivist in that it takes an objective approach, using observable data, and tests hypothesis. Since the positivist philosophy fits well with the quantitative research design as it enables testing of hypotheses and producing objective insights regarding the relationships among the variables under investigation through the use of statistical methods. The study aimed to develop an understanding of how AI auditing, NLP, and IT technologies promote sustainable performance of healthcare management, so the choice of a survey based approach was made to collect data from healthcare professionals in Pakistan.

The study population consisted of those healthcare professionals, who were working in different hospitals, clinics, healthcare organizations of Pakistan. For example, these were doctors, nurses, administrators or IT specialists in a health care setting who had experience with AI, NLP and IT technologies. The healthcare institutions drawn as sampling frame were based on the major cities of Pakistan from where the adoption of these AI and IT technologies has been relatively advanced. Guidelines provided by Krejcie and Morgan (1970) were used in determining the sample size which showed that 384 respondents would be sufficient for generalizable results if the population of the healthcare professional in Pakistan is considered. Nevertheless, to compensate for any non-responses, 500 participants were targeted.

The sample of healthcare professionals and regions were similarly stratified using a probability sampling strategy, stratified random sampling. Strata were formed for the sample on the basis of the respondents' job roles and geographic locations. Respondents were randomly chosen to participate in the study within each stratum. The reason for choosing stratified random sampling was that it enhances the representativeness of the sample as well as better ensures that bias will not occur when the population has diverse subgroups like healthcare professionals with different roles and responsibilities.

Structured survey questionnaire was used to collect the data, which was developed from validated scales from previous studies. The questionnaire had sections that aimed to measure the main variables of the study, namely, AI auditing, NLP, IT technologies, and sustainable healthcare performance. The respondents' perceptions were captured by each section using a five-point Likert scale from "strongly disagree" to "strongly agree". Scales adapted from research on technology audit and compliance systems were used to measure the level of AI auditing, and items about NLP as an enabler of healthcare data management and decision support systems were used to assess the level of NLP. Questions related to electronic health records (EHRs), telemedicine and healthcare information systems were used to measure IT technologies. Finally, scales of operational efficiency, cost reduction, patient satisfaction and

environmental impact were used to evaluate sustainable healthcare performance. A small sample of healthcare professionals took the questionnaire through face to face to pretest its clarity and reliability.

Partial Least Squares Structural Equation Modeling (PLS-SEM) is chosen as it can deal with complex models including multiple constructs and indicators, and the data are analyzed using PLS-SEM. For exploratory research, the aim being to pin point major relations between variables, not to confirm pre-specified models, PLS-SEM is particularly fit. Several stages of analysis were conducted which involved reliability and validity testing for the measurement model and hypothesis testing using the structural model. The internal consistency reliability was assessed by calculating Cornbrash's alpha and composite reliability (CR) while the convergent and discriminant validity was determined using Average Variance Extracted (AVE) and Heterotrait-Monotrait (HTMT) ratio. Variance Inflation Factor (VIF) values were used to check for Multicollinearity between the variables so that the predictors were not highly correlated and distorted the results.

The research process was marked by its ethical considerations. The procedures for the study were conducted in an ethical manner with regards to human research, seeking to respect the rights and the privacy of the participants. All participants were informed that their involvement in the study was on a voluntary basis and that all their responses would remain confidential and anonymous. It was also made clear to the participants that they had the option to withdraw from the study at any time without any penalty. Strict data security measures were in place to protect the data collected such as storage of electronic data in secure manner and allow access only to authorized personnel. In addition to that, institutional ethics review board approval for conducting the study was sought after ensuring its compliance with ethical standards of studies involving human subjects.

Finally, the methodology used in this study established a strong framework to explore the effect of AI auditing, NLP, and IT technologies to sustainable healthcare performance. The data collected were representative and reliable due to the use of a quantitative research design, stratified random sampling and the survey questionnaire. Using PLS-SEM for the analysis provided an overall examination of the relationships between variables, which led to a better understanding of how technological advancement can be a driver of sustainability in healthcare management. Throughout the research process the rights and privacy of the participants were safeguarded in terms of ethical considerations.

4.0 Findings and Results

4.1. Reliability Analysis

Table 1. Reliability Analysis

Construct	Cornbrash's Alpha	Composite Reliability	(AVE)
AI Auditing	0.812	0.876	0.636
NLP	0.841	0.893	0.671
IT Technologies	0.825	0.878	0.643
tSustainable Healthcare formance	0.870	0.910	0.719

All constructs Cornbrash's Alpha values are greater than 0.7, hence there is good internal consistency and reliability. In the same way, the Composite Reliability (CR) values are above 0.7, assessing the reliability of the constructs. All the Average Variance Extracted (AVE) values are higher than the threshold of 0.5 and hence, there exist sufficient convergent validity, implying that the constructs explain a sufficient amount of the variance in their respective indicators.

4.2. Validity Analysis (HTMT)

Table 2. Validity Analysis

Construct	AI Auditin	NLP	IT Technologi	Sustainable Performan
AI Auditing	-	0.412	0.491	0.503
NLP	0.412	-	0.467	0.521
IT Technologies	0.491	0.467	-	0.478
Sustainable Healthc ormance	0.503	0.521	0.478	-

HTMT values for all the constructs are below threshold of 0.85, which means there is strong discriminant validity among the constructs. This implies that the constructs are not the same construct and the measurement items are more highly correlated with its respective construct than with another.

4.3. Variance Inflation Factor (VIF)

Table 3. Variance Inflation Factor

Construct	VIF Value
AI Auditing	1.22
NLP	1.30
IT Technologies	1.18
Sustainable Healthcare Performance	1.35

The VIF values for all the variables are below 3.0, thus there is no problem of Multicollinearity in this model. It indicates a lack of strong nonlinear relationships among the predictor variables so that the possibility of collinearity problems in the regression results is not possible.

4.4 Model Fitness Table

Table 4. Model Fitness Table

Fit Measure	Value	Recommended Threshold
SRMR	0.062	≤ 0.08
NFI	0.901	≥ 0.90
Chi-square (χ^2)	345.25	-
d_ULS	0.182	-
d_G (Geodesic)	0.094	-

The Standardized Root Mean Square Residual (SRMR) value is 0.062, which is below the recommended threshold of 0.08, indicating a good model fit. The Normed Fit Index (NFI) is 0.901, also meeting the threshold for acceptable fit. The model's fit is considered adequate based on these measures, indicating that the hypothesized structural model aligns well with the observed data.

4.5 Structural Equation Model (Path Coefficients)

Table 5. Structural Equation Model

Path	Coefficient (β)	t-Value	p-Value	Decision
AI Auditing → Sustainable Healthc ormance	0.278	5.32	<0.001	Supported
NLP → Sustainable Healthcare Performance	0.346	6.45	<0.001	Supported
IT Technologies → Sustainable Healthc ormance	0.315	5.87	<0.001	Supported

The path coefficients for AI Auditing (β = 0.278), NLP (β = 0.346), and IT Technologies

(β = 0.315) all show significant positive effects on Sustainable Healthcare Performance with p-values less than 0.001. This suggests that AI auditing, NLP, and IT technologies have a positive effect on healthcare management's sustainable performance. The t-values further indicate the significance of these relationships, and they reinforce the hypothesis that technological innovations are very important in improving the sustainability performance in healthcare.

These results reinforce each other and indicate that model is stable and the meaningful relationships between constructs in healthcare management context.

5.0 Discussion and Conclusion

This study's findings offer a detailed view of how AI auditing, IT technologies, and natural language processing (NLP) affect sustainable performance for healthcare management. According to the results, the hypotheses are confirmed, as all three technologies have a significant and positive impact on increasing sustainability in healthcare operations. Results of the quantitative test of AI auditing revealed a strong connection with safe health care performance, signifying its capacity to cut down on the decision-making time and by cutting the inefficiencies, improve compliance with regulatory standards. NLP played a critical role in using the healthcare data to derive useful insights into communication, patient care and operations efficiency. As a positive contribution by IT technologies, cloud computing and data management systems also contributed to sustainability by improving the ways of utilizing resource, flexibility in the operation and delivery of service. These results together highlight the requirement for combining leading edge technologies towards the improvement of healthcare outcomes.

Similar to previous studies that affirm the contribution of automation to enhancing operational efficiency and decision-making accuracy, results supported that AI auditing had positive impacts to sustainable healthcare performance. AI auditing systems help in reducing human error, compliance with regulations and growing the transparency of healthcare management. Moreover, the relationship between NLP and sustainable performance is positively linked, verifying the technology as a tool to optimize communication and decision-making processes. By allowing healthcare providers to excavate relevant insights from a massive chunk of unstructured data, NLP is helping facilitate better care to the patients while providing them with informed decisions. In line with the broader digital transformation trend of healthcare, the contribution of IT technologies to sustainability is also a result of the improvement of data storage, cloud computing and real time communication systems to improve resource utilization, reduce operation costs and enhance service delivery.

The study has theoretical implications to integrate AI auditing, NLP and IT technologies into the sustainable healthcare management framework. These technologies have mainly been researched in isolation or in a broader industrial context however, and their specific effect on healthcare has not yet been fully explored. To fill that gap, this study provides such empirical

evidence regarding how these technologies work together to enhance healthcare performance. The study frames the discussion around the importance of technological resources in an organization's sustainability based on the discussion through Resource Based View (RBV) and Technology-Organization-Environment (TOE) frameworks. The findings are in tune with current literature on digital transformation and thus, the aspiration that healthcare organizations require to dedicate significant resources to advanced technologies if they wish to remain a sustainable and competitive component of the world that is becoming more and more digital.

In addition, the study provides practical implications for healthcare managers and policies. This is evidence that investment into AI auditing, NLP and IT technologies will improve sustainable performance, which is valuable for long term healthcare success. Therefore, AI based systems for auditing and compliance processes should be considered by managers so that better use of resources and operational efficiency can be achieved. Similarly, using NLP tools will enable organizations to extract value from unstructured data, which in turn will improve communication, decision making and patient care. And IT in terms of cloud computing and real time data management should also be prioritized in order to increase operational flexibility and sustainability. The results of these findings would also be helpful to policymakers to draft regulations and incentives to push for the use of advanced technologies in healthcare for sustainability and efficiency.

Although this study made positive contributions, there are some limitations. The research was carried out in Pakistan in the healthcare organizations, which may restrict the generalization of the findings to these other areas or sectors. This research should be extended in future to explore the role of these technologies in other geographies and sectors in order to validate the results. The data are also cross sectional, thus preventing the measurement of the long term impacts of technology adoption on sustainability. Further work should implement longitudinal designs investigating how such implementation of AI, NLP and IT technologies unfold in time and their persisting effects on healthcare performance.

Finally, it is concluded that AI auditing, NLP, and IT will help improve the sustainable performance of healthcare management. It is demonstrated with strong empirical evidence that the use of these technologies integrated into healthcare operations enhances efficiency, effectiveness in decision making and service delivery. With the healthcare organizations stepping up their pace in digital transformation, the advanced technologies adoption will be indispensable in driving sustainability and guaranteeing long term success of the industry. These technologies must integrate into environments created by policymakers and healthcare leaders and where sustainable healthcare practices are promoted. By extending the scope of studies in this research, it enriches the digital transformation literature in healthcare and offers

important findings that academics and practitioners can find useful in terms of sustainable healthcare management.

Contributions

Muhammad Junaid Aamir Shami: Problem Identification, Literature search
Muhammad Adnan: Drafting and data analysis, proofreading and editing
Sharafat Ali Sair: Methodology, Data Collection

Conflict of Interests/Disclosures

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