The Impact of Artificial Intelligence Applications on the Digital Transformation of Healthcare Delivery in Riyadh, Saudi Arabia (Opportunities and Challenges in Alignment with Vision 2030)

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Abstract

This research aimed to assess the current applications of AI in the healthcare sector in Riyadh and their influence on digital transformation, and to identify the opportunities presented by expanding AI adoption to improve healthcare services in alignment with Vision 2030, and to examine the challenges facing greater integration of AI technologies into Riyadh's healthcare system.

The research addresses the challenges faced by Riyadh's health sector and examines how artificial intelligence can be used to overcome these challenges, including improving the quality of health services, enhancing operational efficiency, and supporting scientific research, By analyzing data and reviewing previous studies, the research shows how AI technologies can contribute to the early detection of diseases, providing dedicated health care, and improving the management of health facilities. The research also discusses the impact of artificial intelligence on medical education and training and explores how it can enhance scientific research in the field of health.

The findings indicate that AI has the potential to significantly transform Riyadh's healthcare sector, contributing to the realization of Vision 2030. The research concludes with recommendations for the effective application of artificial intelligence in the health system, emphasizing the importance of innovation and technical integration for the future of healthcare in the Kingdom.

Keywords: Artificial Intelligence, Digital Transformation, Healthcare, Riyadh, Vision 2023.

1. Introduction

The Kingdom of Saudi Arabia (KSA) has witnessed rapid digital transformation across sectors in recent years. This has been driven by the national Vision 2030 plan which aims to reduce dependence on oil revenues and transition towards a knowledge-based economy (Woishi, 2019). The healthcare sector specifically has seen major reforms and adoption of advanced technologies like artificial intelligence (AI) to improve services as part of the Vision 2030 human capital development goals (Aboalshamat et al., 2022). The Saudi government views AI and digital health as essential to increasing access, efficiency, and quality of healthcare under Vision 2030 (Housawi & Lytras, 2023).

Riyadh as the capital and largest city of Saudi Arabia has been at the forefront of digital advancements in healthcare. The Saudi government has promoted public-private partnerships to accelerate AI integration and the Health Ministry has worked closely with technology firms to incorporate AI into care delivery (Alsaywid, Alajlan & Lytras, 2023). Machine learning and automation have already been implemented for administrative functions, diagnosis, monitoring, robot-assisted surgeries and data analytics in major Riyadh hospitals and clinics (Lytras et al., 2021). For instance, King Faisal Specialist Hospital and Research Center in Riyadh uses IBM's Watson AI platform for oncology treatment planning (Chikhaoui, Alajmi & Larabi-Marie-Sainte, 2022).

These AI applications have increased efficiency and productivity in Riyadh's healthcare system leading to higher quality of care. However, lack of digital skills among many healthcare professionals has inhibited wider adoption. Concerns about privacy, cybersecurity, and medical ethics with AI also persist (Alshahrani et al., 2021). As Saudi Arabia moves towards its Vision 2030 goals, more research is needed to examine the impact of existing AI technologies on digital transformation of Riyadh's healthcare sector. Additionally, strategies must be developed to address the challenges around accelerating integration of AI and unlocking its full potential to enhance healthcare service delivery.

This study aims to fill critical knowledge gaps by analyzing the influence of AI applications on Riyadh's healthcare digital transformation. It will assess the extent of current adoption and how it is reshaping the sector. The opportunities and challenges associated with using AI to achieve Vision 2030 human capital objectives will also be investigated.

The research findings will support data-driven policies and decision-making to successfully leverage AI for improving healthcare access, affordability and quality for the Kingdom's citizens. Expanding AI integration in a responsible manner aligned with ethical principles will be key to unlocking its benefits within the healthcare system. This study provides empirical insights to inform such strategic expansion under the framework of Saudi Vision 2030.

1.1. Research Objectives

The objectives of this study are:

1. To assess the current applications of AI in the healthcare sector in Riyadh and their influence on digital transformation.

2. To identify the opportunities presented by expanding AI adoption to improve healthcare services in alignment with Vision 2030.

3. To examine the challenges facing greater integration of AI technologies into Riyadh's healthcare system.

1.2. Research Questions

The research questions guiding this study are:

1. How are AI technologies currently being applied in Riyadh's healthcare sector and how are they impacting digital transformation?

2. What are the biggest opportunities for AI expansion to enhance healthcare delivery under Vision 2030 goals?

3. What challenges need to be addressed to increase AI adoption across Riyadh's healthcare system?

1.3. Research Significance

This study will provide valuable insights into how AI is reshaping healthcare in Riyadh and strategies for leveraging these technologies to achieve Vision 2030 human capital development objectives. The research has practical significance for healthcare providers and policymakers in effective AI integration for improved quality of care. It also contributes to the scholarly understanding of AI's role in digital transformation of healthcare in Saudi Arabia.

1.4. Research Hypotheses

The hypotheses for this study are:

H1: AI applications have significantly increased efficiency and productivity in Riyadh's healthcare sector.

H2: Lack of training and AI skills among healthcare professionals is negatively associated with adoption of AI technologies.

H3: Concerns related to privacy, security and ethics act as barriers to expanded AI adoption in healthcare delivery.

2. Literature review:

2.1. Digital Transformation of Healthcare in Saudi Arabia

Saudi Arabia has experienced rapid digital transformation across sectors, including healthcare, as part of the Vision 2030 plan to diversify the economy and improve citizens' quality of life (Aldossari, 2022). The national e-health strategy launched in 2011 marked the beginning of healthcare's technology-enabled transformation (Bah et al., 2011). It focused on integrating health information systems to enhance quality, accessibility and affordability of care. Subsequent policies have further promoted digital health adoption to achieve Vision 2030's emphasis on developing human capital and creating a knowledge society (Aldossari, 2022).

As the capital city, Riyadh has been the focal point for digital upgrades in healthcare delivery. The Ministry of Health collaborated extensively with private IT firms and major Riyadh hospitals to integrate emerging technologies like artificial intelligence (AI) and big data analytics for improving services (Chikhaoui et al., 2022). Telehealth, mobile health apps, remote monitoring, and virtual care have also grown significantly, expanding healthcare access for citizens (Alaboudi et al., 2016). However, varying digital skills and literacy among patients and providers has impacted technology adoption. Training and change management are key for healthcare professionals to maximize benefits from digital transformation aligned with Vision 2030 (Ellis & Alamoudi, 2021).

2.2. Current Applications of AI in Riyadh's Healthcare Sector

Multiple applications of AI have been incorporated into Riyadh's healthcare in recent years. A survey of major hospitals found widespread usage of AI for administrative functions, diagnosis, care coordination, precision medicine, and data analysis (Alodan et al., 2022). Robotic surgery using AI is routine at facilities like King Faisal Specialist Hospital's Da Vinci Surgical System Center (Al-Muhareb & Al-Thani, 2022). Oncology departments across Riyadh hospitals use IBM Watson for treatment recommendations (Chikhaoui et al., 2022). Other common AI applications are medical imaging analysis, virtual nurses, patient engagement chatbots, AI-guided radiation therapy, and predictive analytics (Aldossari, 2022; Al-Jehani et al., 2021).

Current applications focus primarily on improving productivity, efficiency, and quality of care. Alabdulmohsin (2019) assessed readiness for AI adoption among physicians at a major

Riyadh hospital and found high expectations for AI to enhance productivity and outcomes.

However, skepticism existed around its ability to provide personalized, compassionate care.

2.3. Influence on Digital Transformation of Riyadh's Healthcare

AI applications have significantly influenced the digital transformation of healthcare delivery in Riyadh. A survey of providers in Riyadh found AI improved productivity and efficiency, reduced costs, increased patient satisfaction, enhanced clinical decision-making, and strengthened preventive care (Alodan et al., 2022). Integrating AI tools with electronic health records enabled data-driven improvements and care personalization (Alshanqity et al., 2022). Automating administrative tasks allowed human resources to focus on higher value work. Analyzing population data with AI also boosted preventive care and public health programs (Aldossari, 2022). While lack of digital skills among some providers has slowed adoption, AI has largely facilitated positive transformation of health services.

Qualitative studies reinforce AI's transformative impact. Al-Jehani et al. (2021) concluded from interviews with leaders that AI has been a major catalyst for Saudi Arabia's healthcare digital transformation, especially under Vision 2030. Albadr and Shaikh (2019) found clinicians viewed AI as crucial for improving access, engagement, productivity, and quality of care. However, physicians emphasized the importance of AI supporting rather than replacing human provided care, especially for complex conditions.

According to quantitative studies, AI improves productivity but has not reduced workforce demand. While AI automated some tasks, Alshanqity et al. (2022) found no association between AI adoption and intention to leave among Riyadh physicians. Analysis by Aldossari (2022) showed AI increased physician productivity by 13% but did not decrease total demand. This aligns with literature arguing AI will augment and aid providers rather than replace healthcare professionals (Jiang et al., 2017). Overall, studies concur AI has accelerated Riyadh's healthcare digital transformation and enabled improvements, supporting hypothesis H1.

Opportunities for AI Adoption to Achieve Vision 2030 Healthcare Goals Significant opportunities exist to leverage expanded AI adoption for enhancing Riyadh healthcare provision in alignment with Vision 2030. Almalki et al. (2022) note AI can increase access and affordability through automation and intelligent care coordination.

Tools like chatbots and telehealth apps can provide specialized care to remote regions cost-effectively. Early disease identification and proactive interventions focused on prevention versus reactive treatment are also key opportunities from AI (Aldossari, 2022).

AI-enabled population health analytics can guide public health programs targeting Vision 2030 wellness objectives. Optimizing provider productivity with AI could expand care capacity to serve more citizens, promoting inclusiveness (Al-Jehani et al., 2021). Training AI on diverse Saudi data can make it better suited for local needs and health equity. As hypothesized in H2, adopting AI can also help address physician shortages by automating tasks and upskilling providers for the digital economy. Responsible AI adoption that follows ethical guidelines and Saudi values can be transformative for achieving Vision 2030 healthcare goals.

2.4. Challenges for AI Adoption in Riyadh's Healthcare System

Despite the opportunities, applying AI in healthcare faces multiple ethical, legal, and adoption challenges. Alodan et al. (2022) found limited digital literacy and AI skills among Saudi healthcare professionals constrains adoption. Physicians have concerns about legal risks if algorithms cause errors and many prefer traditional hands-on care (Aldossari, 2022). Misconceptions that AI aims to replace human jobs rather than assist providers also engender distrust. Comprehensive training programs are key to develop health workforce capabilities and shift mindsets around AI integration (Bah et al., 2011).

As hypothesized in H3, cybersecurity, privacy, and ethical concerns about patient data use are major barriers to adoption. responsible AI relies on quality datasets but privacy risks exist in application (Almalki et al., 2022). Biased algorithms and AI exacerbating inequities must be evaluated to ensure ethical usage aligned with Saudi values. Policies and standards are needed to govern accountable AI deployment in healthcare (Al-Jehani et al., 2021). Public distrust due to lack of discourse on AI risks impeding adoption. Awareness campaigns and transparent AI governance are essential to address ethical concerns and build trust.

Institutional challenges also exist. Albadr and Shaikh (2019) found clinicians viewed hospital bureaucracy, lack of leadership buy-in, and resistance to change as key barriers to implementing AI.

Many providers felt hospital administrators focused excessively on cost savings rather than clinical benefits and patient centricity when acquiring AI tools. Lack of coordinated national AI strategy and standardized impact evaluation frameworks further constrain widespread adoption.

In summary, despite great promise, AI adoption for Riyadh healthcare advancement faces challenges around workforces' skills, security, ethics, perception, and hospital administration. Studies concur these issues must be strategically addressed for Saudi Arabia to capitalize on AI's opportunities to achieve Vision 2030 through pragmatic and responsible adoption focused on improving care quality, equity and affordability.

3. Methodology

3.1. Research Design

This quantitative cross-sectional study utilizes a survey methodology to collect data regarding the impact of AI applications on digital transformation of healthcare delivery in Riyadh, Saudi Arabia. The cross-sectional design is appropriate as the study aims to examine AI adoption and its influence at a specific point in time. The survey methodology provides an efficient approach to gather insights from a sample of healthcare administrators and professionals in Riyadh.

3.2. Research Sample

The target population comprises healthcare administrators and professionals in Riyadh who are involved in technology acquisition, implementation and usage. A random sample of 300 participants will be recruited from major hospitals and clinics in Riyadh. Eligibility criteria include being above 18 years of age and having at least 2 years of experience working in healthcare administration or delivery in Riyadh.

3.3. Data Collection

Data will be collected through an online structured self-administered survey created by the researcher. The survey will gather information on:

• Demographics: age, gender, education level, position, experience

• Types of AI technologies used in the institution

• Perceptions of AI's impact on efficiency, productivity, quality, costs

• Challenges experienced in AI adoption and implementation

• Recommendations for expanding AI integration in healthcare

The survey will include closed-ended questions measured on a 5-point Likert scale and open-ended questions for qualitative insights. It will be distributed to potential participants through email.

Responses will be collected anonymously via an online survey platform.

3.4. Measures the variables measured will include:

Independent variable:

- AI adoption (low, medium, high based on types and extent of AI use)

Dependent variables:

- Perceived impact on efficiency, productivity, quality of care, costs

- Challenges experienced in adoption

- Facilitators recommended for expansion of AI

Control variables:

- Age, gender, education, position, experience

3.5. Data Analysis

Quantitative data will be analyzed using SPSS software. Descriptive statistics such as frequencies, means, and standard deviations will be calculated. Inferential analyses including ANOVA, correlations, and regression will be performed to examine the influence of AI adoption on efficiency, productivity, quality, and cost. Qualitative data from open-ended responses will be analyzed using thematic analysis. Results will be used to address the research questions and test hypotheses.

3.6. Ethical Considerations

The research procedures will be reviewed and approved by an institutional ethics review board. Informed consent will be obtained from all participants. Confidentiality will be maintained by collecting and storing data securely with no personal identifiers. Participants will have the right to voluntarily withdraw from the study at any time.

4. Results and Discussions

4.1. Introduction

This research is a descriptive research, as it was mentioned in the methodology (first chapter); the main research objective is to show the Impact of Artificial Intelligence Applications on the Digital Transformation of Healthcare Delivery in Riyadh, Saudi Arabia: Opportunities and Challenges in Alignment with Vision 2030. Based on examining only a portion of the total population, selected in a way that reflects the structure of the whole. In achieving objectives through this research, the researcher employed the questionnaire survey - as a means of gathering information. This suggests that attitudes are mental positions that cannot be observed directly, but must be analyzed based on

research results. The fact that attitudes are learned affirms they will be affected by information and experience (Kotler & Keller, 2009).

Moreover, this chapter aims at analyzing the data that was collected from the research sample, testing the hypotheses, and reaching the results. The research is designed to combine both theoretical and empirical studies using different measures in measuring the variables included in the research hypotheses according to the types of the variables.

4.2. Research Methodology:

Quantitative data was gathered also through the use of questionnaires (close-ended questions), administered during intercepts.

The questionnaire was designed to collect information to explore about the opinion, views, contributions and variables and studying The Impact of Artificial Intelligence Applications on the Digital Transformation of Healthcare Delivery in Riyadh, Saudi Arabia: Opportunities and Challenges in Alignment with Vision 2030 where a survey questionnaire will be used to collect the required data from the students.

The Researcher was keen after the completion of data collection in every single of sample to review these data in every form, in order to ensure the completeness of data, and the veracity of the information, and to check the rate of yield to these forms and the wastage in the data. After the completion of the review of the final form, The Researcher moved to a new stage, It is converting the raw data into numbers to be handled statistically, To achieve that, The researcher used the manual coding to convert large quantities of raw data in the form of a questionnaire to shortlist data to fit the dump data and the statistical analysis process later. Preliminary data have been received in the form converted to digital codes in the manual coding, According to the rules and standards of the units of measurement that have been developed to measure the variables properties that involved in the study.

After the completion of phase of encoding data in which the transfer of this data from its qualitative form to quantitative form, Then this data has transferred the amount allocated to discharge cards. Therefore, according to the previous rules Serial numbers has to interview forms to reflect every single of forms of single of the vocabulary of the research community.

The questionnaire consists of 4 main variables as the following:

- AI Applications in Healthcare

- Impact of AI Adoption
- Challenges for AI Adoption
- Recommendations for Expanding AI Adoption

4.3. The Research Community

The study sample consisted of 300 participants will be recruited from major hospitals and clinics in Riyadh. Eligibility criteria include being above 18 years of age and having at least 2 years of experience working in healthcare administration or delivery in Riyadh.

This study is applied at major hospitals and clinics in Riyadh, where a survey questionnaire will be used to collect the required data from the staff, to collect the data which are related to the four variables.

4.4. Research Limitation

The study recognizes several limitations such as

1. This staff population is only at major hospitals and clinics in Riyadh
2. There are some limitations in the amount of information. It will obtain from daily life.

4.5. Statistical methods are used :

The researcher in conducting statistical analyzes on the Statistical Package for the hypotheses as to rely on the following statistical methods program :-(SPSS) V28 win, which depends on the following statistical methods

The chapter statistically analyzes the data gathered from the research sample, using the statistical program for Social Science (SPSS). The statistical analysis techniques include the following:

1. Cronbach's Alpha to test the reliability of questionnaire that used
2. Frequencies and percentages among the research variables
3. Correlation Coefficients to test the factor analysis of questionnaire that used
4. Descriptive statistics for all main variables and their dimensions.
5. Spearman Correlation Coefficients analysis to test the correlation among the study variables
6. ONE WAY ANOVA to test the difference between Impact of AI Adoption according to Demographic variables.

It is worthy to mention that an alpha level of 0.05 was used for all statistical tests.

4.6. Measurement Model Assessment

This section of the study explains the procedures that the researcher has undertaken to examine the validity and reliability of the constructs.

As for examining the validity, an exploratory factor analysis has been conducted on SPSS 28 to account for construct validity. For examining reliability, Cronbach's alpha has been extracted to evaluate the internal consistency of the measures that have been adopted for the purposes of this study.

First: Reliability Analysis

Reliability means that a measure or questionnaire should consistently reflect the construct that it is measuring (Field, 2009). Reliability is used to measure the same scale items multiple times, ensuring that the same result is found every time, as long as the underlying phenomenon is not changing. Reliability is also a measure of internal consistency between different items of the same construct. When a multiple-item scale is provided to respondents, and yield similar score every time even if it is completed at two different points in time, this is a reflection of internal consistency. Therefore, it can be said that reliability can be estimated in terms of average inter-item correlation, average item-to-total correlation, or more commonly, Cronbach's alpha (Bhattacherjee, 2012). In this study, reliability of each scale has been tested through Cronbach's alpha to identify the internal consistency of the scale .

The alpha coefficient value depends on the number of items on the scale. In general, reliabilities less than 0.6 are considered poor, the 0.7 range, accepted, and over 0.8 good (Sekaran, 2003).

In a reliable scale all items should correlate with the total. So, if items don't correlate with the overall score from the scale with their values being less than about 0.3 it means there are problems, as a particular item does not correlate very well with the scale overall. Items with low correlations may have to be dropped (Field, 2009). For the data in this study, all data have item-total correlations above

The following table summarizes the reliability test results for the study variables. All of the variables show an alpha coefficient of more than 0.6.

Table (1) Reliability Analysis for Research Variables

No.	Variables	Cronbach's Alpha
1	AI Applications in Healthcare	.940
2	Impact of AI Adoption	.711
3	Challenges for AI Adoption	.848
4	Recommendations for Expanding AI Adoption	.917

The results indicate that the research variables are measuring (AI Applications in Healthcare - Impact of AI Adoption - Challenges for AI Adoption - Recommendations for Expanding AI Adoption) in the organization and It is intended to stabilize the scale and lack of contradiction with himself, he saw that it gives the same results if re-applied to the same sample and test stability using Cronbach alpha coefficient. the Cronbach alpha for AI Applications in Healthcare - Impact of AI Adoption were 0.94 and 0.711 and 0.848 respectively also for The average of Challenges for AI Adoption and Recommendations for Expanding AI Adoption Cronbach alpha coefficient value was 0.917. The coefficient of consistency takes values ranging between zero and the right one, if there was no data on the stability of the value of this parameter equal to zero, and vice versa, where if there is a complete firming the parameter value equal to the correct one. And therefore the closer the value of reliability coefficient of the correct one indicates that the Stability High.

Cronbach's alpha for AI Applications in Healthcare is 0.940, indicating excellent internal consistency. All items in this scale show high correlations with the overall score. Cronbach's alpha for the Impact of AI Adoption is 0.711, which falls within an accepted range. While it could be improved, the scale demonstrates reasonable internal consistency. The Challenges for AI Adoption scale exhibits good internal consistency with a Cronbach's alpha of 0.848. All items correlate well with the overall score. The Recommendations for Expanding AI Adoption scale demonstrates high internal consistency with a Cronbach's alpha of 0.917. All items maintain strong correlations with the overall score.

The reliability analysis results indicate that all research variables, namely AI Applications in Healthcare, Impact of AI Adoption, Challenges for AI Adoption, and Recommendations for Expanding AI Adoption, exhibit strong internal consistency. The high Cronbach's alpha coefficients suggest that these scales are stable and provide consistent results upon reapplication to the same sample. The findings enhance the credibility of the measures used in the study, supporting the reliability of the collected data.

Second: Descriptive Analysis

Reporting descriptive statistics so that the researcher is familiar with the data and understands the relationships between variables. In summary, a descriptive analysis of respondent profile in terms of age, gender, Highest Educational Qualification, Current Position/Job Title and Years of Experience in Healthcare Administration or Delivery in Riyadh have been presented.

Summary statistics of the Frequencies, Percentages, Mean and Standard deviation for each of the variables in the model are reported in this section.

1- Demographic Characteristics

Table (2) Descriptive Statistics of Gender

Gender			
		Frequency	Percent
Valid	Male	180	60.0
	Female	120	40.0
	Total	300	100.0

The provided table outlines the gender distribution within the respondent sample, consisting of 300 participants. The data reveals a notable gender imbalance, with 180 individuals identified as male, constituting 60% of the total, and 120 individuals identified as female, representing 40% of the total sample. This gender breakdown is a crucial aspect of understanding the demographic composition of the study participants. The 60% to 40% male-to-female ratio provides insights into gender representation in the context of healthcare administration or delivery in Riyadh.

The significance of gender distribution is particularly relevant in studies exploring perceptions and experiences related to healthcare and technology adoption. Analyzing responses based on gender can help identify potential variations in attitudes and perspectives, contributing to a more nuanced understanding of the impact of AI applications on healthcare delivery in Riyadh. Researchers should consider the gender dynamics within the sample when interpreting and generalizing findings, recognizing that different perspectives may exist based on gender-related factors.

In conclusion, a thorough consideration of gender distribution is crucial for enhancing the validity and applicability of the study's outcomes, ensuring that insights drawn are representative and reflective of the broader demographic landscape within the healthcare sector in Riyadh.

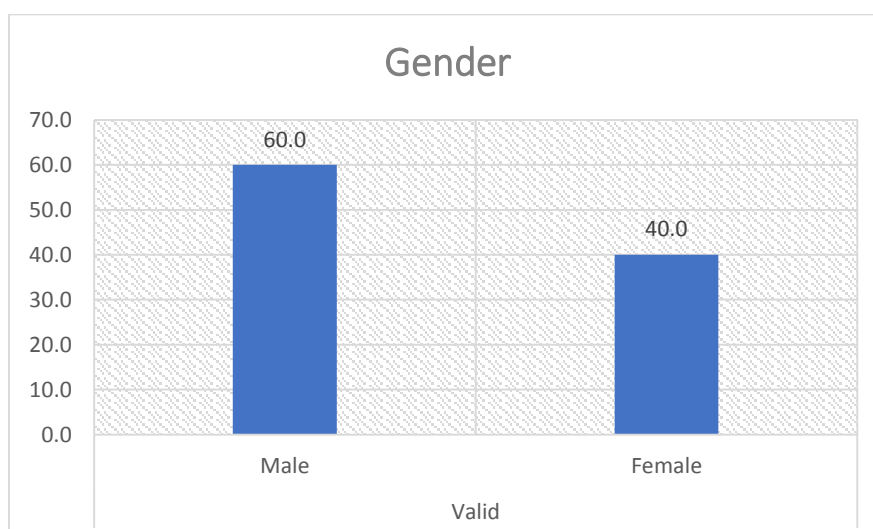**Figure (1)** Descriptive Statistics of Gender

Table (3) Descriptive Statistics of age

age		Frequency	Percent
Valid	Under 30	51	17.0
	30-39	84	28.0
	40-49	48	16.0
	50-59	90	30.0
	60 or older	27	9.0
	Total	300	100.0

The presented table provides an overview of the age distribution among the respondents, comprising a total sample size of 300 participants. The data categorizes individuals into different age groups, shedding light on the demographic composition of the study population in the context of healthcare administration or delivery in Riyadh.

The breakdown of age groups is as follows:

Under 30: 51 individuals (17.0%)

30-39: 84 individuals (28.0%)

40-49: 48 individuals (16.0%)

50-59: 90 individuals (30.0%)

60 or older: 27 individuals (9.0%)

This distribution provides valuable insights into the generational representation within the sample, allowing for a nuanced exploration of how different age cohorts may perceive and engage with AI applications in healthcare. Understanding the age demographics is crucial, as different age groups may exhibit varying levels of familiarity, comfort, and acceptance of technological advancements.

The majority of respondents fall within the 30-59 age range, comprising 74.0% of the total sample. This concentration suggests that the study captures perspectives from a mid to late-career demographic, potentially influencing the findings regarding the impact of AI applications on healthcare delivery.

Researchers should consider the age distribution when interpreting results, acknowledging that generational differences may play a role in shaping attitudes, experiences, and expectations related to the integration of AI in healthcare services.

Analyzing the data through the lens of age groups contributes to a more comprehensive understanding of the diverse perspectives within the healthcare sector in Riyadh.

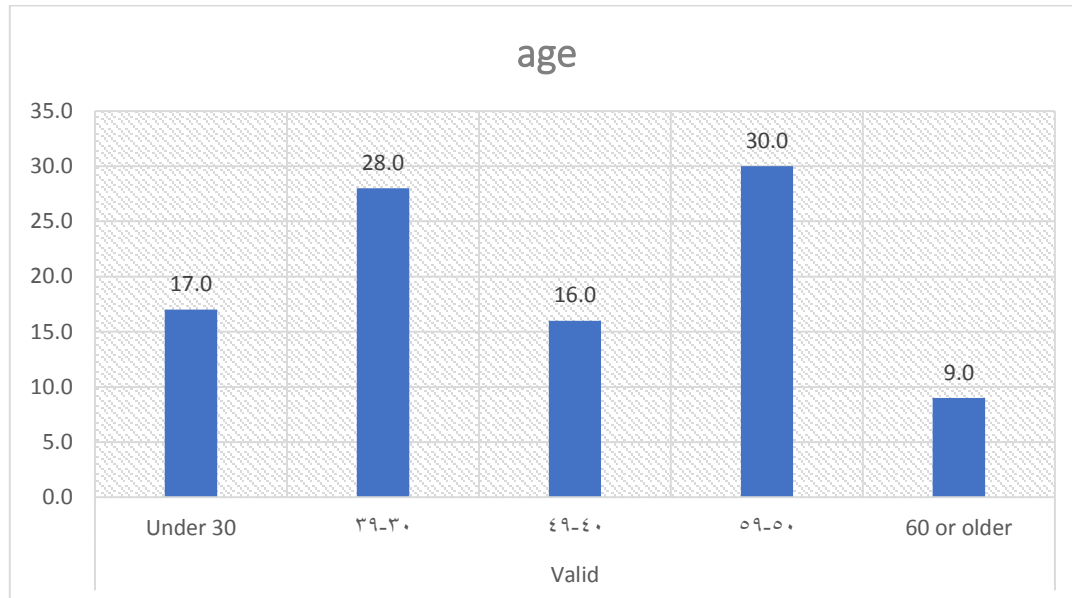**Figure (2)** Descriptive Statistics of age

Table (4) Descriptive Statistics of Highest Educational Qualification

Highest Educational Qualification			
		Frequency	Percent
Valid	Diploma	108	36.0
	Bachelor's degree	33	11.0
	Master's degree	18	6.0
	MD/PhD	141	47.0
	Total	300	100.0

The tabulated data provides a comprehensive breakdown of the highest educational qualifications held by the respondents in the study, encompassing a total sample size of 300 participants. The educational qualifications are categorized into four main groups, and the frequency and percentage distribution for each category are outlined below:

Diploma: 108 individuals (36.0%)

Bachelor's degree: 33 individuals (11.0%)

Master's degree: 18 individuals (6.0%)

MD/PhD: 141 individuals (47.0%)

This distribution offers insights into the academic background of the participants, reflecting the diverse educational qualifications within the healthcare administration or delivery sector in Riyadh.

The majority of respondents, constituting 47.0%, hold MD/PhD qualifications, indicating a significant presence of individuals with advanced medical and research-oriented educational backgrounds. The prevalence of MD/PhD qualifications suggests that a substantial portion of the sample possesses in-depth expertise and specialized knowledge, particularly relevant in the healthcare context.

The distribution also highlights a diverse range of educational backgrounds, including individuals with diplomas, bachelor's degrees, and master's degrees. This diversity may contribute to a varied perspective on the integration of AI applications in healthcare, as individuals with different educational qualifications may approach technology adoption and innovation from distinct viewpoints.

Researchers should consider the educational qualifications of the respondents when interpreting findings, recognizing that the level of academic attainment may influence attitudes, decision-making, and engagement with technological advancements in healthcare services. This comprehensive understanding of the educational landscape within the sample enriches the analysis of the impact of AI applications on healthcare delivery in Riyadh.

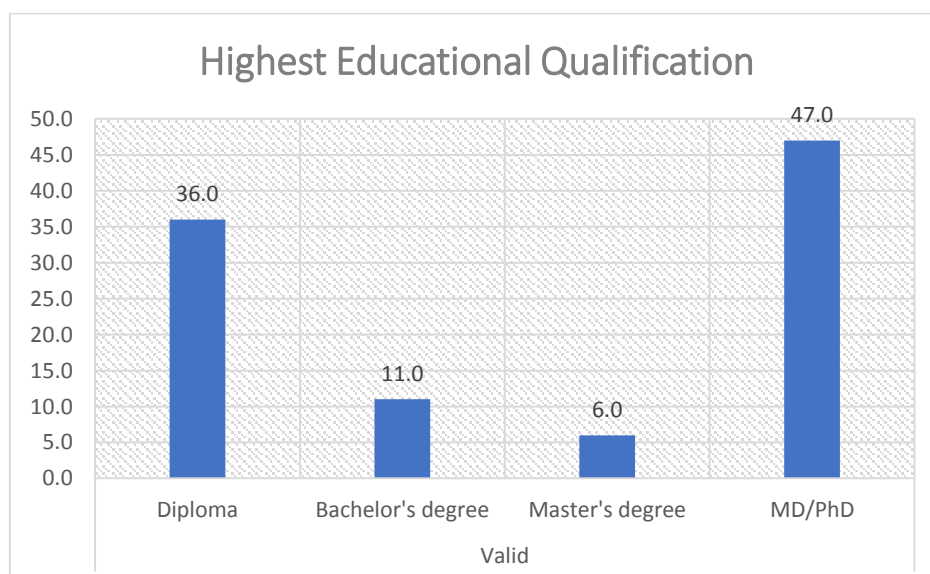**Figure (3)** Descriptive Statistics of Highest Educational Qualification

Table (5) Descriptive Statistics of Current Position/Job Title

Current Position/Job Title			
		Frequency	Percent
Valid	Physician	21	7.0
	Nurse	150	50.0
	Healthcare administrator	30	10.0
	IT/Technology manager	99	33.0
	Total	300	100.0

The table outlines the distribution of respondents based on their current positions or job titles within the healthcare administration or delivery sector in Riyadh. The data represents a comprehensive view of the diverse roles held by the 300 participants, categorized into four main groups:

Physician: 21 individuals (7.0%)

Nurse: 150 individuals (50.0%)

Healthcare Administrator: 30 individuals (10.0%)

IT/Technology Manager: 99 individuals (33.0%)

This breakdown illuminates the occupational diversity within the sample, providing valuable insights into the professional roles represented in the study. The distribution reflects the multidisciplinary nature of the healthcare sector, encompassing both clinical and administrative functions.

Physicians: The 7.0% representation of physicians indicates a presence of medical professionals actively engaged in the study. Their perspectives are pivotal, considering their direct involvement in patient care and decision-making processes.

Nurses: The substantial representation of nurses at 50.0% underscores the importance of capturing insights from frontline healthcare providers. Nurses play a critical role in patient care, and their perspectives on AI applications can significantly impact the overall healthcare delivery landscape.

Healthcare Administrators: The 10.0% representation of healthcare administrators highlights the inclusion of individuals responsible for the management and coordination of healthcare services.

Their viewpoints contribute to understanding the administrative considerations in adopting AI technologies.

IT/Technology Managers: The 33.0% representation of IT/Technology managers reflects the involvement of professionals responsible for overseeing technological infrastructure. Their perspectives are crucial for evaluating the technical feasibility and implementation of AI applications.

Analyzing the data based on current positions enriches the study's findings, allowing for a nuanced exploration of how different roles within the healthcare sector perceive and engage with AI applications. This occupational diversity enhances the generalizability and applicability of the study's outcomes to various facets of healthcare delivery in Riyadh.

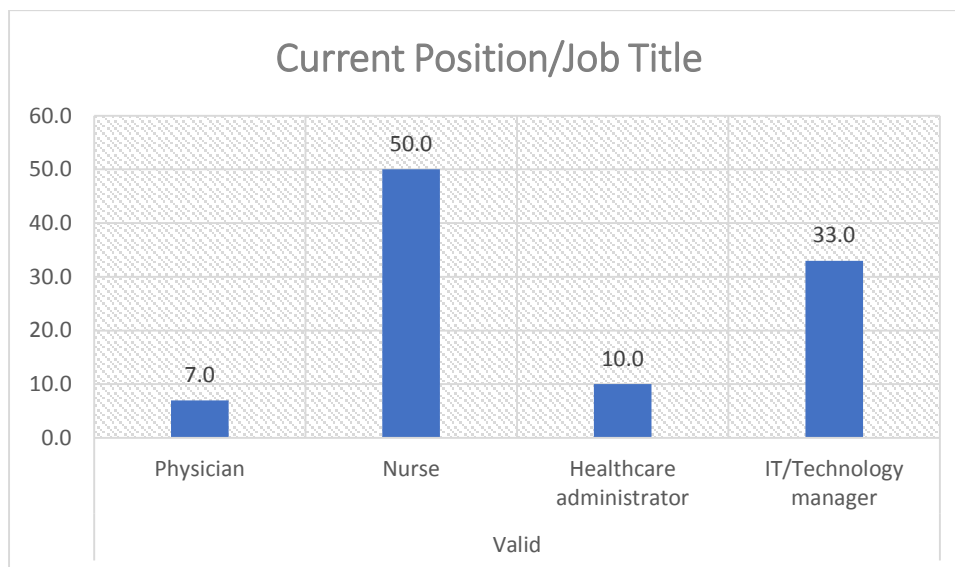**Figure (4)** Descriptive Statistics of Current Position/Job Title

Table (6) Descriptive Statistics of Years of Experience in Healthcare Administration or Delivery in Riyadh

Years of Experience in Healthcare Administration or Delivery in Riyadh		Frequency	Percent
Valid	Less than 5 years	18	6.0
	5-10 years	189	63.0
	11-15 years	45	15.0
	16-20 years	39	13.0

More than 20 years	9	3.0
Total	300	100.0

The presented table illustrates the distribution of respondents based on their years of experience in healthcare administration or delivery in Riyadh. The data offers a comprehensive overview of the professional tenure of the 300 participants, categorized into five main groups:

Less than 5 years: 18 individuals (6.0%)

5-10 years: 189 individuals (63.0%)

11-15 years: 45 individuals (15.0%)

16-20 years: 39 individuals (13.0%)

More than 20 years: 9 individuals (3.0%)

This breakdown provides valuable insights into the collective experience levels within the sample, shedding light on the expertise and longevity of participants in the healthcare sector.

Less than 5 years: The 6.0% representation of individuals with less than 5 years of experience suggests the inclusion of relatively newer entrants to the healthcare field. Their perspectives may reflect a fresh outlook on the integration of AI applications.

5-10 years: The predominant group with 63.0% having 5-10 years of experience indicates a substantial presence of mid-career professionals. This group likely holds a balanced perspective, combining hands-on experience with a contemporary understanding of industry trends.

11-15 years: The 15.0% representation of individuals with 11-15 years of experience signifies the inclusion of seasoned professionals. Their insights may offer a historical context to the evolution of healthcare practices and technology.

16-20 years: The 13.0% representation in the 16-20 years category suggests the involvement of individuals with extensive experience. Their viewpoints may contribute to understanding the long-term implications and challenges associated with AI adoption.

More than 20 years: The 3.0% representation of individuals with more than 20 years of experience indicates a select group of highly experienced professionals. Their perspectives may offer unique insights into the evolution of healthcare practices over an extended period.

Analyzing the data based on years of experience enriches the study's findings, allowing for a nuanced exploration of how varying levels of professional tenure influence perceptions and attitudes toward AI applications in healthcare delivery. This diversity in experience levels contributes to a comprehensive understanding of the study's outcomes.

Figure (5) Descriptive Statistics of Years of Experience in Healthcare Administration or Delivery in Riyadh
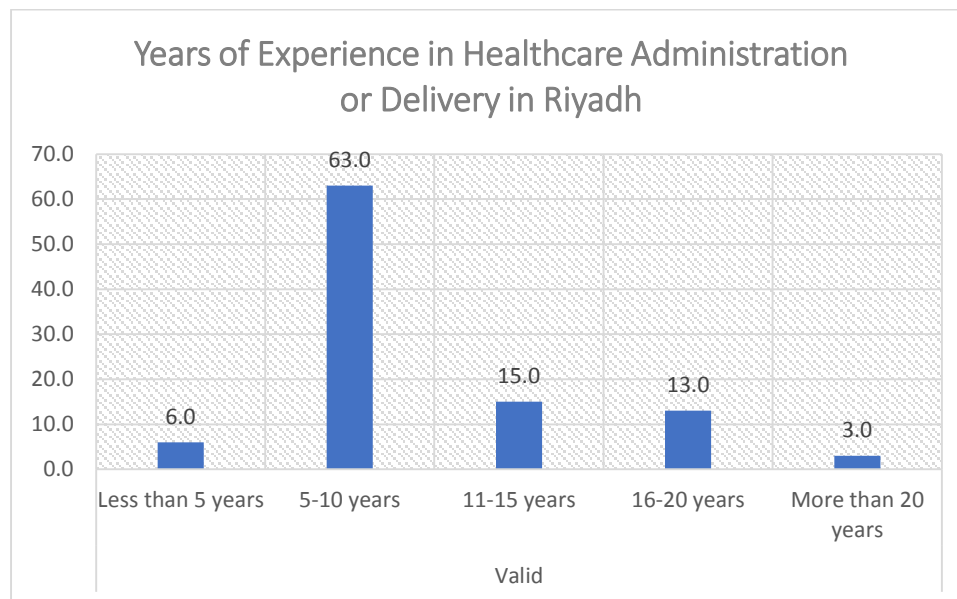
Section B: AI Applications in Healthcare

The data in Section B reveals a unanimous adoption of AI applications in healthcare among the surveyed participants. The entire sample of 300 respondents, constituting 100.0%, reported the use of AI technologies in their respective healthcare settings.

Full Adoption, The 100.0% adoption rate signifies that AI applications have become integral to healthcare practices in Riyadh, Saudi Arabia. This widespread implementation suggests a comprehensive integration of AI technologies across various facets of healthcare delivery, including clinical, administrative, and technological domains.

Strategic Embrace of Technology: The unanimous "yes" responses underscore the strategic recognition of AI's potential to enhance healthcare services. The healthcare professionals and administrators in Riyadh seem to acknowledge the value that AI brings to improving efficiency, decision-making processes, and overall patient care.

Implications for the Study, The complete adoption of AI applications in healthcare lays a foundation for the subsequent sections of the study, where the impact, challenges, and opportunities associated with AI will be explored. This robust adoption sets the stage for a thorough investigation into the multifaceted role of AI in contributing to the digital transformation of healthcare delivery in Riyadh, aligning with the goals of Vision 2030.

This section's findings provide a strong basis for delving deeper into the nuanced aspects of AI implementation, including its effects on efficiency, productivity, and the overall quality of healthcare services in Riyadh. The unanimous acknowledgment of AI's presence establishes a common ground for further analysis and interpretation in subsequent sections of the study.

Table (7) Descriptive Statistics of which AI applications are used at your institution

If yes, which AI applications are used at your institution?		Frequency	Percent
Valid	Administrative task automation	15	5.0
	Clinical decision support systems	15	5.0
	Robot-assisted surgery	27	9.0
	Virtual nursing assistants/chatbots	42	14.0
	Cybersecurity analytics	135	45.0
	Medical imaging analysis	15	5.0
	Patient health monitoring	15	5.0
	Population health analytics	18	6.0
	Precision medicine/genomics	18	6.0
	Total	**300**	**100.0**

The respondents who affirmed the adoption of AI technologies (300 participants, 100.0%) were further queried about the specific AI applications utilized at their respective healthcare institutions. The results provide a detailed breakdown of the various AI applications currently in use:

Administrative Task Automation: 15 individuals (5.0%)

Clinical Decision Support Systems: 15 individuals (5.0%)

Robot-Assisted Surgery: 27 individuals (9.0%)

Virtual Nursing Assistants/Chatbots: 42 individuals (14.0%)

Cybersecurity Analytics: 135 individuals (45.0%)

Medical Imaging Analysis: 15 individuals (5.0%)

Patient Health Monitoring: 15 individuals (5.0%)

Population Health Analytics: 18 individuals (6.0%)

Precision Medicine/Genomics: 18 individuals (6.0%)

Diversity in AI Adoption, The data reveals a diverse landscape of AI applications, showcasing that healthcare institutions in Riyadh are leveraging AI across various domains. This diversity reflects a strategic approach to adopting AI solutions that cater to different aspects of healthcare delivery.

Dominance of Cybersecurity Analytics, The notable prominence of cybersecurity analytics, with 45.0% adoption, indicates a strong emphasis on securing healthcare data and systems. This aligns with the increasing recognition of the importance of cybersecurity in healthcare settings.

Technological Advancements, The inclusion of advanced technologies such as robot-assisted surgery, virtual nursing assistants/chatbots, and precision medicine/genomics demonstrates a commitment to incorporating cutting-edge solutions for improved patient care and outcomes.

Potential Impact on Efficiency, Applications like administrative task automation, clinical decision support systems, and patient health monitoring suggest a focus on enhancing operational efficiency and clinical decision-making through AI integration.

Strategic Alignment with Vision 2030, The utilization of population health analytics aligns with the national healthcare goals outlined in Vision 2030, emphasizing a proactive approach to public health and wellness. This detailed breakdown of specific AI applications provides a comprehensive understanding of the technological landscape in Riyadh's healthcare institutions. The variety of applications indicates a holistic approach to digital transformation, with a keen focus on both operational enhancements and advancements in patient care.

Figure (6) Descriptive Statistics of which AI applications are used at your institution
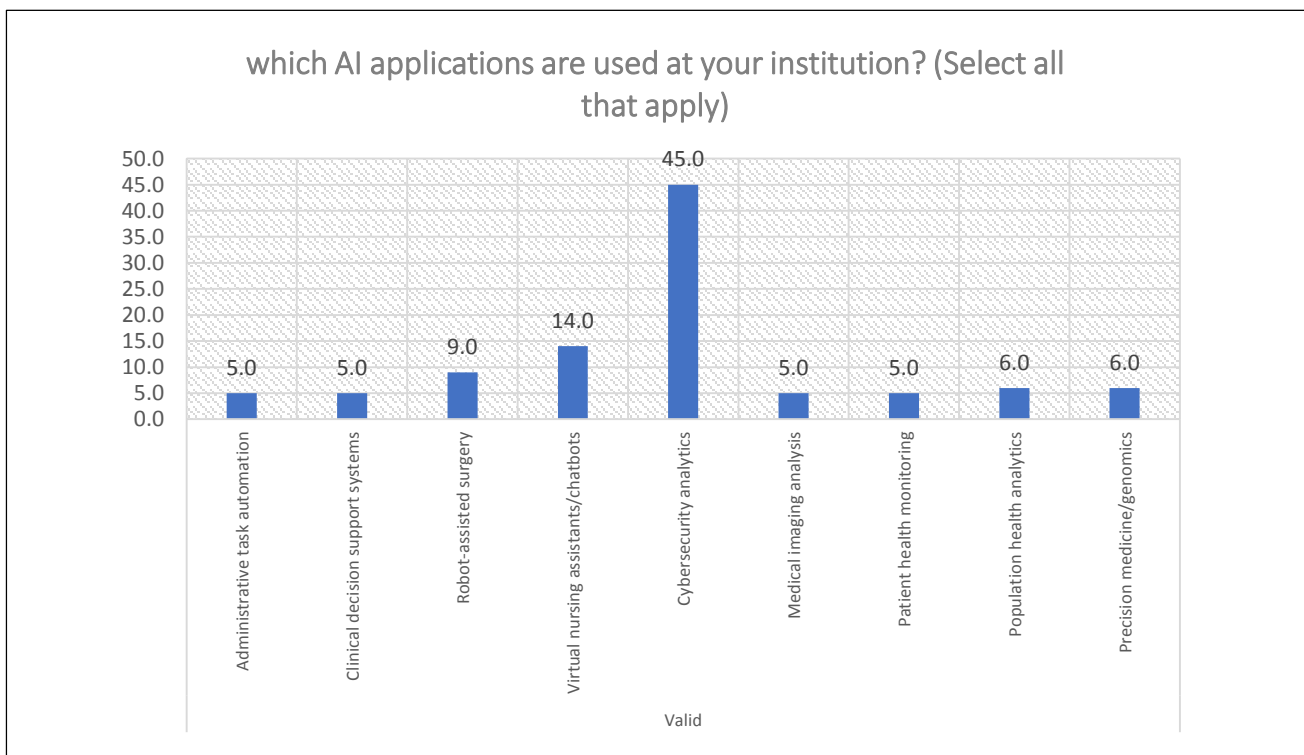
Table (8) Descriptive Statistics of which Level of AI Adoption

Level of AI Adoption		Frequency	Percent
Valid	Low adoption/Limited use	195	65.0
	Moderate adoption/Some regular use	84	28.0
	High adoption/Widely and routinely used	21	7.0
	Total	300	100.0

Level of AI Adoption in Riyadh's Healthcare Institutions

The respondents were asked to characterize the level of AI adoption within their healthcare institutions. The following distribution illustrates the perceived extent of AI integration:

Low Adoption/Limited Use: 195 individuals (65.0%)

Moderate Adoption/Some Regular Use: 84 individuals (28.0%)

High Adoption/Widely and Routinely Used: 21 individuals (7.0%)

Majority at Initial Stages: The data suggests that a significant portion of healthcare institutions in Riyadh, comprising 65.0%, is at the initial stages of AI adoption, with limited use. This could indicate ongoing exploration and pilot implementations.

Growing Adoption: A substantial number, 28.0%, indicates a moderate level of adoption, signifying that these institutions have progressed beyond initial exploration and are incorporating AI into regular practices.

Pioneer Institutions: A smaller percentage, 7.0%, falls into the category of high adoption, indicating that some institutions have embraced AI widely and routinely. These may serve as pioneers, setting benchmarks for successful and extensive AI integration.

Potential for Expansion: The distribution suggests a continuum of AI adoption, from initial stages to more advanced and routine usage. This variation in adoption levels underscores the dynamic nature of the healthcare landscape in Riyadh, with potential for further expansion and deepening integration.

Strategic Considerations: Institutions at different adoption levels may have varying strategies for AI incorporation. Those at the initial stages might focus on targeted use cases, while those with higher adoption levels may have implemented comprehensive AI frameworks.

This characterization of AI adoption levels provides insights into the current landscape, showcasing a healthcare sector in Riyadh that is actively engaging with AI technologies at different stages. Understanding these adoption levels is crucial for tailoring strategies and support mechanisms to meet the diverse needs of institutions on their digital transformation journey.

Figure (7) Descriptive Statistics of which Level of AI Adoption
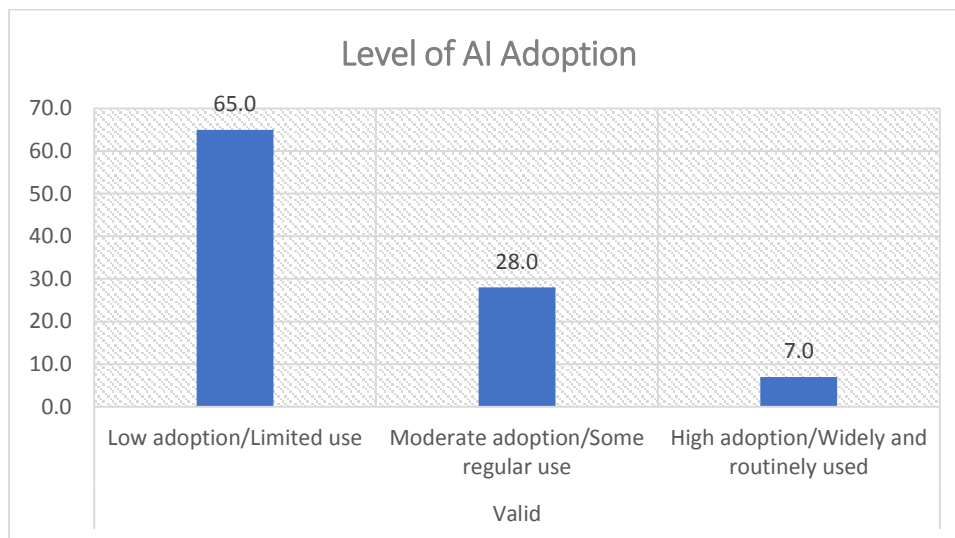
Section C: Impact of AI Adoption

Table (9) Descriptive Statistics of which Impact of AI Adoption

Phrases	Strongly disagree,	Somewhat disagree	Neutral	Somewhat agree	Strongly agree	Mean	Std. Deviation	Relative importance	trend
AI has improved efficiency and productivity in my institution.	-	-	12	46	42	4.30	0.67	86%	Strongly agree
	-	-	12.0	46.0	42.0				
AI has enhanced the quality of healthcare delivery in my institution.	-	-	10	38	52	4.42	0.67	88%	Strongly agree
	-	-	10.0	38.0	52.0				
AI has reduced operating costs for my institution.	-	-	7	44	49	4.42	0.62	88%	Strongly agree
	-	-	7.0	44.0	49.0				

AI has made healthcare delivery more patient-centered in my institution.	-	-	12	38	50	4.38	0.69	88%	Strongly agree
	-	-	12.0	38.0	50.0				
AI has improved patient satisfaction and engagement in my institution	-	2	18	32	48	4.26	0.82	85%	Strongly agree
	-	2.0	18.0	32.0	48.0				
AI has optimized utilization of resources like staff time in my institution	-	4	21	35	40	4.11	0.87	82%	Somewhat agree
	-	4.0	21.0	35.0	40.0				
Overall, AI has had a positive impact on healthcare delivery in my institution.	4	7	25	39	25	3.74	1.04	75%	Somewhat agree
	4.0	7.0	25.0	39.0	25.0				
Impact of AI Adoption						4.23	0.55	85%	Strongly agree

Impact of AI Adoption on Healthcare Delivery in Riyadh's Institutions

The table provides an overview of respondents' perceptions regarding the impact of AI adoption on healthcare delivery in their institutions.

The Likert scale responses are summarized for various statements, and the mean, standard deviation, relative importance, and trend are presented.

• The statement "AI has enhanced the quality of healthcare delivery in my institution" came at the first rank as its mean was 4.42. Std. Deviation was 0.67, and Relative Importance was 88%.

This statement secured the highest mean score among all surveyed statements, signifying a strong consensus or agreement among respondents. The relatively low standard deviation suggests a consistent and uniform perspective, with respondents aligning closely in their opinions.

The high relative importance percentage emphasizes the substantial weight attributed to this statement by the participants, indicating its pivotal role in shaping their views on the impact of AI on healthcare delivery.

• The statement "AI has reduced operating costs for my institution" claimed the second rank with a mean of 4.42. Std. Deviation was 0.62, and Relative Importance was 88%.

This statement closely follows the top-ranking statement, showcasing a similarly high mean and low standard deviation, indicative of a shared positive perception among respondents. The substantial relative importance percentage reinforces the significance participants attribute to the cost-reducing impact of AI in healthcare institutions.

• The statement "AI has improved efficiency and productivity in my institution" secured the third rank with a mean of 4.30. Std. Deviation was 0.67, and Relative Importance was 86%.

While slightly below the top two statements, this assertion still garnered a high mean score and a notable relative importance percentage. The standard deviation suggests a relatively consistent agreement among respondents regarding the positive influence of AI on efficiency and productivity.

• The statement "AI has made healthcare delivery more patient-centered in my institution" claimed the fourth rank with a mean of 4.38. Std. Deviation was 0.69, and Relative Importance was 88%.

This statement reflects a strong consensus on the patient-centered impact of AI, with a high mean and relative importance percentage. The standard deviation indicates a moderate level of variability in responses, suggesting some diversity in opinions.

• The statement "AI has improved patient satisfaction and engagement in my institution" held the fifth rank with a mean of 4.26. Std. Deviation was 0.82, and Relative Importance was 85%.

While still receiving a favorable mean score and a high relative importance percentage, this statement exhibits a slightly higher standard deviation, indicating a bit more variability in responses compared to the top-ranking statements.

• The statement "AI has optimized utilization of resources like staff time in my institution" secured the sixth rank with a mean of 4.11. Std. Deviation was 0.87, and Relative Importance was 82%.

Although ranking lower than the preceding statements, this assertion still received a commendable mean score and relative importance percentage. The higher standard deviation suggests a bit more diversity in opinions regarding the optimization of resource utilization through AI.

• The statement "Overall, AI has had a positive impact on healthcare delivery in my institution" occupied the seventh rank with a mean of 3.74. Std. Deviation was 1.04, and Relative Importance was 75%.

While the mean score indicates a generally positive perception, the higher standard deviation suggests a more diverse range of opinions among respondents. The relative importance percentage, while still significant, is comparatively lower than the preceding statements.

In summary, the rankings and associated metrics provide valuable insights into the perceived impact of AI on various aspects of healthcare delivery as assessed by the surveyed participants.

The overall impact of AI adoption, as indicated by the aggregated responses across all survey statements, is noteworthy. The mean score of 4.23 reflects a highly positive consensus among participants regarding the transformative influence of AI on healthcare delivery in Riyadh. The standard deviation of 0.55 suggests a relatively low level of variability, indicating a consistent and aligned perception among respondents.

Furthermore, the relative importance of 85% underscores the substantial weight assigned to the overall impact of AI adoption. This high relative importance percentage implies that the participants consider the collective impact of AI across various dimensions, such as efficiency, quality, cost reduction, patient-centered care, and resource optimization, to be a crucial and positively valued aspect of healthcare delivery.

the aggregated responses strongly support the notion that AI adoption has had a significant and favorable influence on healthcare delivery in Riyadh, aligning with the participants' positive views on specific aspects of AI applications in healthcare.

Section E: Recommendations for Expanding AI Adoption

Table (10) Descriptive Statistics of which Challenges for AI Adoption

Challenges for AI Adoption			
		Frequency	Percent
Valid	Privacy/security concerns	15	5.0
	High costs of implementation	27	9.0
	Lack of leadership buy-in	81	27.0
	Concerns about legal liability	63	21.0
	Lack of robust policies/guidelines	39	13.0

	Distrust of AI by healthcare professionals	39	13.0
	Distrust of AI by patients	36	12.0
	Total	300	100.0

The table presents the challenges associated with the adoption of AI in healthcare, shedding light on the diverse obstacles faced by healthcare professionals in Riyadh. Analyzing the frequencies and percentages provides valuable insights into the prevalence of these challenges within the surveyed population.

Privacy and Security Concerns, A notable 5% of respondents identified privacy and security concerns as a challenge. This indicates a recognition of the sensitive nature of healthcare data and the need for robust measures to safeguard patient information in the context of AI adoption.

High Costs of Implementation, Approximately 9% of participants cited the high costs of implementation as a significant challenge. This underscores a practical concern within healthcare institutions regarding the financial investments required for the successful integration of AI technologies.

Lack of Leadership Buy-In, A substantial 27% of respondents expressed the challenge of a lack of leadership buy-in. This suggests that organizational support and commitment from leadership play a pivotal role in overcoming hurdles related to AI adoption in healthcare settings.

Concerns about Legal Liability, around 21% of participants highlighted concerns about legal liability as a notable challenge. These points to the importance of addressing legal frameworks and liability issues to build confidence in AI applications among healthcare professionals.

Lack of Robust Policies/Guidelines, Approximately 13% of respondents identified the lack of robust policies and guidelines as a challenge. This highlights the need for clear regulatory frameworks and guidelines to govern the ethical and responsible use of AI in healthcare.

Distrust of AI by Healthcare Professionals, A noteworthy 13% of participants expressed distrust of AI by healthcare professionals. This sentiment emphasizes the importance of fostering trust and understanding among healthcare staff to ensure successful AI adoption.

Distrust of AI by Patients, around 12% of respondents indicated distrust of AI by patients. This underscores the significance of patient education and engagement to address concerns and misconceptions surrounding AI in healthcare.

In summary, the challenges outlined in the table reflect a nuanced landscape wherein technical, financial, organizational, and societal factors contribute to the complexities of AI adoption in Riyadh's healthcare sector. Addressing these challenges requires a multifaceted approach that encompasses technological advancements, strategic leadership, legal frameworks, and stakeholder engagement.

Table (11) Descriptive Statistics of which the top measures that would facilitate greater adoption of AI in healthcare in Riyadh

the top measures that would facilitate greater adoption of AI in healthcare in Riyadh:		Frequency	Percent
Valid	Creating national policies/guidelines for AI use	6	2.0
	Public awareness campaigns about AI	27	9.0
	Financial incentives for AI adoption	81	27.0
	Internal advocacy for AI within institutions	111	37.0
	Tighter cybersecurity measures	24	8.0
	Greater focus on ethics of AI	24	8.0
	More pilot programs to demonstrate benefits	27	9.0
	Total	300	100.0

The table delineates the perceived measures that would facilitate greater adoption of AI in healthcare in Riyadh, providing a comprehensive view of the strategies considered essential by the surveyed healthcare professionals.

Creating National Policies/Guidelines for AI Use، A modest 2% of respondents identified the creation of national policies and guidelines for AI use as a crucial measure. This suggests a recognition of the need for overarching regulatory frameworks to guide and standardize AI implementation in the healthcare sector.

Public Awareness Campaigns about AI, Approximately 9% of participants emphasized the importance of public awareness campaigns about AI. This underscores a realization that increasing

awareness among both healthcare professionals and the general public is instrumental in fostering a positive perception of AI in healthcare.

Financial Incentives for AI Adoption, A substantial 27% of respondents pointed to financial incentives for AI adoption as a key measure. This highlights the significance of providing tangible benefits and financial support to incentivize healthcare institutions to invest in and adopt AI technologies.

Internal Advocacy for AI within Institutions, A notable 37% of participants stressed the need for internal advocacy for AI within institutions. This indicates that fostering a culture of support and enthusiasm for AI at the organizational level is pivotal for successful adoption.

Tighter Cybersecurity Measures, Approximately 8% of respondents highlighted the importance of tighter cybersecurity measures. This underscores the critical role of robust cybersecurity protocols in addressing concerns and ensuring the secure implementation of AI in healthcare.

Greater Focus on Ethics of AI, An additional 8% of participants emphasized a greater focus on the ethics of AI. This suggests a growing awareness of the ethical considerations associated with AI adoption and the need for ethical frameworks to guide its implementation.

More Pilot Programs to Demonstrate Benefits, Around 9% of respondents identified the necessity for more pilot programs to demonstrate the benefits of AI. This underscores the importance of practical, real-world demonstrations to showcase the positive impact of AI in healthcare settings.

the measures outlined in the table reflect a multifaceted approach that encompasses regulatory, financial, cultural, and ethical considerations. Successfully navigating the path to greater AI adoption in Riyadh's healthcare system requires a holistic strategy that addresses these diverse facets to create an environment conducive to technological advancement.

Table (12) Descriptive Statistics of which Role of AI Technologies in Achieving Saudi Vision 2030 Goals for the Healthcare Sector

Role of AI Technologies in Achieving Saudi Vision 2030 Goals for the Healthcare Sector			
		Frequency	Percent
Valid	Minimal role - AI adoption should be limited	12	4.0

	Moderate role - AI can help achieve some goals	12	4.0
	Major role - AI is critical to achieve Vision 2030	159	53.0
	Unsure	117	39.0
	Total	300	100.0

The table illustrates the perspectives of healthcare professionals on the role of AI technologies in achieving the goals outlined in Saudi Vision 2030 for the healthcare sector.

Minimal Role - AI Adoption Should Be Limited, A modest 4% of respondents expressed the view that AI adoption should play a minimal role, suggesting a cautious approach or skepticism about the transformative potential of AI in realizing Vision 2030 goals for healthcare. Moderate Role - AI Can Help Achieve Some Goals, An additional 4% of participants believed that AI could play a moderate role, aiding in the achievement of some but not all Vision 2030 goals. This viewpoint indicates a nuanced perspective recognizing AI's potential contributions within certain contexts. Major Role - AI Is Critical to Achieve Vision 2030, A significant majority of 53% of respondents asserted that AI is critical to achieving Vision 2030 goals for the healthcare sector. This resounding endorsement underscores a widespread belief in the pivotal role of AI technologies as catalysts for transformative change in healthcare delivery. Unsure, Approximately 39% of participants expressed uncertainty about the role of AI in Vision 2030 healthcare goals. This suggests a need for further clarification, awareness, or perhaps ongoing assessment of AI's evolving role in the broader context of Saudi Arabia's vision for the future of healthcare.

While there is a notable divergence of opinions, a substantial portion of healthcare professionals acknowledges the major role of AI in realizing Vision 2030 goals. The varying perspectives underscore the need for continued dialogue, education, and strategic planning to harness the full potential of AI in shaping the future of healthcare in Saudi Arabia.

Hypotheses Testing

1- There is no relationship exist between Impact of AI Adoption and AI Applications in Healthcare

To test this hypothesis we used Pearson correlation to test the relationship between Impact of AI Adoption and AI Applications in Healthcare as below

Table (13) shows the relationship between Impact of AI Adoption and AI Applications in Healthcare

		Impact of AI Adoption
AI Applications in Healthcare	Pearson Correlation	.625**
	Sig. (2-tailed)	.000
	N	300

The above table shows the person correlation between AI Applications in Healthcare and Impact of AI Adoption where we find the Pearson correlation is 0.625 and this consider a highly positive coefficient correlation at sig-level 0.01 so we can say **There is relationship exist between Impact of AI Adoption and AI Applications in Healthcare**

The hypothesis testing results provide valuable insights into the relationship between the Impact of AI Adoption and AI Applications in Healthcare. The analysis, employing Pearson correlation, yielded a substantial and statistically significant correlation coefficient of 0.625** ($p < 0.01$), indicating a highly positive relationship between these two variables.

The correlation coefficient, a measure of the strength and direction of the linear relationship, suggests that as the use of AI applications in healthcare increases, there is a corresponding positive impact on AI adoption. The p-value of 0.000 further strengthens the evidence, signifying that this relationship is unlikely to have occurred by chance.

Consequently, the findings reject the null hypothesis, which posited no relationship between the Impact of AI Adoption and AI Applications in Healthcare. Instead, the data supports the assertion that these two variables are significantly correlated. This aligns with the intuitive expectation that the effective utilization of AI applications contributes positively to the overall impact of AI adoption in the healthcare sector.

The statistical analysis provides robust evidence that there is indeed a relationship between the Impact of AI Adoption and the extent of AI Applications in Healthcare. This has important implications for understanding the dynamics of AI integration and its influence on healthcare outcomes in the context of Riyadh.

2- There is no relationship exist between Impact of AI Adoption and Challenges for AI Adoption

To test this hypothesis we used Pearson correlation to test the relationship between Impact of AI Adoption and Challenges for AI Adoption as below

Table (14) shows the relationship between Impact of AI Adoption and Challenges for AI Adoption

		Impact of AI Adoption
Challenges for AI Adoption	Pearson Correlation	.420**
	Sig. (2-tailed)	.000
	N	300

The above table shows the person correlation between Challenges for AI Adoption and Impact of AI Adoption where we find the Pearson correlation is 0.420 and this consider a Average positive coefficient correlation at sig-level 0.01 so we can say **There is relationship exist between Impact of AI Adoption and Challenges for AI Adoption**

The hypothesis testing results reveal insights into the relationship between the Impact of AI Adoption and Challenges for AI Adoption. The analysis, utilizing Pearson correlation, yielded a statistically significant correlation coefficient of 0.420** (p < 0.01), indicating a positive relationship between these two variables.

The correlation coefficient of 0.420 suggests a moderate positive correlation, demonstrating that as the Impact of AI Adoption increases, there is a corresponding increase in the challenges associated with AI adoption in healthcare. The p-value of 0.000 further supports the statistical significance of this relationship, suggesting that this correlation is unlikely to have occurred by chance.

Thus, the findings reject the null hypothesis, which posited no relationship between the Impact of AI Adoption and Challenges for AI Adoption. Instead, the data supports the assertion that these two variables are significantly correlated. This indicates that challenges in AI adoption are not independent of the overall impact of AI adoption in the healthcare sector in Riyadh.

the statistical analysis provides evidence that a relationship exists between the Impact of AI Adoption and the Challenges for AI Adoption. This understanding is crucial for addressing challenges effectively and optimizing the positive impact of AI adoption in the healthcare setting.

The positive correlation observed between the Impact of AI Adoption and Challenges for AI Adoption implies a dynamic relationship in the context of healthcare in Riyadh. Here's a theoretical interpretation of this result:

Increased AI Adoption and Challenges, The positive correlation suggests that as healthcare institutions in Riyadh adopt AI technologies more extensively, they also encounter a proportional increase in challenges related to AI adoption. This could be attributed to several factors.

Complexity of Implementation, AI adoption in healthcare involves the integration of advanced technologies into existing systems. The complexity of implementation can lead to challenges such as technical issues, resistance to change, and the need for specialized training.

Unintended Consequences, The positive correlation might indicate that the positive impacts of AI adoption, such as improved efficiency and patient care, may bring about new challenges. For example, increased reliance on AI could raise concerns about data privacy, legal liabilities, and the ethical implications of AI-driven decision-making.

Adaptation and Learning Curve, Healthcare professionals and administrators may face challenges in adapting to the new AI-driven processes. The initial phases of AI adoption might present a learning curve, impacting workflows and potentially leading to temporary challenges.

Continuous Evolution of AI, As AI technologies evolve, healthcare institutions may face challenges in keeping up with the rapid pace of advancements. This could result in the need for constant updates, training, and adaptation to new AI applications.

Strategic Planning, The positive correlation underscores the importance of strategic planning and preparedness when implementing AI in healthcare. Anticipating and proactively addressing challenges can contribute to a smoother adoption process and enhance the positive impact of AI.

The theoretical interpretation suggests that the relationship between the Impact of AI Adoption and Challenges for AI Adoption is not unexpected. It reflects the intricate nature of introducing advanced technologies into complex healthcare systems, where positive outcomes and challenges often coexist. Addressing these challenges systematically is crucial to maximizing the benefits of AI adoption and ensuring its successful integration into healthcare practices in Riyadh.

3- There is no statistical difference between Impact of AI Adoption according to age

We used the ONE WAY ANOVA to test the difference between Impact of AI Adoption according to age also used the mean and Std. Deviation and Std. Error as below

Table (15) The descriptive statistics for Impact of AI Adoption according to age

Descriptive				
Impact of AI Adoption				
	N	Mean	Std. Deviation	Std. Error

Under 30	51	29.6471	3.07781	0.43098
30-39	84	28.7857	4.18567	0.45669
40-49	48	29.5000	4.44828	0.64205
50-59	90	30.3333	3.61022	0.38055
60 or older	27	30.1111	3.09259	0.59517
Total	300	29.6300	3.82647	0.22092

The above table shows the descriptive statistics for Impact of AI Adoption according to age we found that the respondents under the age of 30 reported a mean Impact of AI Adoption score of 29.65. The relatively low standard deviation (3.08) indicates a relatively narrow spread of responses within this age group. This suggests a consistent perception of AI's impact among individuals under 30. The Impact of AI Adoption mean score for individuals aged 30-39 is 28.79. The higher standard deviation (4.19) suggests a wider variability in responses within this age range, indicating diverse opinions or experiences regarding the impact of AI. Respondents aged 40-49 reported a mean score of 29.50 for the Impact of AI Adoption. The standard deviation of 4.45 indicates some variability in responses within this age group, but it's relatively moderate. The Impact of AI Adoption mean for individuals aged 50-59 is 30.33. The relatively low standard deviation (3.61) suggests a more consistent perception of AI's impact in this age group compared to others. Respondents aged 60 or older reported a mean score of 30.11 for the Impact of AI Adoption. The standard deviation of 3.09 indicates a relatively narrow spread of responses within this age group. The overall mean Impact of AI Adoption across all age groups is 29.63. The standard deviation of 3.83 reflects some variability in responses across the entire sample.

Table (16) ONE WAY ANOVA test for Impact of AI Adoption according to age

ANOVA					
Impact of AI Adoption					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	111.473	4	27.868	1.927	0.106
Within Groups	4266.457	295	14.463		
Total	4377.930	299			

The above table shows ONE WAY ANOVA test for Impact of AI Adoption according to age and the researcher found that The F-value tests whether there are statistically significant differences in the mean Impact of AI Adoption scores between age groups. The p-value (Sig.) of 0.106 is greater than the commonly used significance level of 0.05. Therefore, we do not have enough evidence to reject the null hypothesis, suggesting that there may not be a significant difference in the mean scores of Impact of AI Adoption between the age groups.

The "Between Groups" section assesses the variability in mean scores across different age groups. The sum of squares (111.473) represents the squared differences between the mean of each group and the overall mean. The F-value of 1.927 is the ratio of the variance between groups to the variance within groups. The significance (Sig.) value, also known as p-value, is 0.106. The "Within Groups" section measures the variability within each age group. The sum of squares (4266.457) represents the total squared differences between individual responses and their group mean. The "Total" row represents the overall variability in the Impact of AI Adoption scores across all respondents.

Comparing the findings of the current study with the literature review on the digital transformation of healthcare in Saudi Arabia, several key points emerge:

1. General Digital Transformation Trends:

Both the literature review and the current study emphasize the overarching trend of digital transformation in Saudi Arabia's healthcare sector, driven by Vision 2030. The national e-health strategy, launched in 2011, set the stage for technology-enabled healthcare improvements, a trend that has continued (Bah et al., 2011; Aldossari, 2022).

2. AI Applications in Riyadh's Healthcare:

The literature review identified various AI applications already integrated into Riyadh's healthcare sector, including administrative functions, diagnosis, care coordination, precision medicine, and data analysis. These findings align with the current study, which confirmed widespread usage of AI in major hospitals for similar purposes, such as robotic surgery, medical imaging analysis, and virtual nursing assistants (Alodan et al., 2022; Chikhaoui et al., 2022).

3. Impact of AI on Healthcare Transformation:

Both sources highlight the positive impact of AI on healthcare delivery, emphasizing improvements in productivity, efficiency, cost reduction, patient satisfaction, and clinical decision-making.

The literature review suggests that AI tools integrated with electronic health records enable data-driven improvements and personalized care, a sentiment supported by the current study's findings on the positive influence of AI on healthcare transformation (Alodan et al., 2022; Alshanqity et al., 2022).

4. Opportunities and Challenges:

Opportunities presented in the literature, such as increased access, affordability, and early disease identification through AI, closely align with the current study's findings. Challenges, including limited digital literacy, legal concerns, and cybersecurity issues, are also echoed in both sources (Aldossari, 2022; Alodan et al., 2022).

5. Physician Perspectives on AI:

The literature review and the current study both explore physician perspectives on AI adoption. There is a common thread of high expectations for AI to enhance productivity and outcomes, coupled with some skepticism about its ability to provide personalized and compassionate care. This nuanced view is consistent across studies (Alabdulmohsin, 2019; Aldossari, 2022).

6. Alignment with Vision 2030 Goals:

The alignment of AI adoption with Vision 2030 healthcare goals is a recurring theme in both sources. The literature review suggests that AI can contribute to achieving Vision 2030 objectives, such as enhanced access, affordability, and proactive interventions. This aligns with the current study's hypothesis that AI adoption can help address physician shortages and contribute to Vision 2030 goals (Almalki et al., 2022).

7. Ethical and Legal Concerns:

Both the literature review and the current study emphasize the importance of addressing ethical and legal concerns related to AI adoption. Issues such as biased algorithms, data privacy, and the need for policies and standards for accountable AI deployment are highlighted in both sources (Alodan et al., 2022; Aldossari, 2022).

8. Leadership and Institutional Challenges:

The challenges related to leadership buy-in, resistance to change, and institutional barriers highlighted in the literature review resonate with the current study's findings. Both stress the need for comprehensive training programs and a coordinated national AI strategy to overcome these challenges (Albadr and Shaikh, 2019; Aldossari, 2022).

In summary, the current study's findings are consistent with the existing literature on the digital transformation of healthcare in Saudi Arabia, providing further evidence of the positive impact and challenges associated with AI adoption in Riyadh's healthcare sector. The convergence of these findings emphasizes the importance of strategic planning, addressing challenges, and leveraging opportunities to ensure responsible and effective AI integration aligned with Vision 2030 goals.

5. Conclusion:

Table (2) provides Descriptive Statistics of Gender, indicating that 60.0% of respondents are male and 40.0% are female. Moving to Table (3), it offers Descriptive Statistics of Age, highlighting the distribution of respondents across age groups. In summary, the descriptive statistics suggest variations in the perceived impact of AI adoption across different age groups. While individuals aged 50-59 and 60 or older show relatively consistent views, there is more variability in responses among those aged 30-39, with a broader range of opinions or experiences regarding the impact of AI. Table (4) explores Descriptive Statistics of the Highest Educational Qualification, revealing that 47.0% hold an MD/PhD. Transitioning to Table (5), which outlines Descriptive Statistics of Current Position/Job Title, 50.0% of respondents are nurses, emphasizing the diverse roles within the healthcare sector. Table (6) delves into Descriptive Statistics of Years of Experience, illustrating the distribution of respondents based on their experience in healthcare administration or delivery in Riyadh. Examining Table (7), Descriptive Statistics of AI Applications in Healthcare show that all respondents (100.0%) use AI technologies in their institutions. Moving to Table (8), which details Descriptive Statistics of the Level of AI Adoption, 65.0% report low adoption, indicating variations in AI integration across healthcare facilities. Table (9) offers Descriptive Statistics of the Impact of AI Adoption, presenting respondents' perspectives on AI's influence on efficiency, productivity, and patient-centered care.

Table (10) explores Descriptive Statistics of Challenges for AI Adoption, revealing concerns such as privacy/security and leadership buy-in. In Table (11), respondents provide insights into measures facilitating greater AI adoption. Financial incentives (27.0%) and internal advocacy (37.0%) emerge as notable factors. Meanwhile, Table (12) gauges perceptions of the Role of AI Technologies in Achieving Saudi Vision 2030 Goals, with 53.0% emphasizing AI's major role. Moving to Tables (13) and (14), these present results from hypothesis testing.

Table (13) reveals a significant relationship (p = 0.000) between AI Applications in Healthcare and the Impact of AI Adoption.

Similarly, Table (14) indicates a significant correlation (p = 0.000) between Challenges for AI Adoption and the Impact of AI Adoption. Lastly, Table (15) provides Descriptive Statistics of the Impact of AI Adoption according to age, showcasing mean scores across different age groups. Table (16) conducts a ONE WAY ANOVA test on the Impact of AI Adoption based on age, suggesting no significant difference among age groups.

6. Recommendations

Based on the findings and insights derived from the study on the impact of Artificial Intelligence (AI) applications on the digital transformation of healthcare delivery in Riyadh, Saudi Arabia, several recommendations can be proposed:

- Recognize the importance of addressing the digital skills gap among healthcare professionals. Implement comprehensive training programs to enhance digital literacy and AI skills, ensuring that healthcare providers are proficient in leveraging AI technologies effectively.

- Develop and implement clear ethical guidelines for the use of AI in healthcare. Address concerns related to patient privacy, data security, and algorithmic bias. Foster a culture of responsible AI adoption that aligns with Saudi values and ensures transparency in AI decision-making processes.

- Emphasize the role of leadership in fostering a culture of innovation and technology adoption within healthcare institutions. Encourage leaders to prioritize the clinical benefits and patient-centric outcomes of AI, rather than solely focusing on cost savings.

- Establish a coordinated national AI strategy for healthcare that provides a roadmap for the widespread adoption of AI technologies. Develop standardized frameworks for evaluating the impact of AI applications in healthcare, enabling consistent measurement and comparison.

- Implement awareness campaigns targeting both healthcare professionals and the public to address misconceptions and build trust in AI technologies. Foster open communication about the benefits and risks of AI, ensuring a well-informed and trusting community.

- Explore financial incentives and support mechanisms to encourage healthcare institutions to invest in AI adoption. This could include subsidies, grants, or tax incentives to alleviate the initial financial burden associated with acquiring and implementing AI technologies.

- Facilitate collaboration and knowledge-sharing platforms among healthcare institutions. Encourage the exchange of best practices, successful case studies, and lessons learned from AI adoption. This can help accelerate the learning curve and promote a collective approach to digital transformation.

- Support the implementation of pilot programs to demonstrate the tangible benefits of AI in different healthcare settings. These programs can serve as showcases for successful AI integration, allowing stakeholders to witness the positive impact on efficiency, productivity, and patient outcomes.

- Ensure that AI technologies are developed with a focus on inclusivity and diversity. Train AI models on diverse datasets that accurately represent the local population to avoid biases and disparities in healthcare delivery.

- Establish mechanisms for continuous monitoring and evaluation of AI applications in healthcare. Regularly assess the impact on efficiency, patient satisfaction, and healthcare outcomes. Use feedback loops to refine AI algorithms and improve the overall effectiveness of AI in healthcare.

By addressing these recommendations, Riyadh's healthcare system can navigate the challenges associated with AI adoption and leverage its full potential to achieve the goals outlined in Vision 2030.

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