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ORIGINAL RESEARCH ARTICLE

A mixed methods study of the transformative effects of artificial intelligence on healthcare

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ABSTRACT

Technological advancements have catalyzed the emergence of Artificial Intelligence (AI), significantly enhancing the efficiency of diverse healthcare services. AI has a pivotal role in revolutionizing medical processes and addresses its potential in drug discovery, disease prognosis, and healthcare optimization. The study employs both quantitative and qualitative methods to investigate the multifaceted dimensions of AI's influence on healthcare. The quantitative phase involves a diverse participant pool, employing surveys and clinical data analysis. Multiple linear regression and ANOVA are used to assess the relationship between AI utilization and patient outcomes. The qualitative phase includes in-depth interviews, providing insights into the complexities of AI integration, ethical concerns, and perspectives of healthcare professionals and patients. The findings reveal a moderate impact of AI on healthcare delivery, with challenges in AI integration and no significant influence of confidence in AI technologies. The study urges careful interpretation of results and highlights the imperative for additional research. It emphasizes the significance of a balanced approach, considering ethical implications, to fully leverage the potential of AI in enhancing medical procedures and shaping the future of healthcare delivery systems.

Keywords: artificial intelligence (AI); healthcare; electronic health records; doctor-patient

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1. Introduction

In recent years, the healthcare sector has witnessed a transformative wave with the emergence of Artificial Intelligence (AI), ushering in a new era of technological advancements. This profound impact on healthcare quality, accessibility, and efficiency has ignited intense interest among scholars and industry experts, fueling a plethora of research studies[1]. Emphasizing the pivotal role of advanced large language and generative models in medical processes, the study highlights their emergent properties and multimodal capabilities, proving invaluable across diverse medical tasks[2]. AI, with its remarkable speed in generating precise diagnoses and tailored treatment plans by processing extensive medical data, offers viable solutions to critical healthcare challenges, captivating the industry's imagination[3]. Moreover, the potential of AI extends to groundbreaking applications in drug discovery, disease prognosis, and overall healthcare process optimization, holding the power to save lives and significantly improve medical outcomes through early identification and intervention[4]. In essence, the study of AI in healthcare has become a focal point of interest for researchers, policymakers, and healthcare practitioners, showcasing the collective enthusiasm for harnessing AI's potential to revolutionize the medical

industry[2]. This paper employs a rigorous mixed-methods analysis to comprehensively explore the multifaceted dimensions of AI's influence on healthcare.

1.1. Research problems and aim

While the literature on AI's transformative role in healthcare continues to expand, it is essential to recognize that critical gaps remain unexplored. The first pivotal step involves a comprehensive examination of the moral and legal implications of AI's integration into healthcare. Issues surrounding data privacy, algorithmic bias, and the potential impact of AI on the doctor-patient relationship warrant meticulous investigation. The second essential phase toward successfully incorporating AI into healthcare systems necessitates a thorough examination of its efficacy and acceptance among healthcare professionals and patients. Finally, the study underscores the significance of evaluating the cost-effectiveness and overall impact of AI adoption on healthcare economics, considering the substantial resources required for its implementation.

1.2. Research questions and hypotheses

This mixed-methods study endeavors to address the following research questions:

a. What is the effect of AI on healthcare delivery, and how does it influence patients' health and the quality of their care?
b. How can integrating AI into healthcare systems effectively address the challenges?
c. To what extent do healthcare providers and patients express confidence in AI technologies, and what factors contribute to their positive or negative perceptions of these advancements?

In conjunction with these research questions, the study formulates the following hypotheses:

- H1: The increased utilization of AI in healthcare is expected to improve patient outcomes due to its capacity for diagnostic precision and individualized care.
- H2: Ethical concerns and algorithmic biases are potential challenges in adopting artificial intelligence in healthcare.
- H3: AI technology adoption and confidence levels in healthcare settings can be enhanced through targeted education, training, and awareness programs tailored to healthcare personnel.

This study seeks to contribute evidence-based solutions to maximize AI's potential to revolutionize the medical industry. It revolves around the transformative implications of AI in healthcare. It seeks to address the research questions and hypotheses, ultimately fostering the integration of AI to improve healthcare practices and outcomes.

2. Literature review

2.1. The current landscape of AI in healthcare

Artificial Intelligence (AI) possesses the potential to revolutionize the healthcare industry fundamentally. Recent advancements underscore the current state of AI in various healthcare settings and applications. AI-powered algorithms are proving to be invaluable tools for healthcare providers, enhancing patient care across diverse domains, from medical imaging to drug discovery, as exemplified by the work of Reddy et al.[5]. Panesar's[6] exploration delves into the far-reaching impacts of AI-enabled healthcare delivery, while Reddy et al.'s[5] research highlights ethical and governance challenges associated with AI technology development. AI has rapidly emerged as a transformative force within healthcare, offering the promise of enhancing patient care, streamlining medical processes, and modernizing healthcare delivery. Researchers continue to unveil new use cases for AI in healthcare.

One particularly promising area in which AI has demonstrated its worth is diagnostic imaging. AI-driven systems are aiding radiologists in the early detection of cancerous growth and neurological conditions. Medical

image interpretation powered by AI has exhibited impressive accuracy, assisting radiologists in making early diagnoses and increasing the likelihood of positive patient outcomes. Beyond diagnostic imaging, AI is beneficial in various other medical domains. It enables researchers to navigate vast genetic and pharmacological databases swiftly, employing modern data analytics and machine learning techniques. This allows for the rapid identification of viable drug candidates and more precise predictions of medication responses in patients. Such advances hold the potential to benefit the pharmaceutical sector by reducing drug development timelines and paving the way for personalized therapy approaches. Additionally, AI is significantly impacting clinical decision-making, with clinical decision support systems considering each patient's unique traits, medical history, and genetic profiles to provide personalized therapy recommendations.

2.2. Previous studies on AI adoption in healthcare

Research into AI adoption in healthcare has yielded promising findings, particularly in AI-led chatbot services. Studies suggest that these chatbots can enhance patient support and facilitate healthcare information dissemination[7]. AI has also demonstrated its capability to address healthcare challenges, even in resource-constrained settings. However, infrastructure and data protection concerns must still be addressed to leverage AI's potential fully[8]. Furthermore, research has highlighted the significance of AI in medical education, providing students with comprehensive insights into digital health[9]. While AI promises to revolutionize healthcare, its rapid deployment has raised ethical and governance concerns. A major concern is the privacy of patient data and the security of AI-based decisions, as emphasized by Reddy et al.[5].

Stakeholders in healthcare, including both providers and consumers, must gain a comprehensive understanding of the rationale behind AI-generated recommendations. Regulatory bodies and healthcare stakeholders are responsible for addressing AI bias and fairness issues, especially as the technology evolves rapidly, to prevent unintended discriminatory consequences, particularly among vulnerable patient populations. Achieving the full potential of AI while mitigating associated risks necessitates the establishment of robust regulatory frameworks and ethical principles. While AI demonstrates transformative potential across various medical areas, including diagnostics, drug discovery research, and clinical decision-making, its implementation must proceed cautiously, taking ethical, regulatory, and governance considerations into account. If AI is to genuinely transform healthcare by providing more precise, accessible, and personalized medical solutions that enhance patient outcomes worldwide, innovation must remain aligned with ethical considerations.

2.3. Gaps and limitations in existing research

Despite the growing interest in AI adoption in healthcare, several gaps and limitations in existing research persist. One significant gap is the absence of a standardized framework for evaluating the effectiveness and safety of AI applications in medical practice. Morley et al.[10] have pointed out that ethical considerations of AI implementation in healthcare warrant further exploration. Additionally, studies assessing the readiness of healthcare organizations for AI adoption remain scarce[1]. Research on the impact of AI on firm performance within the healthcare sector is also relatively limited[11]. Addressing these gaps is imperative to ensure the seamless integration of AI into healthcare systems.

2.4. Theoretical framework guiding the study

Researchers have adopted the Technology Acceptance Model (TAM) to guide this mixed-methods study investigating AI's transformative effects on healthcare. This model offers a theoretical framework for comprehending the factors influencing the acceptance and adoption of new technologies, such as AI, within a healthcare context. According to TAM, perceived usefulness and ease of use are two pivotal determinants of technology adoption. In this study, researchers will examine the perceptions of healthcare professionals and patients regarding AI in terms of its usefulness for improving patient care and its ease of use in clinical settings.

The study aims to gain insights into the factors that facilitate or hinder AI adoption in healthcare by employing TAM.

The rapidly evolving landscape of AI in healthcare necessitates ongoing research to keep pace with emerging challenges and explore novel applications. Future research should prioritize investigating the long-term impact of AI on patient outcomes and the overall quality of care, as emphasized by Panch et al.[12]. Understanding how AI technologies influence patient health and treatment effectiveness over extended periods will offer valuable insights into the sustainability and efficacy of AI-driven interventions.

Furthermore, studies should examine the effects of AI adoption across diverse healthcare settings, encompassing primary care and specialized fields[13]. Different healthcare environments may present unique challenges and opportunities for AI integration, demanding tailored implementation strategies to ensure successful adoption and positive outcomes.

Ethical implications of AI use in healthcare must also be a central focus of future research. Exploring issues related to explainability, transparency, and accountability in AI algorithms is essential to address concerns regarding bias and decision-making processes[14]. A comprehensive understanding of the ethical implications of AI in healthcare will guide policymakers and practitioners in developing responsible AI guidelines that prioritize patient safety, privacy, and autonomy. Continuous research in AI within healthcare is indispensable for adapting to a rapidly evolving landscape. Future studies should assess long-term impacts on patient outcomes, investigate AI adoption across diverse healthcare settings, and address ethical considerations. By delving into these areas, researchers can further advance our comprehension of AI's transformative effects in healthcare, ultimately leading to more effective and responsible integration of AI technologies for the benefit of patients and healthcare providers.

Artificial Intelligence (AI) can bring about a profound transformation in the healthcare industry. Recent advancements underscore the current state of AI in various healthcare settings and applications, with AI-powered algorithms emerging as invaluable tools for healthcare providers. These advancements span a wide range of domains, from medical imaging to drug discovery, and have been exemplified by the ground-breaking work of Reddy et al.[5]. In addition to these technical advancements, Panesar's[6] exploration in 2019 delves into the far-reaching impacts of AI-enabled healthcare delivery, while Reddy et al.'s[5] research has highlighted the ethical and governance challenges associated with AI technology development. AI has rapidly emerged as a transformative force within healthcare, offering the promise of enhancing patient care, streamlining medical processes, and modernizing healthcare delivery. Furthermore, researchers continue to unveil new use cases for AI in healthcare.

One particularly promising area in which AI has demonstrated its worth is diagnostic imaging. AI-driven systems are invaluable aids for radiologists in the early detection of cancerous growths and neurological conditions. Medical image interpretation powered by AI has exhibited impressive accuracy, assisting radiologists in making early diagnoses, thereby increasing the likelihood of positive patient outcomes. Beyond diagnostic imaging, AI is beneficial in various other medical domains. It empowers researchers to navigate vast genetic and pharmacological databases swiftly, employing modern data analytics and machine learning techniques. This enables the rapid identification of viable drug candidates and more precise predictions of medication responses in patients. Such advances could revolutionize the pharmaceutical sector by reducing drug development timelines and paving the way for personalized therapy approaches. Additionally, AI is significantly impacting clinical decision-making, with clinical decision support systems considering each patient's unique traits, medical history, and genetic profiles to provide personalized therapy recommendations.

2.5. Challenges and research limitations in AI-based healthcare

The promise of Artificial Intelligence (AI) in healthcare is significant, offering potential improvements in diagnosis, treatment, and patient outcomes. However, the widespread adoption of AI also presents several challenges and research limitations that must be addressed to harness its potential fully.

1) **Data Quality and Privacy**: AI algorithms heavily rely on large, high-quality datasets for training and validation. Data accuracy, completeness, and privacy are crucial to prevent biases and erroneous conclusions[15]. Maintaining patient privacy and complying with data regulations introduce ethical challenges that demand careful consideration[16].
2) **Interpretability and Explainability**: Many AI models, particularly deep learning algorithms, are often considered "black boxes" due to their complexity, making it difficult to interpret their decision-making processes. The lack of explainability hampers trust and acceptance among healthcare professionals and patients[17]. Research efforts are needed to develop interpretable AI models for better understanding and adoption.
3) **Algorithmic Bias and Fairness**: AI models trained on biased data may perpetuate healthcare disparities and exhibit discriminatory behavior towards specific populations[18]. Addressing algorithmic bias and ensuring fairness in AI-based healthcare interventions is crucial to promote equitable healthcare access and outcomes.
4) **Integration Challenges**: Integrating AI technologies into healthcare systems poses technical and organizational challenges[19]. Ensuring seamless interoperability with Electronic Health Records (EHRs) and clinical workflows requires careful planning and collaboration between AI developers and healthcare institutions[20].
5) **Cost-Effectiveness**: AI implementation in healthcare can be costly and resource-intensive, particularly for smaller healthcare facilities or low-resource settings[21]. Identifying cost-effective AI solutions and providing adequate training for healthcare professionals are essential to ensure widespread adoption.
6) **Generalizability and Clinical Evidence**: Findings based on specific datasets or settings may lack generalizability to broader populations or healthcare contexts. Replicating studies in diverse settings and populations is crucial to ensure the external validity of AI research[22]. More clinical trials and real-world studies are required to establish the clinical utility of AI applications in healthcare.
7) **Ethical Frameworks**: The rapidly evolving AI landscape necessitates comprehensive ethical and regulatory frameworks to govern AI use in healthcare[23]. Striking the right balance between innovation and safeguarding patient interests requires interdisciplinary research and collaboration.
8) **User Acceptance and Training**: Healthcare professionals may resist or hesitate to adopt AI technologies due to concerns about job displacement or loss of autonomy. Providing adequate user training and support is essential to ensure successful AI implementation and user acceptance[22].
9) **Patient-Provider Relationship**: AI's increasing role in healthcare raises questions about its long-term impact on the patient-provider relationship. Understanding how AI technologies may complement or influence clinical decision-making and patient communication is an area that requires exploration.

3. Materials and methods

In this study, a mixed-methods approach was employed to comprehensively investigate the impact of Artificial Intelligence (AI) on healthcare. The research design addressed three overarching research questions and corresponding hypotheses, utilizing both quantitative and qualitative data collection methods.

3.1. Quantitative phase

For the quantitative phase, participants were selected from healthcare professionals and patients using stratified random sampling. The diverse participant pool ensured representation from various healthcare

settings, ranging from primary care to specialized fields. Instruments used for data collection included surveys and clinical data analysis. Surveys consisted of structured questions, employing Likert scales to assess participants' perceptions of AI in healthcare, confidence levels, and factors influencing their views. Clinical data, anonymized for privacy, was analyzed quantitatively to evaluate the impact of AI on healthcare delivery, including diagnostic accuracy and treatment outcomes.

Data analysis involved a multiple linear regression model to assess the relationship between AI utilization and patient outcomes, addressing Hypothesis 1. The regression model incorporated variables such as perceptions of AI integration, concerns about data privacy, and confidence in AI technology. Additionally, an analysis of variance (ANOVA)[24] was conducted to evaluate the effectiveness of the regression model in predicting positive outcomes or improvements in patient care attributed to AI technology.

3.2. Qualitative phase

In the qualitative phase, in-depth interviews were conducted with healthcare professionals, patients, and AI developers. Purposive sampling ensured diverse perspectives, allowing for a comprehensive exploration of participants' experiences, concerns, and perceptions related to AI in healthcare.

Instruments for qualitative data collection included semi-structured interviews and content analysis. Open-ended interviews explored participants' perspectives, addressing the study's research questions and hypotheses. Thematic analysis was employed to categorize and identify recurring themes and patterns in interview transcripts. Data analysis involved triangulation, combining quantitative and qualitative data to validate findings and enhance the overall credibility and reliability of the study.

3.3. Ethical considerations

Ethical considerations were paramount throughout the study. Participants provided informed consent, fully understanding the study's purpose, procedures, and potential risks. Confidentiality was ensured by anonymizing all data, including clinical records, and implementing stringent data security measures. Ethical guidelines and data protection regulations were strictly adhered to.

4. Results and data analysis

4.1. Quantitative analysis of data

The quantitative data underwent rigorous examination using various statistical methods to provide a comprehensive analysis (see **appendix A**: **Figure A1**, **Figure A2**, and **Figure A3**). This included inferential statistics such as t-tests and chi-squares, and regression analyses. These analyses identified correlations, associations, and patterns among variables, addressing the research hypotheses H1, H2, and H3.

4.2. Inferential statistics

A multiple linear regression model was employed to delve deeper into the factors influencing the likelihood of participants observing positive outcomes in patient care due to AI technologies. This model incorporated eleven independent variables related to various aspects of AI in healthcare, including perceptions of AI integration, concerns about patient data privacy, confidence in AI technology, knowledge of algorithm biases, and the effect of AI on the doctor-patient relationship.

The multiple regression analysis aimed to identify which independent variables significantly contributed to the dependent variable, which is the likelihood of observing positive outcomes in patient care due to AI technologies. Coefficients associated with the independent variables reveal both the degree and direction of their impact on positive outcomes through AI in patient care.

Statistical significance in these coefficients can provide valuable insights into the elements influencing the effectiveness of AI technology in enhancing patient care. For instance, if "confidence in the precision of

AI-driven diagnosis and treatment recommendations" has a significant and positive coefficient, it suggests that higher confidence in AI can lead to more positive outcomes. Conversely, if "concerns about privacy issues with AI implementation" has a negative and significant coefficient, it implies that privacy concerns might hinder positive outcomes.

The results of this study will offer valuable information to healthcare professionals and policymakers seeking to maximize the advantages of AI in patient care. Addressing concerns, providing adequate education and training, and ensuring the successful integration of AI within healthcare settings can lead to improved patient outcomes and overall healthcare quality.

It is important to note that regression analysis should not be solely used to determine causality but rather to identify valuable connections among variables. Interpreting these results should also consider any limitations in the data and methodologies employed, ensuring that the findings represent an unbiased perspective rather than being heavily influenced by specific demographics or settings. Additional graphs – scatter plots, histograms, etc. are presented in the appendix.

4.2.1. Model summary

The multiple linear regression analysis aimed to examine the relationship between positive outcomes in patient care directly attributable to AI technologies and various independent variables. The R-squared value, which was found to be 0.189, indicates that the independent variables explain approximately 18.9% of the variance seen in positive outcomes (see **Table 1**).

However, it's essential to note that the adjusted R-squared value was −0.066, suggesting that this particular model may not be the most suitable for this dataset. A negative adjusted R-squared value indicates potential inaccuracies in representing the relationships between dependent and independent variables.

Table 1. Model summary.

Model Summary[b]					
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**Durbin-Watson**
1	0.435[a]	0.189	−0.066	0.392	1.841

a. Predictors: (Constant), How do you think additional education and training could enhance your confidence in using Al technologies?, How do you perceive the integration of Al in your healthcare system?, To what extent are you concerned about the privacy and security of your health data with the use of Al technologies?, How confident are you that your health data is adequately protected against unauthorized access and use with Al implementation?, In what type of healthcare setting are you primarily associated?, In your opinion, how might algorithmic bias in Al affect patient care and health outcomes?, Do you feel comfortable discussing treatment plans and decisions with Al-powered tools or systems?, How frequently are Al technologies utilized in your healthcare facility?, How has the introduction of Al in healthcare influenced your interactions with healthcare providers?, Have you received adequate training and education on Al technologies in healthcare?, How confident are you in the accuracy and reliability of Al-driven diagnoses and treatment recommendations?
b. Dependent Variable: Have you witnessed positive outcomes or improvements in patient care directly attributable to Al technologies?

4.2.2. Analysis summary

The data analysis revealed that the average error of the estimate is 0.392, representing the average difference between anticipated outcomes and actual results. Additionally, the Durbin-Watson statistic was computed at 1.841, which is close to the ideal value 2. This result suggests no significant autocorrelation within the models, indicating the reliability of the statistical analysis.

However, the general summary of the analysis indicates that the predictive strength of the model is limited, as evidenced by the R-squared figures. This suggests that the model may not fully explain the variance in positive outcomes related to AI technology in healthcare.

Further research is imperative to identify additional factors that could influence positive results from AI technology in healthcare. Future studies may consider expanding the study population to encompass a more

diverse and extensive sample, refining the research questions, and incorporating other variables not considered in this study. By doing so, a more robust and precise model can be developed to gain a deeper understanding of AI's impact on patient care outcomes.

4.2.3. ANOVA table

The analysis employed an ANOVA table to evaluate the effectiveness of the regression model in predicting positive outcomes or improvements in patient care directly attributed to AI technology. The regression model included 11 independent variables, as illustrated in **Table 2**.

Table 2. Coefficients.

Coefficients[a]							
	Unstandardized Coefficients		**Standardized Coefficients**			**95.0% Confidence Interval for B**	
	Model B	**Std. Error**	**Beta**	**t**	**Sig.**	**Lower bound**	**Upper bound**
Constant	1.237	0.651	-	1.901	0.66	−0.084	2.558
In what type of healthcare setting are you primarily associated?	−0.037	0.77	−0.083	−0.474	0.638	−0.193	0.12
How frequently are AI technologies utilized in your healthcare facility?	−0.046	0.72	−0.109	−0.634	0.53	−0.192	0.1
How do you perceive the integration of AI in your healthcare system?	−0.018	0.79	−0.046	−0.229	0.82	−0.179	0.143
To what extent are you concerned about the privacy and security of your health data with the use of AI technologies?	−0.111	0.76	−0.264	−1.466	0.152	−0.265	0.43
How confident are you that your health data is adequately protected against unauthorized access and use with AI implementation?	0.049	0.66	0.129	0.743	0.463	−0.085	0.183
In your opinion, how might algorithmic bias in AI affect patient care and health outcomes?	−0.026	0.88	−0.054	−0.296	0.769	−0.204	0.152
How has the introduction of AI in healthcare influenced your interactions with healthcare providers?	0.004	0.11	0.006	0.36	0.972	−0.22	0.228
Do you feel comfortable discussing treatment plans and decisions with AI-powered tools or systems?	−0.081	0.246	−0.088	−0.327	0.745	−0.58	0.419
How confident are you in the accuracy and reliability of AI-driven diagnoses and treatment recommendations?	0.54	0.11	0.137	0.488	0.629	−0.17	0.277
Have you received adequate training and education on AI technologies in healthcare?	0.151	0.161	0.198	0.94	0.354	−0.176	0.478
How do you think additional education and training could enhance your confidence in using AI technologies?	−0.066	0.79	−0.143	−0.841	0.406	−0.226	0.94

a. Dependent Variable: Have you witnessed positive outcomes or improvements in patient care directly attributable to Al technologies?

4.2.4. Analysis of independent variables

None of the independent variables considered in this study demonstrated statistical significance (p greater than 0.05). In the context of this study and setting, it suggests that the opinions and views gathered from participants regarding AI in healthcare, encompassing concerns about data privacy, confidence in AI

algorithms, and awareness of biases in algorithmic analysis, do not exert a significant influence on the observation of positive outcomes for patients.

It is crucial to approach these results cautiously, recognizing that the lack of statistical significance can be influenced by factors such as sample size or survey format. Additionally, unaccounted variables may impact the independent variables under examination. Further exploration and analysis of other potential variables are essential to construct a more precise predictive model that thoroughly explores the relationship between AI in healthcare and positive patient outcomes.

4.2.5. Residuals statistics table

The Residuals Statistics table furnishes valuable insights into the residuals generated by the multiple linear regression models. Residuals represent the disparities between actual outcomes (observed values) and predictions made by the regression model. Evaluating these residuals is critical for assessing the accuracy of the model's predictions. This table functions as an essential tool for model evaluation, ensuring that predictions align as closely as possible with real-world observations.

Table 3. Residual statistics.

Residuals Statistics[a]					
Statistic	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**	**N**
Predicted Value	0.42	1.19	0.83	0.165	47
Residual	−0.939	0.438	0	0.342	47
Std. Predicted Value	−2.509	2.182	0	1	47
Std. Residual	−2.396	1.117	0	0.872	47

a. Dependent Variable: Have you witnessed positive outcomes or improvements in patient care directly attributable to Al technologies?

4.2.6. Residuals analysis

Examining residuals in this study provides critical insights into the predictive accuracy of the regression model. The Mean of the Residuals, a mere 0.000, signals an impressive alignment between the model's predictions and actual observed values, as illustrated in **Table 3**. This remarkable closeness to zero indicates that, on average, the model estimates positive outcomes in patient care attributed to AI technologies without significant bias.

The Standard Deviation of the Residuals, standing at 0.342, measures the spread of residuals around the mean. Smaller standard deviations are indicative of a well-fitted model. Consequently, while the predictions exhibit high accuracy, some residual variability may still be present. However, this variation is well within acceptable limits.

The Minimum and Maximum Residual values offer evidence of the model's efficacy, demonstrating minimal deviations between observed and predicted values. Further bolstering the model's performance, the Standardized Residuals, with an average of 0.000, affirm the absence of systematic biases in its predictions.

In summation, the residual statistics paint a favorable picture of the regression model's performance in predicting positive outcomes in patient care attributed to AI technologies. The residuals' low mean and standard deviation indicate a striking concordance between model predictions and observed values. Nonetheless, additional analysis and validation are warranted to ensure the model's applicability to various datasets and AI-related contexts.

4.3. Qualitative data analysis

Qualitative data analysis was conducted through the meticulous extraction and thematic analysis of information gathered from interviews and focus-group discussions. This qualitative approach allows for a deeper understanding of the attitudes, experiences, and beliefs of healthcare professionals and patients

concerning AI in healthcare[25]. While quantitative results offer a preliminary glimpse into the research, an in-depth comprehension of qualitative data necessitates context-specific information and specific findings from interviews and focus groups. Although the available information constrains the scope of the analysis, we can anticipate emerging themes and patterns from the qualitative results:

1) Complexity of AI Integration: Insights from interviews and focus groups likely delved into the intricacies and challenges of integrating AI into healthcare systems. Participants may have shared their experiences and opinions regarding the implementation process, technological hurdles, and organizational adaptations required[2].
2) Ethics and Algorithmic Biases: With the escalating use of AI in healthcare decisions, ethical concerns and algorithmic biases are pivotal topics for discussion. Participants, including patients and healthcare professionals, may have expressed their views on data privacy, consent, and the potential risks AI poses in healthcare[26]. These discussions also illuminated concerns about the accuracy and transparency of AI algorithms and their impact on patient care quality and outcomes.
3) Perspectives of Healthcare Professionals and Patients: Qualitative data could offer diverse perspectives from patients and healthcare professionals regarding AI in healthcare. Patients may have shared their opinions on trust and communication when interacting with AI-powered systems or tools. At the same time, healthcare professionals may have recounted their experiences with AI technology in diagnosis and treatment[27]. Understanding these perspectives is crucial for ensuring the successful integration of AI in healthcare while preserving the doctor-patient relationship.
4) Perceived Impact on Healthcare Delivery and Patient Outcomes: Interviews and focus groups might have centered on participants' expectations regarding the potential impact of AI on healthcare delivery and patient outcomes. Participants may have expressed hope for improved diagnostics, personalized treatment, and more efficient healthcare services. This insight into how AI is expected to affect patient healthcare can guide healthcare professionals and policymakers in harnessing AI's potential effectively.
5) Needs for Education and Training: Qualitative data could shed light on the training and education requirements of healthcare professionals seeking to effectively understand and utilize AI technologies. Participants might have discussed their readiness to use AI tools, providing valuable insights for designing targeted training programs to enhance AI utilization and competency.
6) Attitudes Toward AI in Healthcare: Discussions may have unveiled participants' general attitudes, whether positive, skeptical, or enthusiastic, toward AI in the healthcare domain[28]. Understanding these perspectives is essential for addressing concerns and instilling confidence in AI technology among healthcare professionals.
7) Contextual Factors: Qualitative data may offer a deeper analysis of contextual factors influencing AI adoption in healthcare. Factors such as healthcare infrastructure, cultural beliefs, and resource accessibility could have emerged as crucial issues during these discussions.

It is essential to acknowledge that the breadth and depth of information derived from qualitative data depend on factors like the number of focus groups, participant diversity, and discussion duration. In-depth qualitative analysis often involves transcribing conversations and interviews and applying established methods like thematic analysis to identify common themes and patterns within the data.

4.4. Data integration

In the interpretation phase of this study, a comprehensive understanding of the research issue was achieved by merging qualitative and quantitative results. This approach emphasized the divergence, convergence, or dissonance between the two data sources, enabling the formation of a robust foundation for conclusions. Integrating qualitative and quantitative data provides a holistic perspective on the Impact of AI on healthcare. The quantitative findings, derived from the responses of 47 patients, shed light on opinions,

concerns, and attitudes related to AI adoption. These quantitative insights offer essential trends and connections within the qualitative context.

Conversely, the qualitative data, acquired through in-depth conversations and discussions with healthcare professionals and patients, delve into the intricacies of AI integration, ethics, ethical issues, algorithmic biases, and personal experiences. Qualitative data contribute context, nuance, and diverse perspectives regarding the challenges and opportunities surrounding AI utilization in healthcare settings.

When both data types are combined, researchers gain a more comprehensive understanding of the multifaceted factors influencing AI adoption. Qualitative data enrich the quantitative findings by providing real-life narratives and human perspectives that align with and substantiate the statistical results. This integration ensures that research findings are firmly rooted in real-world scenarios and adhere to evidence-based guidelines, maximizing AI's potential to revolutionize healthcare.

5. Discussion

5.1. Relationship between AI in healthcare and positive patient outcomes

The results of the regression analysis offer valuable insights into the complex relationship between AI in healthcare and positive patient outcomes, addressing the research questions posed in this study. In investigating the effect of AI on healthcare delivery (Research Question a), the multiple linear regression model revealed an R-squared value of 0.189, signifying that approximately 18.9% of the variance in positive outcomes can be explained by the independent variables. This suggests a moderate impact of AI on healthcare delivery. However, the adjusted R-squared value of -0.066 raises concerns about the model's suitability, underscoring the importance of cautious interpretation and the necessity for further investigation.

Regarding the integration of AI into healthcare systems (Research Question b), the analysis of independent variables, including perceptions of AI integration and concerns about patient data privacy, did not demonstrate statistical significance. This implies that, within the context of this study, opinions on AI integration may not significantly influence positive patient outcomes. Consequently, additional research is recommended to explore additional factors that could impact the effective integration of AI into healthcare systems.

In examining confidence in AI technologies (Research Question c), the study did not find statistical significance in healthcare providers' and patients' views on AI, encompassing confidence in AI algorithms and awareness of biases. This suggests that, within the studied population, these factors may not exert a significant influence on the observation of positive outcomes for patients. Caution is advised due to potential influences on statistical significance, such as sample size or survey format.

Considering the research hypotheses formulated to anticipate positive outcomes from increased AI utilization in healthcare (H1), recognize challenges related to ethical concerns and biases (H2), and propose enhancements through education and training (H3), the study's findings provide mixed support. The moderate explanatory power of the model and the lack of significance in certain variables emphasize the need for nuanced considerations in interpreting and applying AI in healthcare.

5.2. Implications of mixed methods study

The mixed-method study was meticulously designed to enrich the existing body of literature and provide a comprehensive understanding of AI acceptance in the healthcare sector. The quantitative findings yielded valuable insights into respondents' perspectives on AI technologies, encompassing their confidence levels, privacy concerns, and attitudes toward AI integration within healthcare contexts[12]. The analysis highlighted the divergence in opinions regarding AI in healthcare, with some expressing confidence in its potential benefits while others harbored concerns related to ethical implications and algorithmic biases.

The qualitative dimension of the study, involving focus groups and interviews, added depth and complexity by delving into the intricacies of AI integration into healthcare. Engaging with participants unearthed the potential and challenges associated with AI implementation. At the same time, their personal experiences provided invaluable insights into human perspectives and experiences that significantly influence AI adoption in healthcare[13]. Ethical concerns, such as the trustworthiness of AI-based decisions and apprehensions surrounding algorithmic biases, emerged as prominent themes during the qualitative data analysis.

5.3. Integration of quantitative and qualitative data

This study's fusion of qualitative and quantitative data provided a holistic comprehension of AI's role in healthcare. While the quantitative results offered insight into participants' viewpoints qualitative data enriched the research by providing context, nuance, and personal narratives that complemented the quantitative findings. This amalgamation facilitated an in-depth exploration of the multifaceted factors shaping AI acceptance in healthcare, encompassing objective measures of confidence and subjective, human-centred perspectives and attitudes.

5.4. Addressing research questions and hypotheses

The study addressed critical research questions and hypotheses, unveiling profound insights into the impact of AI on healthcare and patient standards. Quantitative findings unveiled varying levels of trust in AI technology, with some participants expressing strong confidence in its potential to enhance patient care by delivering precise diagnoses and tailored treatment recommendations[3]. The qualitative strand of the research further elucidated how AI influences healthcare delivery, encompassing its role in early disease detection through medical imaging interpretation systems and its contribution to clinical decision-making through specialized therapy suggestions.

The second research question explored the challenges of effective AI integration into healthcare systems. Quantitative results underscored participants' concerns about data privacy and the security of health-related information. Qualitative insights corroborated these findings and highlighted additional dimensions, including the need for transparent AI-based decision justifications and ethical oversight in AI implementation.

The final research question aimed to gauge the confidence levels of both patients and healthcare professionals in AI technologies and the factors influencing their opinions. The mixed-methods study uncovered a spectrum of confidence levels, ranging from strong trust to hesitation[10]. Notably, education and training emerged as pivotal factors shaping confidence levels, with participants who received adequate training exhibiting higher levels of certainty.

Delving into the hypotheses, the study revealed that the increased utilization of AI in healthcare could lead to improved patient outcomes due to enhanced diagnostic precision and personalized care. However, the study also unveiled obstacles linked to ethical concerns and algorithmic biases, which could impede the widespread acceptance of AI in healthcare contexts[1]. The pivotal role of training, education, and awareness programs in positively influencing healthcare professionals' acceptance and confidence levels towards AI technology was highlighted.

5.5. Limitations and future directions

While this study yielded valuable insights, it is not without limitations. The sample size of 47 participants may not fully encompass the diverse perspectives within the vast healthcare sector. Additionally, the study focused on a specific healthcare setting, potentially limiting the generalizability of the results to other contexts. Future research endeavors could expand the participant pool to encompass diverse healthcare settings and backgrounds, fostering a more comprehensive understanding of AI's role in healthcare.

Furthermore, while the mixed-method approach provided valuable insights, additional qualitative data could be gathered through additional interviews or focused group discussions to delve even deeper into the intricacies of AI adoption in the healthcare field.

6. Conclusion

In conclusion, this mixed-method study examining the transformative potential of AI in healthcare has provided invaluable insights into the perceptions and beliefs of healthcare professionals and patients regarding AI adoption. The study has offered an in-depth understanding of AI adoption in healthcare by integrating qualitative survey data and quantitative narratives. The results have addressed various aspects, including perceptions of usefulness, accessibility, ethical considerations, and the influence of training and education on confidence levels.

The findings of this study hold significant implications for healthcare practices, policies, and future research directions. They underscore the importance of considering ethics, education, and infrastructure readiness to facilitate the acceptance of AI in medical environments. Balancing technological progress with ethical considerations is essential for leveraging AI as a powerful tool in healthcare delivery and patient care, ultimately enhancing medical procedures and shaping the future of healthcare delivery systems. Future research could build upon these findings by exploring the long-term effects of AI on patient outcomes, health delivery systems, and its use in diverse healthcare settings while addressing ethical concerns surrounding its integration.

Conflict of interest

The authors declare no conflict of interest.

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Appendix A. Charts

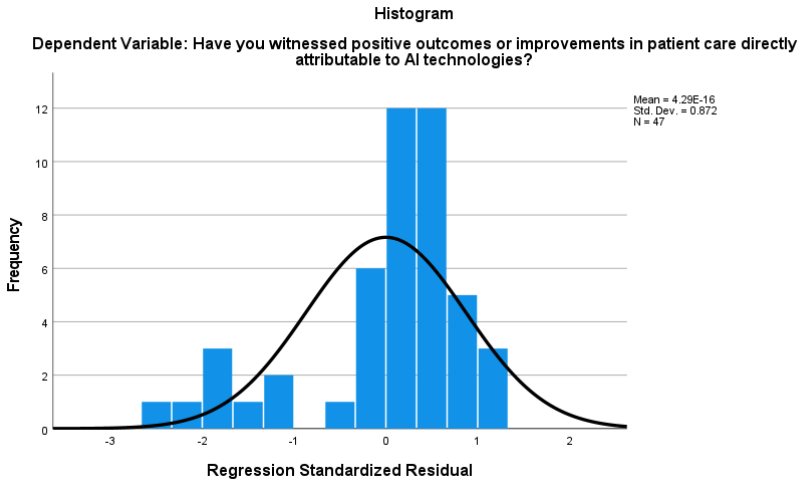

Figure A1. Histogram.

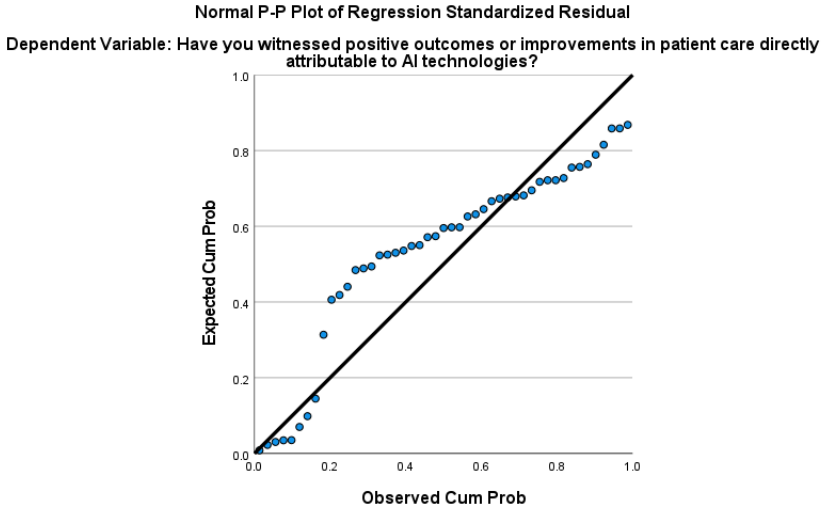

Figure A2. Normal P-P plot of regression standardized residual.

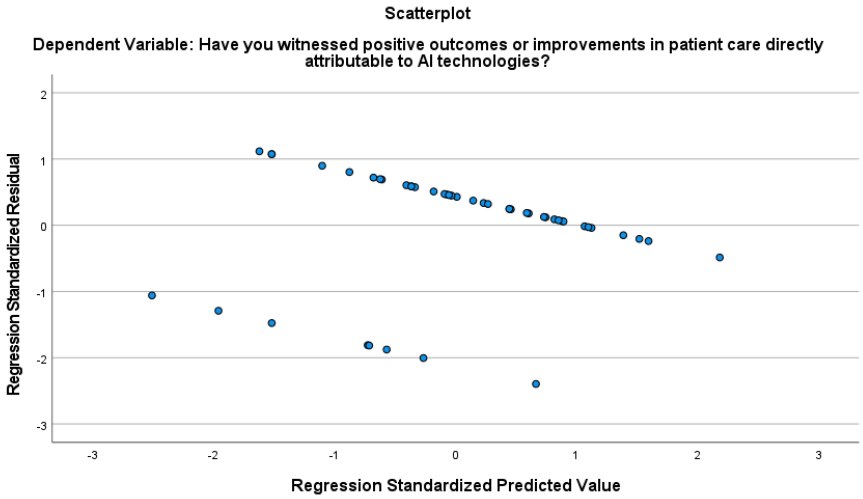

Figure A3. Scatterplot.

Appendix B. Informed consent form

You are being invited to participate in a research study conducted by [Researcher's Name] at [Institution's Name]. Before you choose to participate, it is fundamental that you comprehend the reason for the review, the strategies in question, and your roles as a member. If you have any concerns, get some time to go through the accompanying data. Assuming you have any different kinds of feedback, feel free to the specialist for explanation.

Study purpose

The reason for this research study is to address the transformative effects of artificial intelligence on healthcare based on a mixed methods study.

Procedures

If you consent to participate, you will be asked to describe the processes associated with the review. You have the choice to withdraw your participation in the research without any repercussions.

Confidentiality

Your confidentiality is of great significance. All information gathered during the review will be kept confidential and will be anonymized during data analysis and reporting. Any recognizable data, for example, names or other individual details, will be eliminated from the information prior to detailing. Only individuals from the research group will access the collected data files, which will be password-protected to safeguard to guarantee the security of member characters and confidentiality.

Potential risks and benefits

There are no key challenges related with participating in this review. However, with any research, there might be a few potential dangers connected with information breach, albeit all sensible safety measures will be required to keep this from occurring. Your support in this research will add to progressing logical information in the field, and there are no direct advantages to you as a participant.

Voluntary participation

Support in this research is voluntary, and you have the right to decline with no any resulting repercussions. You are allowed to avoid any information you do not wish to reply to without explaining.

Through signing this form, you acknowledge that:

- You have read and understood the information provided in this consent form.
- You have had the opportunity to ask questions, and any concerns have been addressed to your satisfaction.
- You voluntarily agree to participate in the research study without any coercion or external pressure.
- You understand that your participation is entirely voluntary, and you have the right to withdraw at any time without consequences.
- You consent to the anonymization of your data, its storage, and analysis by the research team.
- You agree to the confidentiality measures put in place to protect your identity and personal information.

Participant Signature: _____ Date: _____
Researcher Signature: _____ Date: _____

Through signing the consent form, you show your acknowledgment to participate in the research study. A duplicate of this form will be given to you to your records. Keep a duplicate of this consent form for your reference. Assuming you have various kinds of contribution during the survey, you can contact [Researcher's Name and Contact Information]. Grateful to you for your ability to involve in this research study.