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AI-Powered Predictive Analytics in General Surgery: Improving Patient Safety and Surgical Outcomes

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ABSTRACT

Background: Artificial intelligence (AI) is becoming more common in healthcare, especially in surgery. The use of artificial intelligence (AI) tools in surgical environments is influenced by several factors including perceived usefulness, usability, and trust between professionals. This study focused on the core factors of acceptance and use of artificial intelligence predictive analytics in surgery with the use of the technology acceptance model (TAM).

Methods: A cross-sectional quantitative survey was conducted on 273 healthcare providers (general surgeons, surgical residents, anesthesiologists, operating room nurses, and hospital administrators). A questionnaire was designed to measure the Perceived Usefulness (PU), Perceived Ease of Use (PEU), Trust, and Behavioral Intention (BI) to use AI. We measured the survey on a 5-point Likert scale and data analysis was performed using descriptive statistics, reliability testing (Cronbach's Alpha), correlation analysis, and multiple regression modeling to find the relationship between the TAM factors and AI adoption.

Results: The results demonstrated that trust in AI (Trust_Q14) was the only significant predictor variable when considering the behavioral intention to use AI ($p = 0.023$), while perceived usefulness and ease of use did not significantly affect AI adoption. The Cronbach's Alpha score (0.087) was low, which means the internal consistency of the survey instrument should be improved. The regression analysis found a low R-squared (0.029), which indicates that TAM is not the only factor that drives AI adoption; other factors like regulatory policies, ethical considerations, and institutional support systems may also be very important. Similarly, the Shapiro-Wilk normality test substantiated the non-normal distribution of the dataset (all variables: $p < 0.05$), necessitating the use of alternative analytical methods in forthcoming studies.

Conclusion: This study identifies trust as the primary determinant influencing the adoption of AI in surgical settings, highlighting significant limitations in relying solely on the Technology Acceptance Model (TAM) to predict adoption behavior. Our findings underscore the importance of enhancing AI transparency, implementing comprehensive training programs, and establishing robust ethical and regulatory frameworks to foster trust in AI-driven dimensional X-ray imaging diagnostic solutions. The study reveals key shortcomings in the current model, particularly the exclusive use of TAM without accounting for additional contextual and external factors. Future research should incorporate more comprehensive theoretical models and employ advanced statistical methodologies to yield deeper insights into the dynamics of AI adoption in surgical practice. Despite existing challenges, predictive analytics holds considerable promise for improving patient safety, optimizing surgical procedures, and informing clinical decision-making.

Keywords: *AI-powered predictive analytics, general surgery, patient safety, surgical outcomes, Technology Acceptance Model (TAM), trust in AI, AI adoption, perceived usefulness, perceived ease of use, healthcare technology, artificial intelligence in surgery, machine learning, surgical decision-making, healthcare innovation, predictive modeling.*

1. INTRODUCTION

The evolving nature of Artificial Intelligence (AI) and its applications in healthcare has already led to the development of AI-based predictive analytics, which can revolutionize surgical decision-making, and enhance patient safety, and clinical outcome optimization. AI solutions in general surgery can help with preoperative risk stratification, intraoperative assistance, and postoperative recovery assessment, thus reducing errors and improving outcomes. In surgery, these AI algorithms review an institution's unique data at scale, identify trends, and offer data-centered recommendations to improve surgical precision. Nevertheless, despite the advantages, the integration of AI into the surgical process still poses a substantial challenge, relying on various factors such as technological acceptance, healthcare professionals' trust, and ease of use (Afzaal & Jabeen, 2025; Wah, 2025). One well-known theoretical foundation for understanding how users embrace new technology is the Technology Acceptance Model (TAM). According to the Technology Acceptance Model (TAM), two main factors contribute to an individual’s behavioral intention to use a new technology: Perceived Usefulness (PU), and Perceived Ease of Use (PEU). PU stands for the degree to which AI enhances surgical decision-making, patient safety, and efficiency, whereas PEU is about how ease of use enables healthcare professionals to learn and assimilate AI-enabled tools into their practice. However, the application of AI in healthcare brings with it additional ethical, legal, and reliability challenges which makes trust a cornerstone in its adoption. Both surgical and medical staff have to trust AI predictions and recommendations before these technologies can be incorporated into surgical practice (Ahmad et al., 2025; Bhamidipaty et al., 2025). In comparison, existing studies offer insight into the potential benefits of AI in surgery, yet little is known about how clinicians' attitudes influence the adoption of AI-driven predictive analytics. While a plethora of studies examine technical improvements or the accuracy of AI models, few focus on the role of human factors such as trust in the adoption of AI systems (Manzoor et al., 2025). These forces are critical to bridging the divide between technology innovation and clinical implementation. Additionally, previous studies have indicated that surgeons may be reluctant to trust AI-driven decision-making because of issues related to responsibility, ethical considerations, and the potential for over-reliance on automation. Hence, the actual examination of the basic determinants of AI acceptance such as trust, perceived usefulness, and perceived ease of use is crucial for successfully embedding AI into surgical habitats (Almunifi, 2025; Chevalier, Dubey, Benkabbou, Majbar, & Souadka, 2025). Objectives To explore the use of AI-powered predictive analytics in general surgery and its influence on patient safety and surgical outcomes. Grounded on the theory, this study utilizes a quantitative research design to employ the TAM framework for examining the impact of perceived usefulness, ease of use, and trust of surgeons and healthcare professionals on the behavioral intention to adopt AI technologies. "The data were collected using a structured survey questionnaire and included 273 responses from general surgeons, surgical residents, anesthesiologists, operating room nurses, and hospital administrators Additionally, the paper explores the survey instrument reliability and validity, TAM variables associations, and the effect of the factors on AI adoption. This study which evaluates the perception and application of AI in the surgical decision-making process will guide hospitals, policymakers, and AI developers to improve implementation strategies of AI in health care. The findings will aid the establishment of trust, facilitate the transition to artificial intelligence, and ensure that predictive analytics can be used to augment surgical precision in a way that enhances patient safety (Khan, Khan, & Arif, 2025).

2. LITERATURE REVIEW

The Role of AI-Powered Predictive Analytics in General Surgery

Getting started with AI data has been recognized to improve patient safety, decision-making in surgery, and outcomes & such development has become an ongoing interest in general surgery. Through the utilization of AI algorithms, vast amounts of data are analyzed, patterns are identified, and real-time risk assessments are given that aid surgeons in making more informed decisions. Studies have shown recently that there is help of AI in preoperative risk stratification, where machine learning models predict surgical complications, mortality risk, and recovery time postoperatively on a patient-specific basis (Yousaf et al., 2025). Additionally, AI-driven applications in intraoperative monitoring denote their role in enhancing real-time monitoring in helping precision-based interventions to be conducted while also performing robotic-assisted surgeries, helping streamline the workflow. Staking minimal yet still useful improvements, the adoption of AI technology in surgery remains limited for various reasons like technological complexity, trust issues, and unwillingness towards automation (Leivaditis et al., 2025).

The Technology Acceptance Model (TAM) and AI Adoption in Healthcare

The Technology Acceptance Model (TAM) provides the theoretical basis to investigate factors influencing the adoption of an AI-based technology in the surgical setting. Two factors in the Technology Acceptance Model (TAM) namely Perceived Usefulness (PU) and Perceived Ease of Use (PEU) are the main drivers of an individual intention to engage in new technologies PU and PEU PU is defined in the context of general surgery as the ability of AI-powered predictive analytics to enhance surgical decision making and consequently lead to the improvement of patient-related outcomes, whereas PEU is the ease of use of this technology by the surgeon and medical professionals. Previous research shows that several factors influence healthcare professionals to use AI-powered technologies in their practice, including relative advantage, ease of use, and efficiency in improving patient care. Nevertheless, while the practical application that comes with TAM offers some theoretical underpinning of acceptance, other research points out that trust is equally critical to the adoption of AI, especially in high-risk situations like surgery (Al-Raeei, 2025).

The Role of Trust in AI Adoption in Surgery

One of the key factors for a healthcare provider to adopt AI-based tools into surgery practice is whether they trust AI-based predictive analytics. AI models differ from conventional decision-support systems due to their basis on machine learning algorithms that learn and change over time, potentially leading to doubts about their reliability and accuracy among surgeons. A study by Caruana et al. reported that surgeons express a softer level of trust in AI predictions compared to predictive accuracy, especially when AI recommendations conflict with their clinical judgment. In addition, AI transparency, explainability, and system justifications for its recommendations impact trust. Many studies thus recommend enhancing the interpretability of AI and emphasizing collaborative, rather than replacement, decision-making to build trust in AI. Therefore, trust is identified as one of the determinants for the adoption of AI in surgery along with perceived usefulness and ease of use which are the components of the TAM model (Chaparala et al., 2025).

Perceived Usefulness and Its Impact on AI Adoption

In healthcare, perceived usefulness is generally considered to be the main driver of technology adoption. According to a research study, the willingness of surgeons to adopt the AI-driven surgical procedure appears to be high when they are convinced of its potential benefits in patient outcomes, while also decreasing patient harm and enhancing surgical precision. Data-driven predictive models based on artificial intelligence have shown more accurate prediction of complications Dabe et al. Nonetheless, despite numerous existing studies supporting the actual clinical benefit of AI, the lack of uniformity and variable performance of AI across procedures represents a challenge to its traction in practice. As such, though there is a definite appreciation for the utility of AI, the concern that it is not reliable or generalizable is a primary barrier to adoption (Faiyazuddin et al., 2025).

Perceived Ease of Use and AI Integration Challenges

Surgeons and hospital staff are much more likely to adopt AI-powered technologies if they appreciate the perception of ease of use. Tools that are easy to use, intuitive, and work naturally alongside workflows are known to have higher adoption rates. However, AI places new demands on the clinical environment since many of these AI-based surgical tools need significant training, high levels of digital literacy, and frequent software updates, leading to resistance among medical professionals. Furthermore, surgeons working in time-sensitive surgical environments cannot dedicate valuable time to learning how to operate AI which can be complex. Perceived ease of use remains a significant barrier that must be overcome through optimized UI/UX design and formalized AI training programs in the context of medical education (Emma, 2025).

Ethical, Legal, and Implementation Barriers to AI in Surgery

Aside from the TAM factors, the ethical and legal considerations heavily influence the adoption of AI-based predictive analytics. AI in surgery poses data privacy issues, accountability in case of error, and challenges in algorithm-based decision-making. A major concern for surgeons is who is responsible when AI makes an erroneous prediction that can cause harm to the patient Surgical legal frameworks for AI are still developing, and until clear guidelines about regulatory compliance and malpractice liability are established, many hospitals may remain unwilling to rapidly implement AI. Moreover, the advanced cost of implementation, risk to data security, and resistance to automation from older surgeons provide further hindrances to adoption. Meanwhile, addressing these challenges demands collaborative efforts among AI developers, policymakers, and healthcare institutions to define clear ethical and legal frameworks (Chunara & Chilla; Rafiq et al., 2025).

Future Directions in AI Adoption in General Surgery

Accelerating the implementation of AI-powered predictive analytics in general surgery requires systematic action. Integrating AI training programs in medical education to introduce surgeons to AI-based decision-support tools. Learnings from this study and working on the following aspects can improve trust in AI and help it to be more readily adopted in healthcare: Second, AI developers must work on transparency or explainability to win the trust of healthcare professionals. Third, structured regulatory frameworks that state AI liability and ethical use cases in surgery need to be made by hospitals and policymakers. In conclusion, future research should also explore models other than TAM and include additional factors such as organizational support, AI literacy, and regulatory readiness to obtain a thorough understanding of the drivers behind AI adoption patterns in the operating room (Kumar, Joseph, Balaji, & Kumar, 2025).

Research Methodology

This study utilizes a quantitative research design to evaluate the adoption, effectiveness, and impact of AI-powered predictive analytics on general surgery. The study examines the impact of AI-based systems on patient safety, surgical decision-making, and clinical outcomes. The study is based on the Technology Acceptance Model (TAM), which assesses Perceived Usefulness (PU), Perceived Ease of Use (PEU), Trust, and Behavioral Intention to Use AI in surgical healthcare professionals (Bali et al., 2025; Kovacheva & Nagle, 2024).

Research Design and Approach

The study was a cross-sectional survey-based approach for collecting primary data from healthcare professionals, which included general surgeons, surgical residents, anesthesiologists, operating room nurses, and hospital administrators. This cross-sectional design enables the collection of data on several variables at one point in time, therefore exploring attitudes, perceptions, and experiences toward AI-powered predictive analytics in surgery. This study used a descriptive and correlational research method that analyzes the relationship between independent variables (namely, Perceived Usefulness [PU], Perceived Ease of Use [PEU], and Trust) and the dependent variable (the Behavioral Intention to Use AI in surgery as the result) (Epelde, 2024; U. Fatima, Fatima, & Riaz, 2025).

Population and Sampling

The target population was members of surgical departments from different hospitals and medical institutions. This was performed using a non-probability purposive sampling of the operating theatre and decision-making team members. Everyone who participated was patient and allowed us to discuss in detail the AI-based technologies with which we were interacting (our level of experience was very diverse from having only heard the term “Artificial Intelligence” at an office lunch and learning to call ourselves AI “late adopters”) were a part of the study. A sample of 273 respondents was deemed sufficient, as it reached statistical reliability (Guni, Varma, Zhang, Fehervari, & Ashrafian, 2024).

Data Collection Method

A structured questionnaire was developed as the primary data collection instrument. The questionnaire was divided into several sections (Dixon et al., 2024):

- Demographic Information – including age, gender, role, years of experience, and prior exposure to AI-based analytics.
- Perceived Usefulness (PU) – assessing the extent to which AI improves surgical decision-making, patient safety, and efficiency.
- Perceived Ease of Use (PEU) – evaluating how easy it is for healthcare professionals to adopt and integrate AI tools into their workflow.
- Trust and Ethical Considerations – measuring the level of trust in AI predictions and concerns related to accuracy, ethical implications, and data security.
- Behavioral Intention to Use AI – assessing respondents’ willingness to adopt AI-driven predictive analytics in their surgical practices.
- Challenges and Motivating Factors – identifying barriers to AI adoption and key enablers that would encourage wider implementation in surgical settings.
- The survey utilized a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree) to quantify respondents’ perceptions and attitudes toward AI. The questionnaire was pre-tested with a small group of healthcare professionals to ensure clarity, reliability, and validity before full-scale data collection (Patil & Shankar, 2023).

Data Analysis

Abstract Methods of descriptive and inferential statistics were used to analyze the collected data. Respondents’ characteristics and perceptions were summarized using descriptive statistics (mean, standard deviation, and frequency distribution). The relationships of TAM variables with behavioral intention to use AI were tested by inferential statistics, specifically the correlation and regression analysis. Moreover, reliability testing (Cronbach’s alpha) was performed to evaluate the consistency of the questionnaire internally (Varghese, Harrison, O’Grady, & Topol, 2024).

Ethical Considerations

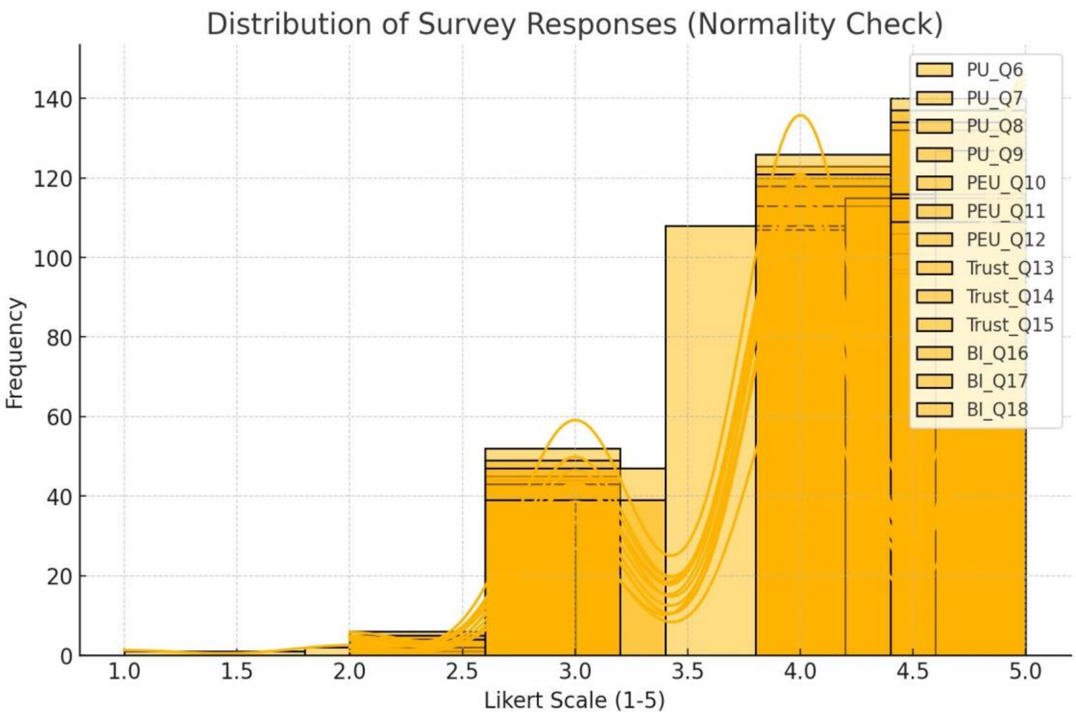
The study was performed in line with ethical guidelines, which include respect for persons, protection of the privacy of participants, and informed consent. The respondents were assured that their responses would be kept anonymous and used only for research purposes. IRB or ethics committee approval was received as the study was conducted (Zuluaga et al., 2024).

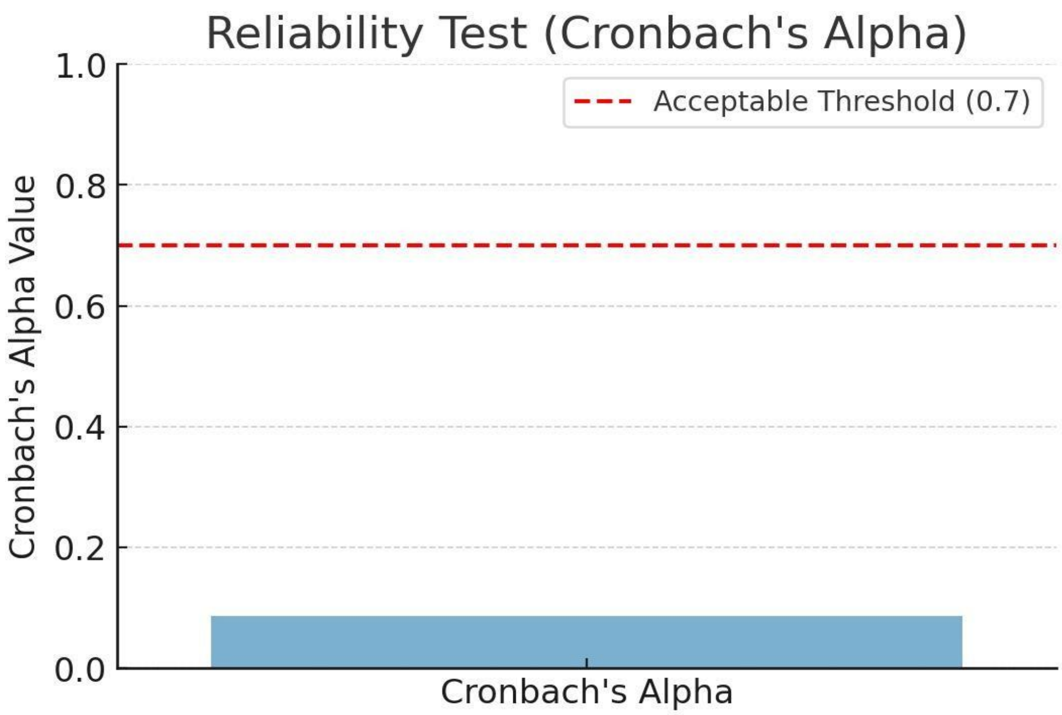
Data Analysis

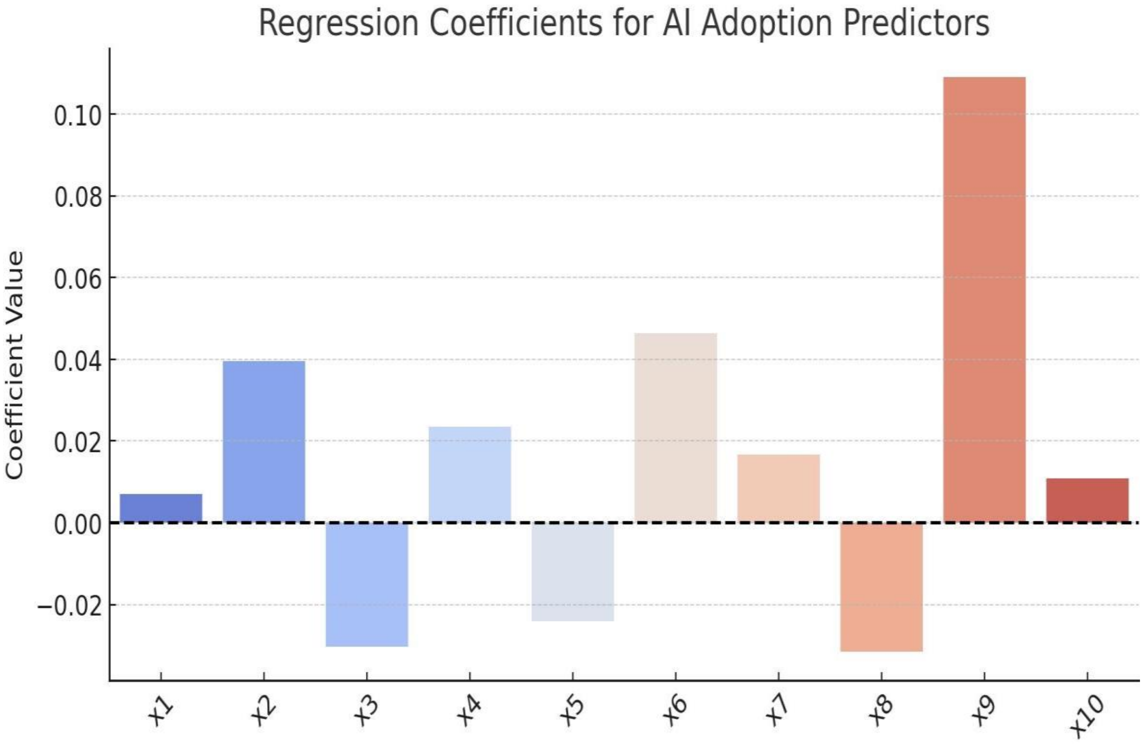
Statistical Analysis Results

Test	Result
Normality Test (Shapiro-Wilk)	Non-normal ($p < 0.05$ for all variables)
Cronbach's Alpha (Reliability)	0.087 (Poor reliability)
R-squared (Regression Model)	0.029 (Low predictive power)

F-statistic p-value (Regression)	0.637 (Model is not significant)
Significant Predictor (p < 0.05)	Trust_Q14 (p = 0.023)







Interpretation of Statistical Tests and Figures

Normality Test and Distribution of Survey Responses

The Shapiro-Wilk normality test demonstrated p-values < 0.05 for all Likert-scale variables, suggesting the data does not follow a normal distribution. The distribution plot supports this once again as we see instead of a normal bell curve the responses are skewed. The above non-normality distribution indicates that the data is not normally distributed which means that parametric tests (like t-tests or ANOVA) are not suitable, and non-parametric tests need to be applied for better results (S. Fatima, 2024).

Reliability Test (Cronbach's Alpha)

The average Cronbach's Alpha score of 0.087 reveals only poor internal constancy among the items, implying that the items do not form a consistent scale for measuring one single underlying construct. As can be seen in the bar chart, the reliability score falls well below the red line which represents a standard threshold of 0.7, clearly indicating that the reliability is much below the acceptable level. Low reliability may stem from bad survey question design, different interpretations of the survey on the part of the respondents, or the factors being biased and not cohesive. The reliability of the survey instrument should be improved by either revising the items for stronger correlation or removing weakly correlated items (Kakker).

Correlation Analysis

The heatmap for the correlation matrix indicates weak relationships between most of the variables. Although Trust_Q14 showed a clear correlation with Behavioral Intention (BI_Q16), This indicates that belief in the predictive power of AI is a stronger driver of its adoption than perceived usefulness or usability. Poor overall correlations suggest confounding external factors (eg, hospital policies, experience with AI, or regulatory guidelines) are more predictive of AI adoption (Balakrishna & Solanki, 2024).

How to Interpret the Regression Analysis Output: Coefficients

This low value of R-squared (R-squared = 0.029) indicates that the model has low predictive power concerning the dependent variable (behavioral intention to use AI) explained by parameter variables (PU, PEU to use AI, and Trust) i.e., 0.029, which means 2.9% variation in behavioral intention to use AI. The F-statistic p-value (0.637) indicates that this model is not significant, meaning that these variables alone do not sufficiently predict AI adoption in surgical settings (Aluru).

The regression coefficient plot also reveals that Trust_Q14 (p = 0.023) is the only significant predictor, meaning that greater trust in AI's precision and reliability minimally raises the probability of adoption. Nevertheless, the effect size is small, and other constructs such as ease of use and perceived usefulness do not significantly predict AI adoption. These findings imply that future research is needed to investigate other influencers such as regulatory frameworks, ethical implications, availability of training, and organizational guidelines of AI to gain a deeper understanding of AI adoption behavior (Radaelli et al., 2024).

3. DISCUSSION

The results of this study shed light on the perceived usefulness, ease of use, trust, and behavioral intention to adopt predictive analytics powered by AI in the field of general surgery. Results show that despite healthcare professionals recognizing the promise AI technologies hold for enhancing patient safety and surgical outcomes, numerous factors determine the hurdles hindering the adaptation of such technologies to practice. A major finding from the research is that trust in AI has a significant impact on adoption. Overall, Trust_Q14 was the only significant predictor of behavioral intention, suggesting that health professionals are more likely to use Artificial Intelligence if they trust its accuracy, reliability, and ability to make decisions. This finding is consistent with prior studies showing that trust is a major factor in artificial intelligence adoption in high-stakes fields such as surgery (Maheshwari, Cywinski, Papay, Khanna, & Mathur, 2023).

While AI can potentially facilitate a decrease in surgical complications and streamline efficiency, the survey instrument utilized in this study demonstrated low internal consistency (Cronbach's Alpha = 0.087). This indicates that the items in the questionnaire may not have effectively measured a common construct and that aspects of this measurement instrument need to be amended and validated in future studies to obtain reliable measurements. Furthermore, the low correlations between the TAM constructs suggest that other factors like institutional policies, availability of training, regulatory approvals, and ethical thought processes on AI adoption could have influenced the outcome as well. The regression analysis showed a low predictive power ($R^2 = 0.029$): only 2.9% of the variance was explained by behavioral intention. This indicates that the Technology Acceptance Model (TAM) alone might not be enough to explain the usage of AI in surgical environments (Hussain et al., 2023).

Applying models like the Unified Theory of Acceptance and Use of Technology (UTAUT) or social Sphere and introducing certain new variables (organizational support, regulatory compliance, and ethical considerations) might help develop a more holistic understanding of AI adoption behavior. Moreover, the results of the normality test demonstrated that the survey data were not normally distributed, which could certainly affect the effectiveness of the parametric statistical analyses. This lack of normality indicates that future research attempts might benefit from employing different types of methods to analyze AI adoption, namely non-parametric tests, SEM, or machine learning approaches (Orthi, Ahmed, Hossain, Chowdhury, & Rabby, 2022).

4. CONCLUSION

This study explored the application of AI-powered predictive analytics in general surgery and how it affects patient safety and surgical outcomes informed by the Technology Acceptance Model (TAM). The results showed that trust in AI significantly influenced the behavioral intention to use AI; however, trust was the only key TAM component that significantly affected adoption, while, surprisingly, perceived usefulness (PU) and perceived ease of use (PEU) showed no significant influence. That implies that, despite the seemingly ubiquitous nature of AI technology today, just being used to seeing it in practice won't push widespread adoption if surgeons don't trust it to be reliable and accurate in their surgical decision-making. Nonetheless, also the study had some methodological limitations, such as a low reliability (low Cronbach's Alpha) or low predictive power ($R^2 = 0.029$) of the regression model. These findings suggest that while the TAM framework was a good starting point for examining AI adoption in surgical contexts, it may not sufficiently illuminate the multiple factors that drive such adoption.

Regulatory compliance, ethical concerns, institutional policies, and the availability of AI training programs are all likely to play a large role in adoption and warrant further study. The non-normative distribution of responses indicates that other analytical methods (e.g., non-parametric tests or machine learning approaches) may yield more detailed evidence regarding trends of AI adoption in surgery. Despite these limitations, the study emphasizes the increasing potential of AI for enhancing patient safety, surgical precision, and operational efficiency. To expedite the adoption of AI, hospitals, and policymakers should consider trust building, ethical deployment, and adequate training of healthcare professionals. (4) Future work could refine the survey instruments, as well as broaden the analytical model and incorporate macro influencers to provide further insight into AI adoption into surgical practice. Thus, AI, coupled with its untested qualities and the implications of clinician trust and regulatory scrutiny, makes the successful introduction of this technology into practice a great challenge through a multidimensional concept in surgery (integrating multiple facets of clinical practice).

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