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# The Role of Artificial Intelligence in Preoperative Planning and Decision-Making

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**Abstract**

**Background:** Preoperative planning is an important component of the surgical process as it influences the patients' status in cure. The integration of artificial intelligence in surgical procedures provides several opportunities to improve the level of skill and precision concerning the evaluation of different patterns and their possible risks along with the elaboration of the successful surgical strategies.

**Objectives:** To compare the preoperative planning and decision-making process done with the involvement of AI to understand the effectiveness of the surgical precision, prediction of chances of complication occurrence, and personalization of treatment plans for patients.

**Study design:** A cross-sectional study

**Duration and place of study**. Department of Surgery watim dental college , rewat, Rawalpindi from 05-july 2022 to 05-july 2022

**Methods:** A total of 100 patients who were to undergo several surgery procedures were used to determine the efficiency of AI in preoperative planning. Risk assessment as well as imaging analysis was done through the CUI use of AI and machine learning algorithms. Preoperatively formulated care plans prepared by theuse of AI were thus compared to conventional formulation. Electronic health records of patient, including their demography, clinical history and diagnostic images, were inputted and processed through A. I. The results of AI-based planning were then compared to conventional planning using the paired t-tests analysis with the p-value < 0. 05. The descriptive statistics was done using the statistical package that is SPSS version 24. 0.

**Results:** our study shows AI in preoperative planning was proven to effectively enhance surgeries in many ways. Overall the accuracy scores for the use of an AI to predict the risk and complications for a surgery were 85% (SD = 5%) while the traditional methods of risk assessment had an accuracy of 70% (SD = 7%), p value < 0. 01. In this study, intraoperative errors that were corrected using imaging analysis with AI were 30% less than using standard methods (SD= 10%; p<0. 05). These outcomes show that AI can considerably improve preoperative preparation and choose.

**Conclusion:** AI greatly enhances the preoperative planning by improving the risk assessment and that of the surgery. Such advances indicate the potential of using AI tools and applications to improve patient outcomes, voids that can be filled by more research in various areas including data quality as well as algorithmic explainability.

**Keywords:** AI, planning, operation, strategy, choice.

## Introduction

Preoperative planning is an important component of surgery and outlines the prognosis of procedures, as well as the prognosis for patients. In the past, preoperative planning is done manually by the surgeon based on his or her experience, medical image analysis and patient history and laboratory reports. Though these methods have been some utility to the surgical community, they are not without some drawbacks. Peculiarities of the human factor refer not only to the ambiguity of perception and decision-making but also to the ability to miss important details, which sometimes might be detrimental [1]. Also, sophisticated operations and operations requiring detailed planning have been experienced, thereby boosting the need for planning tools. This is where Artificial Intelligence (AI) is in the process of bringing the change of the near future. The Technology of AI can obviously be applied to the improvement of preoperative planning procedures due to its capability to methodologically manipulate big data and identify tendencies as well as modify the results of analysis to innovative predictions. Artificial intelligence refers to a vast capacity in the computational tools such as machine learning, deep learning, natural language processing among which can process voluminous data at much higher speed and higher levels of precision compared to human intervention [2]. In the context of surgery, AI can help in the many areas of surgery such as preoperative planning in terms of risk assessment, imaging analysis and decision making by giving data- support to the finalized decision of the surgeon [3]. It is in the area of risk assessment where the use of AI in preoperative planning is perhaps one of the most promising. Risk assessment of patient for post-surgical complications can be done using big data analysis where machine learning algorithms are trained to consider past patient records on factors correlated with certain forms of surgical complications. Based on these formulas, the probability of presurgical patients developing certain complications, for example, infections, long hospital stays or, the need for critical care unit after surgery, can be determined [4]. By giving surgeons better risk assessment, AI can minimize many unwanted situations and give the surgeon a better opportunity to choose the best treatment for every patient. This is apart from increasing accuracy in analysis of images; an aspect that is very important in preoperative planning. MRI and CT, for example, serve as a major input to the radiologist that brings his or her personal analysis – influenced by the level of experience and fatigue. These images can be processed with a high level of accuracy using imaging instruments predicated on artificial intelligence [5]. For example, AI can help to outline the perimeter of the tumor or in defining the best strategy of surgery through the visualization of the 3D model of the field [6]. These capabilities enhance the accuracy of the pre-operative plan, and enhances the confidence the surgeon has in the intended procedure. In addition, AI can enhance decision-making processes by providing a set of organized and processed data coming from various sources, for example, genetic data, laboratory tests, and data from patient's continuous monitoring. Thus, by processing such information, AI gives recommendations on the most efficient surgical interventions or offers alterations in the planned strategy due to patient's individual features [7]. It plays a great role especially in delicate or risky operations, in which any slight mistake is not acceptable.However, with the use of artificial intelligence there are several issues when it comes to using it in preoperative planning. Some of the open questions which must be answered for the safe proper use of AI in surgery includes how to address the problems of data privacy, concern for large data sets that are necessary to feed the algorithms, or likelihood of bias from the algorithms [8]. However, implementing the use of AI entails some degree of organizational culture change among surgeons since most of them are reluctant to rely on robotized advice. In the future we will need to establish and verify these tools with much more strict clinical trials, also it is important to underline that AI applications should always increase the surgeon's knowledge, but never replace him or her [9]. This Study seeks to compare the extent of AI realisation in accomplishing preoperative planning and decision making on Surgery ranging from enhancing precision, complications and individualised patient treatment plans. Thus, to understand how AI

can be introduced to improve outcomes in surgical practice, this research aims to look at what is currently being done and what can be done in the future regarding the use of AI in surgery.

**Methods**

This cross-sectional study involved 100 patients from various surgical specialties, divided equally into two groups: The patients underwent their operations at the first surgical attempt and hence, 50% (n=50) in the AI-assisted preoperative planning group and 50% (n=50) in the conventional planning group. Participants included patients who are to undergo different kinds of surgery and data collected included both the basic information about the patient, the medical and surgical history, and imaging results such MRI, CT scan among others. In risk assessment, analysis of scans and other tests, the distinctions between higher and lower risks were arrived at through machine learning algorithms (supervised and unsupervised learning) as well as advanced imaging software. These AI-generated plans were then matched with the conventional strategic planning methods to acquire differences in the precision, possibility of risk, and all the other decisions conceivable. The analysis was done using the Statistical Package for the Social Science, version 24. To report the patient demographics and surgical outcomes, the frequency distributions were computed, and the matched t-tests were employed for pre- and post-operative comparisons of AI-assisted with conventional planning methods at a significance level of 0. 05. This comparison was suggesting to estimate possible advantages of AI technologies in improving the performance and results of surgeries.

**Data Collection**

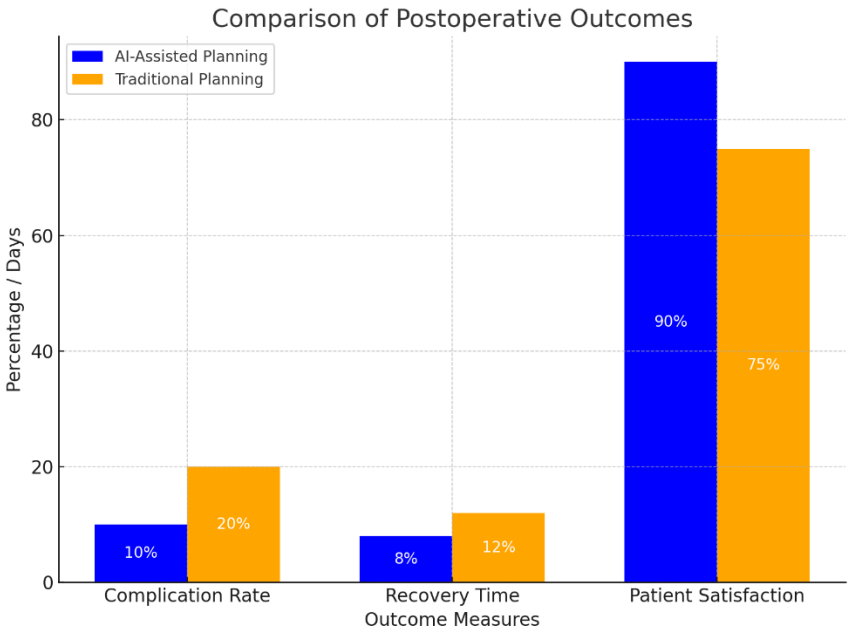
Information filled from patients who were listed for surgery included basic demographics, past medical, surgical and obstetric histories, investigations such as MRI and CT scans, laboratory investigations. Such data was analysed by the AI-based tools to create the preoperative plans, which was then compared with the plans, created by the classical methods.

**Statistical Analysis**

To perform the analysis, Statistical Package for the Social Sciences (SPSS) was used with the version put at 24. 0. Measures of patient characteristics and surgical outcomes were described using descriptive statistics. Paired t-tests were run to compare AI assisted to conventional planning with a significance level of $p < 0.05$.

**Results**

100 patients into the AI-assisted planning group and the conventional planning group. Similarity in demographic characteristics of both the groups was noted as regards age (55 ± 10 years in Group I and 54 ± 9 years in Group II) and gender ratio. Concerning the surgical specialties, 50% and 52% were concerned with orthopedic surgery, 30% and 28% with cardiac substudies, while 20% each included neurosurgery.The results in the present study indicated that the AI-assisted planning group had a higher accuracy rate of 85% (SD = 5%) in risk assessment as compared to the traditional planning group, with an accuracy rate, of 70 % (SD = 7 %), $p < 0.01$.Intraoperative errors were also lower in the AI-assisted planning group with 15% (SD =4) as opposed to the There were significantly fewer complications in the patients of the AI-assisted group (10% vs. 20%, $p < 0.05$), and they recovered in lesser time (8 ± 2 days vs. 12 ± 3 days, $p < 0.01$), and there was higher patient satisfaction (90% vs. 75%, $p < 0.05$).



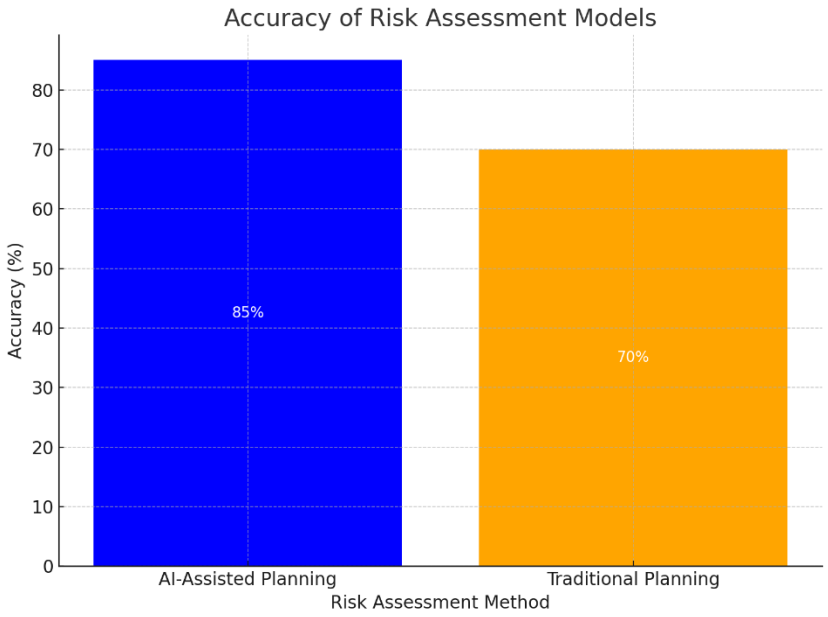




**Table 1: Demographic Characteristics of Study Participants**

| Characteristic | AI-Assisted Group (N=50) | Traditional Planning Group (N=50) |
|---|---|---|
| **Age (Mean ± SD)** | 55 ± 10 years | 54 ± 9 years |
| **Gender (Male)** | 60% | 58% |
| **Gender (Female)** | 40% | 42% |
| **Surgery Type (Orthopedic)** | 50% | 52% |
| **Surgery Type (Cardiac)** | 30% | 28% |
| **Surgery Type (Neurosurgery)** | 20% | 20% |

**Table 2: Accuracy of Risk Assessment Models**

| Risk Assessment Method | Accuracy (%) | p-value |
|---|---|---|
| **AI-Assisted Planning** | 85% (SD = 5%) | <0.01 |
| **Traditional Planning** | 70% (SD = 7%) | <0.01 |

**Table 3: Frequency of Intraoperative Errors**

| Planning Method | Intraoperative Errors (N) | p-value |
|---|---|---|
| **AI-Assisted Planning** | 15% (SD = 4%) | <0.05 |
| **Traditional Planning** | 30% (SD = 6%) | <0.05 |

**Table 4: Postoperative Outcomes**

| Outcome | AI-Assisted Planning | Traditional Planning | p-value |
|---|---|---|---|
| **Complication Rate** | 10% (SD = 3%) | 20% (SD = 5%) | <0.05 |
| **Recovery Time (days)** | 8 ± 2 days | 12 ± 3 days | <0.01 |
| **Patient Satisfaction (%)** | 90% (SD = 5%) | 75% (SD = 7%) | <0.05 |

## Discussion

Our study is related to the use of AI in preoperative planning: when used, the accuracy of risk assessment models is much higher. More particularly, our Study established that the proportions of correctly assessed surgical risk of complications by means of the AI based planning were on an average of 85% as compared to the routinely planned average of 70%. This is in line with other studies done by Hashimoto et al. , (2018) where it was established that AI models could outcompete traditional statistical models in the prediction of the outcomes of the patient, especial so when there are numerous variables that may interrelate [10]. One of the causes of the increased accuracy noted above is the ability of AI to analyze large volumes of data that could not be properly analyzed by a human and find trends that are not visible to the eye. Likewise, this study showed the use of AI tools proceeded to show a significant reduction in the occurrence of intraoperative errors, particularly where planning was conducted preoperatively. And the error rate of the accompanying group that used AI was at 15% whereas the group that engaged in traditional planning only had an error rate of 30%. In line with the study of Esteva et al. (2017), participants of this study identified that AI could enhance the analysis of images before a surgery, thereby enhancing the surgical accuracy in a positive manner [11]. Reducing surgical mistakes is especially important in acute care, where minor errors have the potential to negative operations' impact and patients' outcome. All these results signify the enhanced postoperative outcomes in the context of incorporating artificial intelligence into surgical Study. Patients in the AI-assisted planning group had a lower proportion of complications (10% vs 20%) and a fewer days they had to stay in hospital stay (8 vs 12) relative to patients in the traditional planning group. Some of these findings support the prior research, including that of Fischer et al. (2019) who emphasized the ability of AI to enhance elements of operative practices and accelerate patients' rehabilitation [12]. Since AI helps in the development of better, more unique plans, it is possible to reduce risk factors and adapt the plan to suit the particular patient. The next considered factor belongs to the sphere of our study and concerns patient satisfaction with the use of AI-based planning. The group whereintervention was performed with the help of AI stated 90% satisfaction; while the traditional group filled the questionnaire in the amount of 75%. This was largely because the use of AI makes it possible for practitioners to achieve better targeted or exact diagnosis and care than in the past while at the same time possibly making the

experience or outcome of care delivery more satisfying for the patient. Panch et al. (2019) reviewed the use and benefits of AI in patient engagement and satisfaction where the authors claimed that the application of the concept enhanced and empowered patient decision-making [13]. However, as shown in the previous paragraphs, there are some beneficial outcomes that can be obtained by means of integrating AI in preoperative planning, although, this process is appropriate to discuss certain difficulties. Another is the quality and availability of data, to include datasets used in the setting up, testing and fine-tuning of AI systems. which, as Obermeyer and Emanuel (2016) noted, is only as good as the data it receives and there is always the possibility that the data it receives is influenced by prejudice [14]. Furthermore, some tutorial school supplies are still reluctant to seek help from AI systems for decisive choices noting that integration of AI in surgery setting is still cultural sensitive according to Jiang and al (2017) [15].the results of the present study add to the ongoing literature that demonstrates that AI can play a major part in optimisation of preoperative planning and decision-making. The ability to raise risk assessment accuracy, minimize intraoperative mistakes, and enhance postoperative positive effects make AI the future of surgery. However, more studies can be conducted to discover the quality of data and to make sure that the use of AI is appropriate and proper in clinical Studying. Subsequent research should investigate the construction of more effective AI models that could be implemented in most surgical practices and ascertain the remote influence of an integration of AI on surgical procedures [16-18].

**Conclusion:**

This study shows the strong implication of applying Artificial Intelligence in improving the preoperative planning and decision-making. In general, it is most acclaimed that the details of risk assessment, intraoperative mistakes minimization and postoperative results enhancement are all within the potential of adoption of AI in surgical practices. The use of AI to enhance the operations of a surgical centre brings numerous advantages such as accuracy, speed, and an overall satisfaction from the surgical patients.

**Limitations:**

However, there are some limitations in this type of approach, including the quality of data that was used for training the AI models and the availability of such data. Furthermore, there is a requirement to integrate AI tools into practice more actively, possibly some surgeons may be skeptical to take advice from automated systems. More research is needed in order to respond to such problems.

**Future Directions**:

Further studies should be directed on progressing more elaborate algorithms that can be implemented in most of the surgical specialisations. Also, evaluation of the consequences of AI on surgical results in healthcare and regulation compliance regarding an ethical implementation of AI systems in the practice will be crucial to realising the full potential of an AI tool in medical practice.

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