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## Perception and Awareness of Surgical Professionals About Potential Role Of Artificial Intelligence In Surgery: A Survey Analysis

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**IMPORTANCE** Artificial intelligence (AI) is defined as the ability of the machine to think like a human being. Since the advent of AI, there has been a major change in the medical and surgical fields. The AI-based algorithms are being incorporated into the decision-making and automation aspects of the surgical discipline. This study aims to investigate the perception and awareness of medical professionals about the role of AI in surgical fields.

**METHODS** A questionnaire was prepared by a panel of six experts in the field of surgery who were well-aware of the role of AI in surgery. They formulated the basic themes, and these items underwent the process of content and construct validation. The questionnaire was disseminated through Google forms. The intended participants included medical professionals interested in surgery were approached to take part in this survey. The data was collected after the approval of the ethical committee of the institute and the analysis of the data was done using IBM SPSS Statistics 23.0, for quantitative analysis, and the qualitative data were subjected to thematic analysis.

**RESULTS AND DISCUSSION** 197 individuals having an interest in surgery took part in this survey. Most of the participants were not familiar with the AI-based concepts and their potential role in the surgical field in the coming years. Only a limited number of participants were involved in surgical AI projects. According to the results of this survey, general acceptability towards the integration of AI in surgical practices was observed. There was a mixed opinion regarding the application of AI in surgery among medical professionals.

**CONCLUSIONS** Despite the limited awareness of the participants, the perception of the surgical professionals about Artificial intelligence (AI) is changing and the acceptability towards integration of AI in surgical practice is increasing.

**KEYWORDS** Artificial intelligence, AI, Machine learning, Surgery, neural networks, Survey,

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### Original Research

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Artificial intelligence deals with training a machine to think and solve problems like a human being. Artificial intelligence is changing the outlook of every field of life. AI has been used in different fields of medicine and it has shown some outstanding results in those fields. AI is currently being used in different areas of surgery in limited capacity<sup>1</sup>. However, it is being speculated that in the future AI will be used as a major tool in different areas of surgery. In the surgical discipline, the role of Artificial Intelligence (AI) is evolving and is important in supporting clinical decision-making, imaging, and diagnosis, precision medicine, for risk stratification, genomics, and discovery of novel drugs<sup>1</sup>. The potential role of AI in imaging and navigation provides a potent notion for computer-assisted intervention both in the preoperative and intraoperative setting. Computer-aided intraoperative guidance through a minimally invasive approach provides another avenue for active exploration. Researchers are exploring four main areas in this regard: shape instantiation, endoscopic navigation, tissue tracking, and Augmented Reality (AR).

The research in these areas would likely expand exponentially in the coming days and would have a significant impact on research and ultimately our surgical practice<sup>1</sup>.

Despite the current use of AI-based technology in different surgical fields, a general skepticism is still seen among medical professionals about the integration of AI-based tools in surgical and medical practice. We conducted this survey to investigate the knowledge, acceptability, and general perception of medical professionals about artificial intelligence in surgery.

### METHODS

A questionnaire was prepared by a panel of six experts in the field of surgery who were well aware of the role of AI in surgery. They formulated the basic themes, and respective items underwent the process of content and construct validation. This study was conducted after getting approval from the ethical committee of the institution. The

questionnaire was designed to get multiple choice and free-text responses from the participant. The questionnaire was disseminated through Google forms. The intended participants included medical professionals interested in surgery were approached to take part in this survey. 70.6% of the participants were medical students, 15.7% of them were consultants while the remaining 13.7% population consisted of medical professionals of varying clinical experience. The analysis of data was done using IBM SPSS Statistics 23.0 and p values were calculated using the chi-square test.

## RESULTS AND DISCUSSION

### Characteristics of the Participants:

A total of 197 individuals participated in this survey. A brief overview of the characteristics of the participants has been depicted in Table 1. Younger professionals in earlier phases of their careers participated more in the survey as opposed to older professionals. Most of the participants (51%) who took part in this survey belonged to the specialty of general surgery. Although the survey was circulated among the younger health professionals and the consultants alike, the professionals at earlier stages of their career responded more enthusiastically. 70.6% of the respondents were medical students, 15.7% were consultants, and 13.7% were post-graduate trainees or intern rank professionals. The research experience and experience about AI-related research experience were variable. When the participants were asked to rate their scientific experience 66.3% responded that they had been involved in some research project in the past, 23% said that they had never done any research project in their entire life while 10.7% said that they had led many research projects in the past. Similarly, the duration of the experience among the participants was also variable among the participants. 51.5% of the participants had research experience of 1 year, 12.4% had an experience of 2 years, 4.6% had an experience of 3 years, and 12.9% of them had an experience of more than four years while 18.6% had no research experience at all.

Despite a high level of enthusiasm in AI-based research, the understanding of the subject and the awareness about its potential applications still remains limited. Moreover, the surgical literature exploring the perception of medical professionals about surgical AI is even exiguous. Such a drive is probably timely and needs of the hour to stimulate the research hierarchy to focus on the subject and harness the fruits of AI in the field of surgery. A few articles exploring the attitude of medical students and medical professionals about AI in the field of medicine have been published<sup>2,3</sup>. A recent survey exploring the patient's perception of the use of AI in neurosurgery has been published<sup>4</sup>. However, there are only a limited number of surveys that have investigated the perception of surgeons and the integration of artificial intelligence in the field of

surgery. In this survey, we have investigated the familiarity and acceptability of surgical AI in medical professionals who have a formal interest in the field of surgery.

Age	Percentage
The Twenties	78.06% (N = 153)
Thirties	16.32% (N = 32)
Fifties	3.57% (N = 7)
Sixties	4% (N = 8)
Gender	Percentage
Males	42.9%
Females	56.6%
Unidentified	0.5%
Specialty	Percentage
General Surgery	51%
Cardiothoracic Surgery	8.2%
Obstetrics And Gynecology	5.1%
Neurosurgery	2.6%
Ophthalmic Surgery	3.6%
Oral And Maxillofacial Surgery	2.6%
Orthopedic Surgery	3.1%
Otorhinolaryngology	2.6%
Pediatric Surgery	2.6%
Plastic Surgery	2%
Urology	1.5%
Vascular Surgery	0.5%
Radiology	0.5%
Dermatology	0.5%
Internal Medicine	0.5%

### Survey Exploration and Outcomes:

The following themes were explored through the survey:

#### A. Familiarity and Involvement with Surgical AI-Based Research:

With the rapid growth of artificial intelligence, it has become important for physicians to develop an understanding of AI. The majority are not familiar with the basic concepts of artificial intelligence and structured data handling (which is the core of AI science), as most of them do not like to focus on complex algorithms, software languages, and engineering skills which all lead to the integrative thought process. In a recent survey conducted in 2019, it was revealed that merely 6% of the health professional participants had a good familiarity with the structured data handling, database, and AI-related concepts<sup>3</sup>. When the participants were asked about familiarity with the concept of surgical data science, 51.4% of them said that they didn't know what it means, 33% of them said that they have heard about it but they were not familiar with it and 14.6% of the participants said that they knew what it means but they were not working in this field. Only 1.1% of the respondents said that they were familiar

with surgical data science and they had worked in this field. This clearly shows the need for creating awareness among the hospital professionals to generate and handle the data in a more structured fashion and to train the faculty for this particular purpose. In this survey, participants were specifically asked about the procedure of surgical data collection in their institutes. More than 60% of participants believed that their institutional data handling has progressed to a more structured approach. The rest either did not have the will or the infrastructure to handle the data in a more systematic and structured way to make it more useful and good enough to be used for any research-related activity. The quality of the structured data handling however varies and only 9.7% of participants believed that their surgical data was ripe enough for use in machine learning-based projects. Awareness and practice of annotation of surgical data remain sub-optimal; 70.3% of the participants responded that they had never done it, 9.2% said that they have annotated surgical data and 20.5% of the participants were not familiar with the concept of data annotation.

Artificial Intelligence can be instrumental at many fronts in surgery starting from diagnosis, decision-making algorithms, automation, and robotic integration. For successful application of AI in these different domains needs significant in-depth knowledge of computer programming, data science, and knowledge of mechanical engineering science. The successful outcomes in this domain would depend upon the successful integration of these all domains. Therefore, a surgeon's knowledge about AI would require a significant hold of these disciplines. Participants' cognitive depth about AI was explored in this survey as well. Around 55% of them said that they have never studied anything related to artificial intelligence, 34.4% said that they have read about it, 8.2% said that they have attended seminars about it, 2.1% of them said that they had taken an online course about it and 0.5% of the participants said that they had a degree related to this subject. The survey participants were traversed about their understanding of scientific articles on artificial intelligence. 70.5% of the participants answered that they had never read any scientific article on artificial intelligence, 17.1% said that they had read AI-based articles in surgical journals but they could not understand the details dealing with artificial intelligence, 8.3% said that they had read AI-based articles in surgical journals and they were able to understand AI-related details, and 4.1% of the respondents said that they had read AI-based articles in computer science or engineering journals and they could understand the AI-related details.

The participant's familiarity with AI-related terms was scouted. The terms we used in the questionnaire were machine learning, deep learning, supervised learning, unsupervised learning, and neural networks. More than 50% of the participants were not familiar with these terms, 24.7% said that they did not understand them completely but they had heard about some of these terms, 20.6% said that they

could understand some of these terms and only 2.1% said that they could understand all of these terms completely.

AI-related projects mandate a multidisciplinary research approach. On a question about collaboration with engineers in surgical AI projects, 97.8% of the participants said that they had never worked with engineers on such projects and 2.2% of the respondents said that they had worked with engineers in a surgical AI project. Participants were asked to give their opinion on leadership in surgical AI research. 11.9% of the participants said that surgeons should take lead while 9.7% said that AI researchers should take lead in researching surgical AI. 78.4% of them said that there should be a collaboration between surgeons and AI researchers in researching surgical AI. Participants were asked about their computer programming experience. 57.4% of them said that they had no experience in programming, 37.1% said that they were a little bit experienced while 5.6% said that they were somewhat experienced in computer programming. Looking at these results, it can be concluded that the involvement of participants in AI projects and their familiarity with the AI terms was limited. This clearly shows the need for an in-depth cognitive base of the surgical professionals to conduct a meaningful AI-related search and provide leadership to the research team.

### B. Acceptability of AI-based technology:

Skepticism regarding the implementation of new technology is always seen in the general public. Artificial intelligence is a relatively recent concept and the understanding of this concept is limited. In this survey, we wanted to probe the adaptive and adoptive attitudes of medical professionals towards AI-based technology.

Participants of this survey were scrutinized for their reaction to new technology. 56.3% of the participants responded that they adopt technology at an average rate, 28.9% said that they accept new technology very quickly and 14.7% of the respondents said that they are usually skeptical about the new technology. Participants were asked to give their opinion about whether or not AI should be used to make an autonomous surgical robot. 23.2% of them were in favor of making AI-based autonomous surgical robots, 12.4% were against it and 47% of the participants said that it should be done only if we have solid evidence of its safety. This shows the safety remains a priority before incorporating AI-based applications into the practice. 16.2% of the participants thought that only humans should be permitted to do surgeries. Participants were also asked about their opinion about using AI for clinical decision-making. 57.3% of the respondents answered that AI should be used as a tool to help us make clinical decisions, 4.9% of the participants said that AI should replace humans and 3.8% said that AI should be used for clinical decision making because it is a more financially viable option. 34.1% of the participants said that AI should not be used for clinical decision-making. Out of these 34.1% participants,

21.1% of respondents said that AI cannot be trusted with the lives of human beings. While answering another question about willingness to use AI tools in surgical practice, 35.1% of participants answered that they would be willing to use AI tools in their surgical practice while 8.6% of the participants said that they would not use them. 56.2% of the respondents said that they would like to know more about surgical AI before using them in their surgical practice. At large, patient safety concerns remains a significant concern in the adoption of AI-based surgical solutions. The surgeons are also skeptical about the ability of the AI-based algorithms, however, they think to continue the research in this area more robustly.

Integration of AI-based solutions into the surgical practice especially in the preoperative and per-operative setting remains in infancy. Participants were asked for their opinion about the integration of AI into daily surgical practices. 25.6% of the participants said that AI will be integrated into daily surgical practices while 8.7% of respondents answered that AI will not be integrated into surgical practices. 65.6% of the participants were not sure about whether AI will be integrated into surgical practices or not. 24% of the respondents answered that AI will be integrated within five years, 34.7% said that it will be integrated within five to ten years, 37.2% said that it will be integrated in more than ten years while 4.1% of the respondents said that AI will never be integrated into daily surgical practices. Participants were asked to tell us how their jobs as surgeons will be impacted by AI. 57.4% of the respondents said that their job will be impacted for the better, 25.4% said that their job will be changed as a surgeon and 4.1% of them said that their jobs will be replaced. 13.2% of the respondents said that AI will not impact their job in any way. 54.3% of the participants said that intraoperative care will be impacted the most within the next 10 years, 17.3% said that preoperative care will be the most impacted area, 13.7% said that postoperative care will be the most affected area within the next ten years. 14.7% of the respondents said that hospital management will be the most impacted area within the next ten years. Participants were given an arbitrary scenario to investigate whether they liked explainability or accuracy in their AI-based surgical tools. 39.1% of the participants answered that they prefer accuracy, 9.6% preferred explainability while 51.3 said that their decision will depend on how much accuracy they will get at expense of explainability.

Contrary to our presupposition, there was general acceptability towards the integration of AI in surgical practice. Most of the participants were willing to use AI in their surgical practice but most of them were skeptical of AI-based autonomous surgical capacity. Most of the participants believed that AI will be integrated into general surgical practice in the future and most of them said that their jobs as surgeons will be impacted for the better.

### C. Perception about the application of AI in surgery

Artificial intelligence is being used in preoperative risk assessment and prediction of post-operative complications, overall survival, and 30 day readmission<sup>5</sup>. AI is playing a major role in different surgical fields like ophthalmology, plastic surgery, and vascular surgery<sup>6,7,8,9,10</sup>. In the future, AI will be a major part of surgical practice. In this study, we wanted to know the perception of medical professionals about the application of AI in surgery.

The participants were asked to express their thoughts about what the role of AI will be in surgery within the next 10 years. Out of 197 people who answered this question on a scale of 1-5 in increasing agreement, 47 people thought that there's a 40% possibility of an increased role of AI in enhanced surgical vision (augmented reality, fusion imaging, surgical guidance system, etc.). 41 participants answered 4/5, 39 participants answered 1/5, 37 people answered 3/5 and 33 respondents answered 5/5 on the agreement scale. In response to the question about the role of AI in medical training and education 56 people answered 2/5, 45 people answered 3/5, 37 people answered 4/5, 33 respondents answered 1/5 and 26 participants answered 5/5 on an agreement scale to this question. When they were asked about the role of AI in surgical automation, 66 people answered 2/5, 44 respondents answered 3/5, 41 participants answered 1/5, 31 of them answered 4/4 and 15 people answered 5/5 on the agreement scale. 55 participants responded with 2/5 on the agreement scale to the question about the role of AI in hospital administration. 43 of them answered with 1/5, 41 participants answered with 3/5, 38 of them answered with 4/5, and 20 participants answered with 5/5 on an agreement scale. 58 participants answered 2/5, 50 participants answered 4/5, 39 people answered 1/5, 37 participants answered 3/5 and 13 people answered 5/5 on an agreement scale when they were asked about their opinion on the integration of AI in intraoperative decision support. We asked the participants to give their opinion about the role of AI in perioperative decision support on a scale of agreement from 1 to 5. 57 participants answered 2/5, 45 people answered 3/5, 40 people answered 1/5, 40 people answered 4/5 and 5 people answered 5/5 on agreement scale. Our study clearly shows that AI would significantly impact the surgical practice both in the preoperative and intraoperative setting.

### D. Barriers to implementation of AI in surgical practices:

Despite the utility of AI-based tools, there are still some problems regarding the implementation of AI in surgery. In this survey, we asked the participants different questions relating to the barriers to implementing AI in surgery. They were asked to give their answer in the form of a scale of agreement from 1 to 5. When the participants were asked to give their opinion about the lack of technical infrastructure as an impediment to the integration of AI in surgical practice, 59 participants answered 5/5, 45 people

answered 4/4, 33 people answered 3/5, 31 people answered 1/5 and 29 people answered 2/5 on agreement scale. We asked the opinion of participants about the lack of trust in AI-based tools as a barrier to the implementation of AI in surgical practices. 51 participants answered 4/5, 48 people answered 3/5, 39 respondents answered 2/5, 38 people answered 5/5 and 21 people answered 1/5 on an agreement scale from 1 to 5. 51 people answered 4/5, 44 participants answered 5/5, 41 people answered 3/5, 34 participants answered 2/5 and 27 people answered 1/5 on agreement scale when they were asked about the unavailability of AI-based tools as a hurdle in implementing AI in surgery. Participants were asked about unclear legislation and ethical aspects as an impediment to the integration of AI in surgery. 51 people answered 4/5, 50 people answered 3/5, 40 people answered 5/5, 29 people answered 2/5 and 27 people answered 1/5 on the agreement scale to this statement. 51 people answered 3/5 on an agreement scale while giving their opinion about the

lack of trust in AI among healthcare professionals and hospital management. 46 people answered 4/5, 44 participants answered 2/5, 32 respondents answered 5/5 and 24 people answered 1/5 on the agreement scale. Hence, the issues related to infrastructure, general trust in applications, patient safety, ethics, and legal perspectives emerged as important barriers or challenges in the expedited implementation of AI-based solutions.

### CONCLUSION:

The perception of medical professionals about the role of Artificial intelligence (AI) in surgery is changing and there is a general increase in acceptability towards the integration of AI-based technology in surgical practice. In the future, the momentum of AI giant would likely influence surgical science and art significantly and our jobs and roles as surgeons would significantly be modified.

### ARTICLE INFORMATION

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### Conflicts of Interest:

There are no conflicts of interest

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