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Role of Artificial Intelligence in Supporting the Performance of Surgical Robots: A Survey

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Abstract. The applications of AI in medicine go well beyond what people may think. With an application that analyses data and forecasts infections and diseases, diseases can be predicted. In addition to giving physicians the ability to quickly and accurately assess thousands of patients, this aids in their decision-making process. As a result, doctors can eliminate the lengthy time it takes to analyze these tests without diminishing their importance because they will continue to be an integral part of doctors' medical routes, serving as an auxiliary tool. When AI is used correctly, diseases can be detected early, thereby reducing government expenditures, as this area carries significant opportunities for the growth of the healthcare sector.This study aims to shed light on the latest developments regarding the reality of using artificial intelligence and surgical robots in the healthcare sector and whether they are compatible with the wise leadership's vision for the transformation of the healthcare sector in the Kingdom of Saudi Arabia, which aims to restructure the healthcare sector as it is a fundamental pillar of the Kingdom's Vision 2030. Are we keeping up with this technological development in the healthcare sector in Saudi Arabia, and where are we heading? What is the future of artificial intelligence and surgical robots? Will robots replace human surgeons? This research relied on a survey critique methodology, reviewing previous studies between 2011 and 2021 on artificial intelligence and surgical robots. The study reached several conclusions, including the following: There is a level of responsibility and patients' ability to accept surgical robots. The clinical medical trend is to increase reliance on the capabilities of artificial intelligence and surgical robots in predicting diseases and therapeutic diagnosis. The reliance on artificial intelligence in processing big data and its development in fields such as radiology, imaging, and data analysis.

Keywords. Artificial intelligence, robotic surgeries, medical systems, automation, endoscopy, robots, Internet of Things (IoT), ophthalmology, spinal surgery, prostate surgery, machine learning, deep learning, and blockchain.

1 Introduction

The healthcare sector in Saudi Arabia has achieved many accomplishments in the previous stage, such as improving the quality and efficiency of healthcare services and facilitating their access through the digitization of the healthcare sector, launching a package of applications (Sehaty, Mawid) and increasing services to cover all regions of the Kingdom.

This highlights the importance of artificial intelligence in developing the healthcare sector and the opportunity for rapid improvement in healthcare quality [1]. This requires the increasing role of artificial intelligence in the field of medicine in the future. In a report prepared by Accenture Consulting in 2014, it was found that the global market value of artificial intelligence in medicine reached $600 million. By 2021, the indications showed that this number had reached $6.6 billion [2].

The focus of this research is on predicting what a visit to the doctor will be like in the next 20 years in light of the astonishing and rapid developments in the field of communications and information technology, including the use of artificial intelligence and surgical robots as supportive tools to begin building a future of appropriate healthcare for both the surgeon and the patient.

This research highlights the importance of using artificial intelligence robots in surgical operations and increasing awareness of using this technology to increase the success rates of these

operations. The research also shows some gaps in artificial intelligence robot research for surgical operations due to their low usage worldwide, despite their many benefits, which reduce complications and the duration of surgical operations [3].

Based on the above, the problem of this research revolves around answering the following question: How did the science of artificial intelligence begin and develop in the medical field, and what is its vital role in activating the performance of surgical robots?

2 Surgical Robots and their Multiple Uses

The National Aeronautics and Space Administration (NASA) of the United States investigated the idea of remote surgery in the 1970s,intending to use it on astronauts in orbit. The main concept was to create a surgical tool-equipped machine that could be operated by a ground-based surgeon and installed in a space station. The removal of undesired movement was the other objective of robotic surgery.

The first surgical robot was utilized in a laparoscopic procedure in 1985. An Imperial College London-developed robot was used for a prostate operation in 1988. In 1992, a robot developed by Integrated Surgical Systems was used to prepare a cavity in the thigh bone and replace the hip joint, and the task was successfully executed with greater precision and speed than human surgeons [4].

The 1980s and 1990s were known as the laparoscopic surgery era. A laparoscope is a thin, lighted optical device that looks like a small telescope and inspects the abdominal and thoracic chambers. Surgeons discovered they could operate on patients with smaller incisions, shortening their hospital stay and recovery period.

Since this method is one kind of minimally invasive surgery, some surgeons have worked to create surgical robots that can help with this kind of surgery. In the field of artificial intelligence, robots are the most exciting devices. While it may seem premature to discuss the possibility of robots performing surgery in the far future, imagination has become a reality.

A Chinese robot that used artificial intelligence to pass the nation's professional exam did it in 2017. The surgical robot Versius, created by the British medical technology company CMR Surgical, carried out its first accurate surgical procedure in colon and rectal surgery in February 2022. Versius has many arms that can help surgeons in operating rooms [5].

Even in the most developed nations, the congestion of hospitals and medical centres and the pressures placed on physicians and nurses are persistent issues facing the healthcare industry. For instance, a 2016 study done in the United States found that 96% of patient complaints centre around difficulty completing registration forms and unsatisfactory encounters at reception desks.

As a result, several artificial intelligence-based systems and apps have attempted to address these issues. This was supported by a study [6], which stated that the pandemic posed a major challenge to healthcare workers and hospitals and that robots and artificial intelligence could be used to reduce communicable contamination and assist patients and management in the surgical environment during times of high patient flow to healthcare centres and hospitals.

To ascertain whether device diagnoses were better and more accurate than physician diagnoses, researchers at Northwestern University in Illinois, USA, collaborated with Google and numerous medical centres in 2019. The researchers examined data used with the consent of thousands of cancer patients.

Although artificial intelligence in healthcare is still in its early stages of research and is not yet suitable for general application, a recent study featured in The New York Times and published in the journal "Nature Medicine" offers some insight into what lies ahead for the technology.

Medical robots assist surgeons in performing precise and complex surgical operations, where the surgeon controls the robot's arms remotely, and they can reach precise locations that the human hand cannot reach. The camera provides the surgeon with highly precise vision of the surgical site.

The advantages of using robots in surgical operations include precision, flexibility, and reduced complications resulting from surgical operations, such as infections, bleeding, and

reduced vibrations. This was confirmed by a study [7] that showed that there are four main areas where artificial intelligence methodology is used in medicine: diagnosis, predictive methods, robotic surgery, and therapeutic diagnosis, where robotic oral surgery provides less risky treatment methods and better results in terms of reducing blood loss and quick recovery.

At an advanced level, robots can now assist surgeons in many minimally invasive surgical procedures. For example, in operations to remove a tumour that has affected one of the body's organs, the doctor cannot be 100% certain of the exact location of the tumour, the actual distance of the arteries adjacent to the tumour, or the possibility of the surgical scalpel injuring adjacent organs.

In addition, robots and computers can provide a great service to surgeons. After computed tomography (CT) imaging, the tumour's location can be accurately determined, and the distance of adjacent organs can be measured. Additionally, a three-dimensional image can be formed to assist the doctor during the surgical procedure.

A study [8] confirmed that gastroenterology is an area artificial intelligence can significantly impact. It is possible to analyze images, perform accurate evaluations, and provide more information than traditional analysis, helping surgeons in gastrointestinal surgical procedures.

The surgeon controls the robot's arms by placing a control device in front of a computer screen in the assigned spot. It would be truer to state that the robot programmes the motions the surgeon wishes to make and then executes those actions on the patient's body. The constraints of surgical intervention have been greatly increased by robot-assisted surgery, which outperforms open surgery in several ways, including increased accuracy, fewer incisions, reduced pain, and decreased blood loss.

The surgeon makes a tiny, barely noticeable incision in the patient's abdomen, inserts a tiny robotic arm with a camera attached to it via a computer screen, and the arm moves through the patient's organs based on the surgeon's observations made in front of the computer screen, which is magnified ten times. The application of artificial intelligence in robotic surgery has been shown in a study to substantially impact future training and improve the surgical experience during the process to raise the standard of surgical care.

3 Virtual Healthcare and Cloud Computing

Using technology like video communication, messaging, or software, virtual healthcare, commonly called remote healthcare, facilitates quicker contact between patients and doctors located far away. Many patients use fitness trackers or health monitoring gadgets to monitor any changes in their health and communicate that information to their physicians.

With the capacity to do tests and quickly monitor their health from home, this technology allows patients to be completely comfortable and facilitates speedy communication between them and their doctor. Furthermore, it lessens the need for travel by enabling patients to consult with professionals outside of the city. These days, many web-based or mobile applications are available for obtaining information, including ones that read blood glucose levels, measure blood pressure, measure blood glucose levels, or measure the function of the lungs.

In this sense, the primary care physician forwards to the specialist for review of examination notes, medical history, test results, X-rays, or other imaging tests. The specialist may ask to meet with the patient, arrange a virtual appointment at the doctor's office, or reply electronically. These virtual consultations can eliminate the need for pointless in-person referrals to the specialist and shorten the time needed to hear back from the doctor [9].

This was addressed in a study [10], which explained that artificial intelligence applications and machine learning have helped support diagnostic decision-making and dental treatment with the help of data-driven algorithms and called for the use of advanced modern technologies such as Dentronics to help improve healthcare.

Cloud computing is an important technology that provides the ability to store, process, and analyze data necessary for the application and operation of artificial intelligence and machine learning systems and to drive innovation. The AWS cloud platform facilitates the absorption and

processing of data, whether structured, unstructured, or continuously streaming, and simplifies the process of building, training, and deploying machine learning models.

With this technology, healthcare facilities worldwide can share information on genetic medical analyses while maintaining patient data [11]. However, a study [12] noted that artificial intelligence is expected to face significant challenges in independent development, data mining, and machine learning.

4 Surgical Robots

Pattern recognition and image interpretation are skills humans use to read microscope slides, X-rays, MRI scans, and other medical examination processes, which are some of the most promising scientific fields. In light of this, a study [13] talks about a revolution in the field of comprehensive spine surgery care, which is still good and improving and can reduce surgeon stress, improve technical accuracy, and assist in predictive analytics for surgeons. It also helps improve patient selection before surgery.

With the massive amounts of data made possible by medical imaging, researchers can teach computers to recognize patterns associated with conditions like pneumonia, cancer, or a wrist fracture that is difficult for a person to see. This is done by transferring the data to "artificial neural networks".

The system then operates based on an algorithm or a set of rules; the interpretation becomes easier and more accurate with more data. Numerous medical applications currently use this technique, which is called deep learning. A study [14] confirmed that eye surgery requires sensory and motor skills that approach human limits, and yet machine learning-enhanced surgical robots could ultimately improve retina surgery and potentially change the system.

In a related medical use, Google has previously developed tools to help ophthalmologists identify eye conditions in diabetic people, and pathologists diagnose cancer by analyzing microscope slides. According to a study [15], people with prostate cancer are receiving care more quickly, thanks to the growing use of machine learning for diagnosis and treatment planning.

According to studies, screening lowers the chance of dying from lung cancer. Aside from identifying specific tumours, screening can also discover areas potentially developing into cancer. This allows radiologists to classify patients into risk exposure groups and ascertain if they require skin tissue tests or ongoing monitoring of areas likely to be affected.

But radiographic testing has shortcomings, according to researchers, as it can miss tumours or misidentify benign areas as malignant ones, sending patients to dangerous procedures like lung tissue testing or surgery. Different radiologists may view this matter differently depending on how they examine the scan itself.

"The entire experiment process is like a student in school," stated Dr. Tsai. Until students can comprehend what cancer is and what will or will not be cancer in the future, we use a sizable quantity of data for training, teaching, and pop quizzes. After spending a lot of time teaching, we gave them a final exam on data we had never seen before, and the outcome we observed on the final exam was good" [16].

A study [17] concluded that surgical practice would change completely in the future with the use of artificial intelligence and robots in diagnostic, radiology, pathology, and ultimately, supervision of independent surgery without allowing the decline of surgical skills of the surgeon's hand and emphasizes the need for surgeons to be prepared to adopt more intelligent training methods.

Many people, including healthcare professionals, fear that robots and artificial intelligence systems will replace their occupations despite the remarkable technological advances and the emergence of increasingly intelligent technologies. According to existing signs, integrating artificial and human intelligence is the best approach to bring about the impending transformation in the healthcare industry [18].

Therefore, a study concludes that clinically meaningful surgical robots are likely to be achieved by the end of the 21st century and that combining artificial intelligence allows surgical robots to improve outcomes to achieve optimal care. According to a technology and future-focused website, surgical robots, particularly the Da Vinci

system, extend the surgeon's control over the device from a remote control unit inside the operating room. A study noted that the Da Vinci system developed an operating and recording system that can benefit surgeons when evaluating surgical skills and teaching trainees [19]. This can provide the best results by combining artificial intelligence with clinical examination.

One of the most ambitious procedures, and one that is said to be the first in the world, took place in Montreal in 2010, where the first joint performance between a robotic surgeon and a robotic anesthesiologist (dubbed "McSleepy" as a kind of pun) was achieved, and the data collected on this procedure reflected the excellent performance of these robotic doctors.

To evaluate the safety of robotic surgery, the Massachusetts Institute of Technology looked back at data from the FDA more than ten years after surgical robots were first used in operating rooms. 1,391 patient injuries and 144 patient deaths were reported during the study period, the majority of which were brought on by equipment malfunctions or technical issues.

The summary stated, "despite the relatively high number of reports, the vast majority of procedures were successful and did not involve any problems." Nonetheless, compared to specialities like gynaecology and general surgery, the frequency of occurrences in the most complex surgical fields (such as cardiovascular surgery) was "much higher".

It seems this situation is similar to fast food; while robotic surgery can be performed well in some specialities, human surgeons should perform complex surgical procedures, at least for now. However, this situation can quickly change, and robotic surgeons may become more capable of working independently of human surgeons. Then, it will become difficult to determine who will be held liable when errors occur.

In this context, a study focused on legal aspects and classified responsibility into the issue, responsibility, and blame, where the last element (blame) was the least clear, as it cannot be imagined in the current state of technology. Moreover, many patients may not agree to be ready to relinquish control of their lives through surgical robots. Therefore, can a patient sue a robot for malpractice?Even though the technology in these circumstances may still be relatively young, the litigation is legally ambiguous. Experts typically believe that medical malpractice results from a doctor's negligence or a breach of a particular standard of care. Still, there are unanswered questions. Can the patient's relatives hold the human surgeon in charge of the robot accountable?

Will the manufacturer of the robot face the consequences? Or will the engineer who created the robot be held accountable? Although there are no satisfactory solutions for these problems, they must be addressed as soon as possible.

5 Previous Studies

Most studies have emphasized the importance of collaboration between doctors, engineers, and technicians in improving, developing, and supporting artificial intelligence and robotic surgery without replacing or lowering the level of human surgeons.

Robotic surgery offers high precision and skill, low error rates, more accurate diagnoses, better results, less risk of blood loss, faster wound healing, and faster recovery. Therefore, the researcher concluded from previous studies that surgical robots represent a significant upcoming revolution that requires everyone (doctors and patients) to accept, deal with, and help spread and develop them.

Note that responsibility and the patients' ability to accept surgical robots were classified. Studies [1, 12], on the other hand, have shown that increasing artificial intelligence capabilities and surgical robots' ability to predict and diagnose treatment can improve outcomes and increase access to desired healthcare. Studies [9, 14] have also discussed how the use of big data and its development in radiology, imaging, and data analysis can benefit surgeons in evaluating their technical skills contributing to surgical training and decision-making.

A study [10] considered the Internet of Things (IoT) and healthcare systems as global data support collected from medical devices. Most studies used a descriptive-analytical approach to provide an overview of the artificial intelligence and surgical robot revolution in healthcare in previous,

current, and future years. They also pointed out some of the difficulties facing this technology and encouraged cooperation from everyone to benefit from it. In a study [11] in this paper, it was noted that responsibility and the patients' ability to accept surgical robots were classified.

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A study focused on the legal, regulatory, and ethical frameworks for developing future artificial intelligence and surgical robot standards. The discussion has pushed forward the potential for independent surgical robotics and AI, focusing on ethics, regulations, and legal aspects (such as civil law, liability, international law, privacy, product/device legislation, and malpractice).

Responsibility was classified into several legal aspects as follows: (1) the issue, (2) responsibility, and (3) blame. These three aspects were addressed when discussing responsibility for artificial intelligence and independent surgical robots. We believe that shortly, surgical robots may learn and perform routine surgical tasks that a human surgeon can later supervise.

If robots acquire human citizenship, these responsibilities could need to be reviewed. Blame is the least evident outcome of this, as it is unimaginable given the state of technology now. Furthermore, many patients might not be prepared to give up control over their lives and security to steel arms, fingers, and electronic circuits. Employment is also in jeopardy. Professional associations may oppose autonomous surgical robotics and AI applications.

A paper on artificial intelligence and robots: A Mix Transforms the Operating Room summarised the existing evidence in the literature regarding the AI techniques used during robotic surgery. According to the study, the application of AI in robotic surgery is anticipated to improve the surgical experience throughout the procedure and have a major influence on future surgical training.

Both seek to improve the quality of surgical care through precise surgery, which calls for multidisciplinary collaboration between software developers, engineers, and surgeons. According to a recent age study, prostate cancer detection, prediction, diagnosis, and treatment have become faster with the growing application of AI and machine learning.

The effective training, operation, and regulation of artificial intelligence-based decision support applications necessitates cooperation between urologists, data scientists, computer researchers, and engineers. Doctors cannot be replaced by artificial intelligence; nevertheless, physicians who acquire and apply artificial intelligence skills will take the position of conventional physicians who fail to adapt to the rapidly emerging digital landscape.

A study on artificial intelligence and robotic eye surgery questioned whether we are ready for this technology. The author mentioned that precise surgery of the specific retina involves sensory and motor skills that approach the limits of human physiology for stability, accuracy, and the ability to detect small forces.

Despite assumptions favouring robots in surgery and development efforts, machine learning-enhanced robotic systems may improve retina surgery with robot assistance and potentially change the system. Many obstacles prevent end users from adopting robots, including cost, size, functional limitations, accuracy, human acceptance, and, most importantly, superior safety outcomes. A study [12] discusses artificial intelligence and the future of surgical robotics.

The author describes clinical trials of artificial intelligence in the surgical context, providing insight into the surgical future. Clinically

meaningful surgical robots will likely be developed by the end of the 21st century, combining artificial intelligence with human expertise to increase surgical capability, improve outcomes, and increase access to desired care.

Independent surgical devices must be highly developed; however, they must also be relatively developed and provide technical or financial advantages over traditional surgical technologies to be widely used. A study [9] discusses the digital surgeon and how big data, automation, and artificial intelligence will fundamentally change surgical practice in the future. The surge of big data and artificial intelligence will radically change surgical practice in the future.

The study emphasizes the importance of using artificial intelligence and robots in diagnosis, radiology, and pathology while ultimately supervising independent surgery without allowing the degradation of manual surgical skills. The study recommends that Surgeons must also be prepared to adopt more intelligent training methods, as the possibility of losing manual surgical skills is high.

Robots and artificial intelligence in dentistry were the subject of a study [4]. Data-driven algorithmic analysis has been used in dentistry to improve diagnosis, treatment planning, and dental decision-making by analyzing vast volumes of data using artificial intelligence and machine learning. This review seeks to offer fresh perspectives to the community and advocates for a greater application of these cutting-edge contemporary technologies, sometimes known as dentronics.

Only a few robotic applications,mostly restricted to experimental use cases,have been implemented thus far. A study [13] discusses the potential of artificial intelligence (AI) and robots in comprehensive spinal surgery. Most published literature on AI in spinal surgery focuses on predictive analytics and radiographic imaging. AI has enormous potential to revolutionize comprehensive spinal surgery care.

In research, AI computation can collect, process, and analyze patient data to extract valuable clinical information for studies. While still new and improving, robotic-assisted surgerycanreduce surgeon fatigue and improve technical precision. Predictive surgical analytics can help improve patient selection before surgery, surgical indicators, and individualized care after surgery. Spinal surgery is constantly evolving.

AI and machine learning in the surgical domains are the subject of a study [2]. AI and machine learning have been used to evaluate surgical technical proficiency. These methods can follow the surgeon's eye and body movements, identify patterns in video records, detect machine movement, and assess the surgeon's cognitive abilities.

A mechanism for recording and replay has been created for the conventional da Vinci surgical equipment. Surgeons can assess trainees' surgical abilities and impart knowledge using this technology. Combining AI and physician clinical examination can lead to better results and more efficient shared decision-making. Telemedicine is another use of AI and machine learning that has helped provide care to underserved communities.

Machine learning requires large data sets to program computers to create algorithms. There is also the possibility of misclassifying data points that do not follow the typical patterns learned by the device. Further studies are needed to determine feasibility, effectiveness, and cost. The introduction of robots in surgical settings during COVID-19 is the subject of a study [17].

The extent to which human interaction is necessary for our activities has been made clear by the current pandemic. This requirement presents a major obstacle in COVID-19. During periods of heavy patient flow, the employment of robotics and AI can help reduce infectious contamination and help patients manage surgical surroundings.

Since robotic surgery can be technically performed in an operating room with just the patient present, it would also be the best situation for preventing the spread of germs. This transformed how surgery was performed, and hospitals are now under unprecedented pressure to address the present pandemic.

A study [15] on Artificial Intelligence in Digestive System Diseases: In this study, researchers addressed several questions, such as: where are we headed? Gastroenterology is a field where artificial intelligence can have a significant impact. With the help of artificial intelligence, image analysis can provide more accurate evaluation and information than traditional analysis.

Artificial intelligence and robots can also assist surgeons in performing digestive system operations. Technological advancements are rapidly expanding in digestive system diseases and surgery. Researchers must continue to work on new artificial intelligence technology and human-machine interfaces to improve diagnosis and warning accuracy.

A study [18] concerning the use of AI in surgery: Technological developments in imaging, navigation, and automation are bringing about a progressive transformation in surgical practice through artificial intelligence. Artificial intelligence capable of learning complex tasks independently with minimal initial training data will be crucial for next-generation systems.

Robots that follow a gradual path represented by different levels of autonomy are evolving, and most specialists will turn to diagnosis and decision-making. We still have a long way to go to match robotic surgery with the level of surgical intelligence. Clearly, different issues must be addressed before artificial intelligence is smoothly integrated into the future of surgery.

The main focus of a study [14] reviewing medical artificial intelligence was using AI in machine learning, robotics, image recognition, and expert systems, among other medical domains. It also covered issues and developments in various past and present fields. Due to globalization, many research institutes worldwide have conducted many studies on this subject in recent years.

As a result, artificial intelligence in medicine has advanced significantly and has a bright future. By now, the number of publications on artificial intelligence has grown quickly, especially in China, which has steadily emerged as a pioneer in the area thanks to high-speed network transmission. Stable, dependable, and secure remote collaborative surgery can be guaranteed with remote technical guidance [20].

Surgical hazards can be efficiently reduced by experts who understand the patient's condition and the procedure's progress. Future developments in artificial intelligence are anticipated to provide more difficulties, especially in data mining and machine learning. The review of artificial intelligence for the Internet of Things and medical systems, which encompasses the application and practice of artificial intelligence methodology in many healthcare domains, was covered in a study [10] on artificial intelligence, the Internet of Things, and enhanced medical systems.

The review demonstrates that artificial intelligence techniques are applied in medicine in four primary areas: robotic surgery, personalized therapy, predictive approaches, and heart disease diagnosis. These techniques are mostly applied to patient data analysis for better health outcomes.

Robotic surgery technologies, such as automated endoscopic systems and robotic oral surgery, have significant benefits because they reduce patient risk, yield better blood loss outcomes, and hasten recovery. Personal healthcare systems and the Internet of Things (IoT) can support medical device data globally. The use of blockchain for IoT in medicine is a broad field.

6 Conclusion and Recommendations

Through reviewing previous studies, we can conclude that the support provided by artificial intelligence technologies played a pivotal role for doctors, particularly in supporting more accurate disease diagnoses and reducing the psychological pressure and physical effort required to reach their goals.

They were designed to help doctors rather than replace their essential role, resulting in positive impacts on strengthening communication and interaction between doctors and patients, raising patient morale, improving surgical accuracy and reducing surgical errors, accelerating recovery, and providing good levels of healthcare without replacing the skills of human surgeons.

Training surgeons to use machines, teaching them how to input medical data, and combining the efforts of technical and medical experts will open up a vast world of information, which will lead to the development of intelligent applications in areas such as remote diagnosis and surgery disease prediction. In the near future, it is possible that a surgeon could be a surgical robot that determines your appointment based on your condition and is the only one with you in the operating room.

Artificial intelligence and robots constitute the future of the healthcare sector in the Kingdom of Saudi Arabia, according to Vision 2030. We are

moving in a good direction so far. Still, it is necessary to conduct and disseminate studies on artificial intelligence and surgical robots within academic circles, especially among doctors, technicians, and the media, to promote the concept of artificial intelligence and the healthcare services it will provide, which everyone desires.

Therefore, we will conclude this paper with some recommendations:

1. Developing independent surgical devices and providing them with technological and financial advantages to revolutionize robotic surgeries.
2. Machine learning training should be increased through long-term repetition to match robotic surgery methods with those of surgeons in surgical procedures.
3. Raising patient awareness about surgical robots and their numerous benefits.
4. Teaching surgeons about using artificial intelligence and surgical robots from the early years of medical studies.
5. Organizing competitive competitions at universities, especially in technical, engineering, and medical departments, on artificial intelligence and surgical robots to better promote surgical robot culture in scientific circles.
6. Establishing huge medical information platforms that doctors and surgeons can benefit from in diagnosis and treatment planning.
7. Private and charitable institutions collaborate with researchers and developers to accelerate this technological revolution of artificial intelligence and surgical robots and contribute to the country's healthcare development.

Using surgical robotic technologies, the article probably explains how AI may improve surgical operations, leading to better accuracy, efficiency, and patient outcomes. It may look into how AI algorithms might help with diagnosis, evaluate medical data, and even do certain activities independently with some guidance from healthcare providers. To further use AI in healthcare, especially surgical robots, the article will likely conclude with recommendations for more research, funding, and implementation strategies.

These recommendations may address the need for multidisciplinary cooperation between healthcare providers and AI specialists, as well as ethical concerns and regulatory obstacles. By reviewing these recent studies from 2011-2023, we found that it is essential to develop and collaborate with doctors and experts in artificial intelligence and patients to improve healthcare level, quality, and efficiency.

We are on the cusp of a great and massive revolution in artificial intelligence and surgical robots, which is moving at a relatively rapid pace in various healthcare fields. This necessitates our acceptance and dissemination of it and accelerating its education and training so that we can reach the ambitious level of Vision 2030 in healthcare. We must not neglect the obstacles this technology will face, but by collaborating with specialists, we can facilitate those obstacles.

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