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Ethical Reflections on the Application of Medical Robots in Healthcare

Xingtong Chen[1, *]

[1]Beijing No.4 High School International Campus, Beijing, China
*Corresponding author: Ariacxt@outlook.com

Abstract:

With the development and utilization of medical robots, more and more members of the public have begun to pay attention to the risks of practicing medical robots and have expressed concerns about their application. In order to deeply study the ethical risks of medical robots applied in health care, this study chooses the literature research method to reflect on the moral and ethical issues involved in medical robots. The study found that current medical robots have many application scenarios, such as: surgery, rehabilitation care, assisted work and telemedicine. These application scenarios of medical robots may bring ethical risks such as attribution of medical responsibility, doctor-patient relationship, and data algorithms. Intensively, the study points out that inadequate laws, immature values, and technological deficiencies are the most significant factors leading to the aforementioned risks. Thus, adequate attention should be paid to the medical career, the intelligent technology of robots should be improved, and the relevant laws and regulations should be actively improved. This study realistically reflects the current situation and risks of medical robot application, and through in-depth reflection, provides inspiration for robots to better serve the medical cause.

Keywords: Medical robots; AI; ethical issues; healthcare.

1. Introduction

With the development of modern science and technology, artificial intelligence technology has become one of the iconic products of the digital age. With the rapid development and upgrading of artificial intelligence, it has gradually been applied to all fields of human society. For example, workers can use AI technology to monitor the working environment and improve productivity. Teachers can use AI services to provide a variety of teaching programs. Gamers can use virtual reality technology to access new gaming experiences and more. In the healthcare industry, the invention of medical service robots enables doctors to use artificial intelligence technology to provide professional treatment programs for patients, and patients can enjoy a high level of medical care. Different types of medical robots can help medical undertakings from different angles, such as assisting doctors to operate, assisting nurses to make ward rounds, helping the elderly to rebuild and so on. However, the application of medical robots is not without limitations. The public is often concerned about the possibility of medical robots replacing humans and increasingly focuses on the issue of robotic applications in the healthcare industry. At present, the academic research on the ethics of medical robots can be summarized from three aspects: doctors, patients and the public. Doctors hold both positive and negative attitudes towards the development of medical robots. From the perspective of doctors, although older and more experienced doctors tend to have a positive attitude toward medical robots, many doctors, especially younger ones, still question the reliability of medical robots [1]. From the perspective of patients, based on their previous impression of artificial intelligence, some patients have some concerns about the reliability, safety and lack of personal care of medical robots [2]. From the public's point of view, they are worried about the leakage of medical information privacy [3]. However, the existing research on the ethical review of medical robots and their relationship with social morality is not mature enough and needs further exploration.

In order to better guide medical robots to serve human health needs, it is necessary to pay reasonable attention to the ethical issues in the use of medical robots and promote the safe and sustainable renewal and development of medical robots. This study will focus on the use of medical robots supported by AI technology, adopting the literature research method to collect the attitudes and opinions of the community on this issue. Specifically, this study will sort out the various application scenarios of medical robots and summarize the ethical issues in the application of medical robots. Then, the authors will analyze the many factors affecting the application of medical robots to provide recommendations for promoting the reasonable and compliant use of medical robots. Focusing on the ethical issues and risks in the application of medical robots will

enhance public attention and reflection on the development of medical robots to better serve the medical cause.

2. Methodology

To gather information as widely and comprehensively as possible, this paper adopts the literature research method. The literature research method itself can comprehensively analyze the problem from a professional point of view, which is more suitable for the research topic of this paper. Literature research is a kind of research method to obtain information by analyzing and interpreting existing literature. Searching for data through the large amount of existing literature helps to save research costs, provide historical perspective and promote theoretical construction. In addition, the literature research method also helps to avoid duplication of research and improve the efficiency and depth of research. This study attempts to systematically understand the ethical issues and risks in the use of medical robots, which requires long-term and large-scale literature data as the research basis. Therefore, compared with other methods, literature research is a more appropriate and rational choice to study this problem. In this paper, Google Scholar is mainly used as a literature search platform. The keywords mainly conclude medical robots, ethical issues, risks, patients, doctors, the public and so on. Through the above search process, the research found a total of more than 200 related literature, including journal literature, conference papers, dissertations and monographs. Through further reading and screening, more than 30 journals or peer-reviewed literatures were found to provide direct and important support for this research question.

3. The Application Area of the Medical Robots

With the continuous progress and upgrading of AI technology, the current medical robots applying AI technology have developed a relatively rich industrial chain and diversified application scenarios. These specific application scenarios cover many aspects such as surgical diagnosis and treatment, rehabilitation care, auxiliary logistics and telemedicine, and play an important role in the medical field.

3.1 Application Scenarios of Surgery

In the surgical application scenario, medical robots can automatically or semi-automatically help doctors complete complex and precise operations. Robots that help with surgery can enhance surgical outcomes by improving accuracy, stability, and flexibility [4]. There are many kinds of surgical diagnosis and treatment robots, including surgical robots, endoscopic robots, targeted treatment micro-robots, auxiliary biopsy robots, and antimicrobial nano-robots. For example, surgical robots, such as Da Vinci surgical robot, can perform minimally invasive surgery with high precision and reduce the risk of infection. Endoscopic robots can enter the body through natural openings for disease diagnosis and treatment, such as capsule endoscopes. Micro-robots can precisely deliver drugs or therapies to specific parts of the body. Assisted biopsy robots can be used for minimally invasive techniques for early cancer diagnosis. While antibacterial nanorobots are able to clear bacterial infections from the blood.

3.2 Application Scenarios of Rehabilitation

In the application scenario of patient rehabilitation, medical robots can automatically or semi-automatically help doctors complete complex and precise surgeries. A medical robot can help patients who need to regain their physical, social, communication or cognitive functions to recover faster. In addition, it can help disabled people make up for missing physical abilities and assist them in integrating into the normal pace of life [5]. For instance, there are prosthetic robots that can use advanced control technology to provide haptic feedback and improve the quality of life for amputees. Exoskeleton robots can help paralyzed or mobility-impaired patients regain the ability to walk by mimicking the function of human bones. In addition, companion robots can provide meticulous companionship and care services for special populations, especially for the elderly or physically weak.

3.3 Application Scenarios of Ancillary Works

In the application scenario of medical auxiliary work, medical robots can act as the assistants of doctors and nurses, help medical staff improve work efficiency and medical service level, and reduce work errors. These medical assistance robots include Ai diagnostic robots, nurse robots, dispensing robots, disinfection robots, AI epidemiology robots, and clinical training robots. For example, artificial intelligence diagnostic robots can assist doctors in disease diagnosis through machine learning. Nurse robots can assist nurses with daily tasks such as electronic document filling and vital signs measurement. Dispensing robots can automate the dispensing process, improving efficiency and accuracy. Disinfection robots can use technologies such as ultraviolet light to disinfect hospitals and reduce infections. AI epidemiology robots can analyze disease outbreak data to predict and prevent the spread of disease. Clinical training robots can simulate real patient situations and be used for training medical personnel.

3.4 Application Scenarios of Telemedicine

In the application scenario of telemedicine, medical robots can break the restrictions of time and space, and efficiently connect the professional resources of doctors and the diversified needs of patients, so that patients around

the world can access medical consultation and services anytime and anywhere. This type of service robot is dominated by telemedicine robots. On the one hand, the telemedicine robot can spread the specialized medical knowledge of top doctors to remote areas and break the medical information barriers. On the other hand, it can also help the delivery of medical needs of patients in different regions to find the right medical program in a timely and rapid manner [6]. Telemedicine robots can help those who need professional help from a distance. For example, telemedicine robots can bring the expertise of top doctors to remote areas and also help telemedicine personnel provide professional assistance to the lives of elderly people.

4. The Ethical Issues Involved in Medical Robots

The application of medical robots in surgical diagnosis and treatment, rehabilitation care, auxiliary logistics and telemedicine is increasingly extensive. While improving the level of medical technology and service capacity, it is also accompanied by some ethical problems or risks that cannot be ignored. On the whole, medical liability attribution, doctor-patient relationship and data algorithm risk are the three most significant and important ethical issues.

4.1 Attribution of Medical Liability

Medical liability refers to the attribution of responsibility for problems arising in the course of medical treatment. The ethical risk of medical liability usually involves the ethical principles and legal responsibilities that medical institutions and medical personnel should abide by in the process of providing medical services. The principles of medical ethics include respect for patient autonomy, the principle of no harm, the principle of good deeds and the principle of justice. Some behaviors that violate the principles of medical ethics, such as not fully informing patients of medical risks, violating patients' personal privacy, and not obtaining patients' informed consent, may lead to the loss of patients' rights and interests. In addition, the legal liability of medical robots is unclear. When medical malpractice and medical errors occur, the current law does not specify whether medical robots can or should be held legally liable for medical malpractice, as well as whether the legal liability should be assumed by the robot's designer, producer or hospital. It is very important to study the responsibility and ethics of medical robots, because it has a great impact on the long-term development of medical robots, and the rights and interests of patients need to be reasonably protected.

4.2 The Doctor-patient Relationship

The use of medical robots will also greatly affect the doctor-patient relationship. The ethical risk of doctor-patient relationship involves the interaction and communication between doctors and patients. When robots intervene in the traditional doctor-patient relationship, it may lead to a loss of trust, misunderstanding and conflict between the two parties. The ethics of doctor-patient relationship emphasizes the moral responsibility of doctors, the protection of patients' rights and interests, and the trust and cooperation of both sides. On the one hand, medical robots, as tools to assist doctors in treating patients, will only mechanically execute computer instructions, ignoring patients' choices and autonomy. Medical robots do not intelligently consider patients' personal will, especially their emotional state and cognitive level. This can easily lead to the dehumanization of medical practices. On the other hand, doctors may make patients feel deprived of compassion and care by not adequately informing them about treatment options using medical robots. Maintaining empathy and care during the treatment process has a positive effect on the treatment outcome. Whether these human talents that can provide emotional links can be replaced by medical robots requires further research. If patients are unable to get emotional help from robots, their trust in doctors may be weakened, hindering the progress of treatment.

4.3 Data and Algorithm Risks

Data and algorithms are essential for the operation of medical robots. Medical robots will collect and process a large number of patients' personal data during their operation, which involves data quality and privacy protection issues. Data and algorithm ethical risk refers to the ethical issues that may arise in the process of data collection, processing and analysis by medical robots. These concerns include the patient's right to data privacy, ownership and use of healthcare data, transparency of healthcare delivery algorithms, and fairness of services. When patients use medical robots, their own health data are collected by the robots for evaluation and calculation so as to provide optimal services to patients. However, the legality and reasonableness of this data collection are not legally recognized, and there is a risk of illegal profiteering. The security of patients' personal information and the ethical design of robots lack clear rules and boundaries. This could easily lead to personal safety and social responsibility risks.

5. Discussion

5.1 The Factors Influencing Ethical Issues of Medical Robots

In view of the above ethical problems in the application of medical robots, this study further considers the potential influencing factors behind these problems. To be specific, unsound laws, immature values and technical defects are

three important aspects that cause ethical risks.

From the legal point of view, the laws and regulations on the use of medical robots are not sound, the relevant rules have not been established, and the rights and responsibilities of people using medical robots have not been fully confirmed by law. For example, as mentioned above, if the operation of a medical robot causes a risk to the patient's treatment process, the law does not clearly specify who should bear the relevant responsibility [7].

From the perspective of values, the requirements of ethical values may be ignored in the design process of medical robots. Privacy, right to know and autonomy are important value factors that must be considered in the design and application of medical robots. The original purpose of robots is to serve humans, so the basic rights and needs of humans should always be the primary value goal. In the current usage behavior of medical robots, technicians sometimes pay too much attention to optimizing the algorithm of robots and increasing the functions of robots, while ignoring the original intention of robot design, which is to improve the well-being of human society. As mentioned above, medical robots do not establish emotional links with patients, are not so "human", and may even lead to the deterioration of the doctor-patient relationship [8].

From the technical point of view, the current medical robot based on AI technology still has many problems that the core algorithm is not advanced enough and the key technology has not been broken through. This creates data and privacy risks for robot users. Due to the imperfection of key technologies, such as system integration and human-computer interaction, it is easy to bring security risks to the application of intelligent medical robots. For example, surgical robots lack tactile feedback, which may affect surgical accuracy. In addition, algorithmic black boxes and algorithmic discrimination issues can also lead to unforeseen medical harm. The algorithm of robot operation is complex and easy to be manipulated by criminals, reducing the fairness and accuracy of diagnosis and treatment.

5.2 Suggestions for Rational Use of Medical Robots

In general, because medical robots can provide certain help for humans, medical workers can gradually put medical robots into the use of the medical industry. However, due to technical limitations and possible social ethical concerns, overreliance on medical robots may also pose many social risks. Therefore, the public should pay more attention to the medical cause of human beings at first while developing medical robots. Therefore, while developing medical robots, people should first focus on human medical care. Starting from the healthcare services most needed by the public, people should reflect on the supply and demand of the services, so as to better improve the satisfaction of the services. Secondly, developers need to focus on improving the functional aspects of medical robots to ensure that they can accurately help treat patients, minimizing data and algorithmic risks. Thirdly, the law needs to pay attention to the ethical issues involved in medical robots and maximize patient benefits as much as possible. There is no perfect classification method for medical robots at present, and medical researchers should be committed to studying different use scenarios and uses of different medical robots, so as to provide better help to patients [9]. For the public and patients, it is important to fully understand and accept the current technological development and avoid allowing bias to influence their judgment. Comparatively speaking, medical researchers and clinical medical workers have a more professional understanding and a deeper understanding of medical robots. The public should treat the application of medical robots with the values of tolerance and respect, work with medical researchers and clinical workers to create a better medical environment, and promote the establishment and improvement of relevant laws.

6. Conclusion

The wide application of medical robots has aroused a lot of ethical thinking among the public. This study found that the current medical robot has been widely used in human surgical diagnosis and treatment, rehabilitation care, auxiliary logistics and telemedicine and other medical fields, and has obtained very positive results. However, while medical robots improve the level of medical technology and service capabilities, they are also accompanied by such ethical issues as medical responsibility attribution, doctor-patient relationship and data algorithm risks that cannot be ignored. The ethical risk of medical liability is mainly concerned with the problems posed by medical robots violating medical principles. The ethical risk of the doctor-patient relationship refers to the impact of the use of robots on the trust between doctors and patients. Data algorithmic risk is the data security and privacy issues that accompany the use of medical robots. These problems are mainly due to the lack of law, immature values and technical defects and other deep factors. Among them, the lack of relevant laws leads to the absence of an accountability system for medical robots, making it difficult to safeguard patients' rights. Robots are designed with immature values, emphasizing technology, but neglecting the humanized medical needs. Deficiencies in robot technology can make it difficult for users to enjoy intelligent services while gaining the security of data privacy. In response to these ethical issues and influences, the authors provide recommendations from the perspectives of the medical

profession, the law, technology, and different stakeholders. Through this study, people can better clarify the role, influence and limitations of medical robot at this stage, and clarify the direction of future development of medical robot and human. This study calls for the public to maintain an open and objective attitude towards medical undertakings and the development of medical robots. As for future research directions, it is recommended to further carry out features of each type of medical robots, and examine how to distinguish the functions and responsibilities of doctors and medical robots.

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