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Research on the Application of Artificial Intelligence in Medical Field from the Perspective of Behavioral Law

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Abstract

Artificial intelligence is widely used in medical fields such as auxiliary diagnosis, participation in treatment and personal health monitoring and management, and the associated risks also arise. In view of its strong practical characteristics, the analysis from the perspective of behavioral law can be based on the behavioral practice of artificial intelligence medical care, and can be analyzed from two aspects: the dynamic application risk brought by behavior and the lack of static legal regulation. There are some legal problems in the application of artificial intelligence in medical field, such as restricting the autonomy of medical subjects, lack of transparency in medical process, discrimination in medical algorithms, unclear qualifications of medical artificial intelligence subjects, unclear legal responsibilities, inadequate protection of personal information and data, etc., which urgently need to be responded from the aspects of dynamic behavior regulation and static legal perfection.

Keywords

Artificial Intelligence Medical Treatment, Behavioral Law, Application Risk, Legal Regulation

1. Introduction

Both the 19th National Congress of the Communist Party of China and Report to the 20th CPC National Congress pointed out that people's health is an important symbol of national prosperity and national prosperity. It is necessary to promote the construction of a healthy China and give priority to the protection of people's health. Medical care is an important line of defense to protect people's health. At present, artificial intelligence is being applied to the medical

field at an unprecedented speed. In the process of gradually becoming an important force to promote medical innovation and improve the quality of medical services, a series of potential risks and unsolved problems caused by the application of artificial intelligence have also emerged. These problems are not only related to the healthy development of the medical industry, but also profoundly affect the rights and interests of medical subjects and social ethical norms. Therefore, it is necessary to systematically study these problems in order to provide normative ideas for the application of artificial intelligence in the medical field and ensure its stability.

2. The Perspective Choice of Behavioral Law Research on Legal Issues in the Field of Artificial Intelligence Medical Care

2.1. The Concept of Research Perspective and Research Field

2.1.1. Behavior-Behavior-Behavioral Law

Behavior is all kinds of actions and activities that people show in their daily lives, including words, actions and decisions. It is a way of human interaction with the outside world, reflecting people's wishes, attitudes and values. Behavior can be simple-walking and talking; It can also be complicated-such as making plans and solving problems. Behavior is not only a personal expression, but also a reflection of social culture. Behaviorism is a discipline that studies human behavior, which focuses on the causes, processes and results behind behavior. Behaviorism tries to understand the internal mechanism of behavior, including the influence of psychological, physiological and social factors. The methodology of ethology includes experiments, observations and questionnaires to reveal the inherent laws and characteristics of behavior. Behaviorism not only pays attention to individual behavior, but also pays attention to group and social behavior.

Behavioral law is a discipline that studies the relationship between human behavior and law. It pays attention to legal behavior and its laws, and tries to promote the gradual improvement of the rule of law system through legal implementation. Behavioral law advocates that "law is behavior" and thinks that law exists not in rules, but in observable behaviors. The research of behavioral law in the west emphasizes the separation of fact and value, advocates value neutrality, and expresses how the law behaves with patterns, formulas or theorems. In China, the development of behavioral law began in the 1980s, when Mr. Qian Xuesen put forward the concept of behavioral science and applied it to legal research. Unlike western behavioral law, behavioral law in China not only attaches importance to the applied research and empirical research of law, but also emphasizes the guidance of Socialism with Chinese characteristics' values on legal application and empirical research. After decades of development and in-depth theoretical research, the academic circles have similar views on the definition of behavioral law, especially the research object. Some scholars define behavioral law as the methodology, legal thought and legal tendency to solve legal problems

by using the research method of behavioral science as the main research object (Wang, 2016). Some scholars also define behavioral law as a science that studies the behavior laws of legal persons (in a broad sense, the scope of traditional legal persons and all ordinary people regulated by law) and realizes the orderly control of society.

2.1.2. Medical Artificial Intelligence-Artificial Intelligence Medical Treatment

Medical artificial intelligence (MAI) refers to the technology that uses artificial intelligence technology, especially deep learning and natural language processing technology, to interpret data, diagnose diseases and make treatment plans in the medical field. MAI has a wide range of application scenarios, covering health management, intelligent diagnosis, intelligent treatment and intelligent rehabilitation. For example, it can assist doctors to analyze medical images and improve the accuracy and efficiency of diagnosis; It can also help doctors quickly extract useful information from a large number of medical data and formulate personalized treatment plans; It can also play an important role in drug research and development and new drug discovery, shorten the time to market and reduce the research and development cost. Artificial intelligence in medicine (AIM) refers to the field of applying the research results of artificial intelligence to medical practice. AIM not only covers the application scope of MAI, but also includes broader fields such as medical data management, prevention and health care. The core of AIM is to deeply analyze and learn medical data through artificial intelligence algorithms and models, so as to provide more accurate and efficient medical services for doctors and patients.

Medical artificial intelligence focuses on the application of artificial intelligence technology in medical activities themselves, emphasizing the application of technology in specific medical links such as diagnosis and treatment. In contrast, artificial intelligence medical care is a broader concept, which not only includes the content of medical artificial intelligence, but also extends to a wider range of fields such as medical data management and intelligent drug research and development (Sun et al., 2021). In short, medical artificial intelligence is an important part of artificial intelligence medical care, but the scope of artificial intelligence medical care is broader and deeper. Because both of them belong to the field where artificial intelligence can be applied, they are both within the range of research.

2.1.3. Health Field-Public Health Field-Medical Field

The field of health is a broad concept, which includes two sub-fields of public health and medical health. Its focus is on maintaining, improving and promoting human health and providing products and services directly or closely related to health for the public. It covers comprehensive services from preventive health care to disease treatment, and emphasizes the improvement of health and well-being (Hu et al., 2022). The field of public health focuses on the prevention

and control of diseases, and puts forward public health policies and health promotion measures by studying epidemiology, environmental hygiene, social medicine and other disciplines. Its goal is to reduce the occurrence and spread of diseases through prevention, so as to improve the health level and quality of life of the population. The medical field pays more attention to the individualized diagnosis, treatment and care of patients, and it adopts clinical evaluation, laboratory examination, surgery and other methods to carry out medical practice. The focus of the medical field is to provide targeted medical services to treat diseases and maintain health. Therefore, health is the biggest concept in the field of public health and medical treatment. According to the report of China Journal of Health, the Professional Introduction of Postgraduate Education Discipline and Basic Requirements for Degree (Trial Edition) compiled and published by China Academic Degree and Postgraduate Education Society has included the content of "health and health law" for the first time under the discipline of "law", which can also reflect that the connotation of health and health concept is broader than the other two fields. Because the first two are related to many lower concepts and levels, my paper only looks at the application of artificial intelligence in medical field.

2.2. The Inevitable Choice to Conduct Research from the Perspective of Behavioral Law

From the above, there are many complicated factors behind a person's behavior. People's needs at different levels generate motivation, motivation drives behavior, and behavior promotes law. Behavioral law emphasizes the relationship between human behavior and law, pays attention to the study of human behavior law and how law regulates and adjusts human behavior. Mainly take the behavior law as the research object, take sociology, law and other comprehensive disciplines as the research methods, and finally achieve the fundamental goal of social order control. The difference between the above-mentioned medical artificial intelligence and artificial intelligence medical treatment mainly lies in the scope of medical activities and processes, but whether it is diagnosis, treatment or medical data management in specific medical links, it can reflect the behavior law of medical subjects, especially in today's increasingly in-depth application of artificial intelligence in the medical field. It is not enough to respond to the realistic foundation of artificial intelligence medical treatment in the ascendant. The change of medical subjects' behavior law, the motivation behind the behavior and the fundamental demand generated by the motivation should also be the focus of research in this field (Rao & Zhang, 2002).

The behaviors involved in artificial intelligence medical care include but are not limited to data collection, analysis, diagnosis, treatment, etc. These behaviors are regulated and adjusted by law. The advantage of studying from the perspective of behavioral law lies in paying more attention to analyzing the motivation, purpose and influence behind these behaviors, as well as the provisions and re-

strictions of laws on these behaviors, so as to better understand the legal issues in the field of artificial intelligence medical care. Furthermore, by studying the behavior law of medical subjects, more possible solutions can be found and excavated to help solve legal problems in the field of artificial intelligence medical care. For example, by studying the behavior law of doctors, we can find out the precautions and risk points when doctors use artificial intelligence medical technology, so as to provide better training and support for doctors and help them use artificial intelligence medical technology better. At the same time, from the perspective of behavioral law, various research methods and tools such as experiment, observation and questionnaire survey can be used to study the behavior law of medical subjects. These methods and tools can also be applied to the research of legal issues in the field of artificial intelligence medical care, helping us to better understand and solve these problems.

3. The Application Status of Artificial Intelligence in the Medical Field

3.1. The Application of Artificial Intelligence Image Diagnosis and Auxiliary Diagnosis and Treatment

The application of artificial intelligence (AI) in image diagnosis and auxiliary diagnosis and treatment has become an important direction of modern medical technology innovation. AI can learn and extract useful features from a large number of medical image data through deep learning network. These algorithms can imitate the diagnosis process of doctors and automatically identify and analyze abnormal areas in images, such as tumors, vascular stenosis or infection. For example, AI system can detect lesions in mammography (molybdenum target), CT scanning, MRI and other types of medical images, and preliminarily evaluate their properties. In addition to basic lesion detection, AI can also help doctors find subtle changes in lesions through pattern recognition and data mining techniques, which may be imperceptible to the naked eye. Japan's CAD (Computer Aided Diagnosis) system can detect tuberculosis and other diseases with high accuracy by analyzing chest CT photos. In a diagnosis competition of metastatic breast cancer held in Japan in 2016, it was found that the misdiagnosis rate of pathologists was 3.5%, but doctors can reduce the misdiagnosis rate to 0.5% with this system (Report of the IX Academic Advancement Conference, 2018). The AI system can also make use of the previous case database to compare and provide doctors with auxiliary diagnosis opinions, thus assisting doctors to make more accurate diagnosis decisions. This kind of assistance not only improves the diagnosis quality, but also shortens the diagnosis time, which is especially critical for rapid response in emergency. In terms of auxiliary diagnosis and treatment, AI can combine the patient's historical medical records, laboratory test results and real-time monitoring data to predict the disease development trend, recommend the best treatment plan and even predict the treatment effect through complex algorithm models. In addition, AI has shown great

potential in drug research and development, clinical trial design, patient management and other fields, which is expected to greatly improve the overall quality and efficiency of medical services.

3.2. Related Applications of Artificial Intelligence in Treatment

The application of medical AI in the field of surgical treatment is gradually changing the traditional surgical mode, providing doctors with more accurate and efficient auxiliary decision-making. Through deep learning and image recognition technology, AI can quickly and accurately analyze medical images, help doctors better understand the pathological changes, and thus make a more reasonable surgical plan. Taking neurosurgery as an example, AI can assist doctors in locating and grading brain tumors by analyzing a large number of brain image data. This technique can not only improve the accuracy and safety of operation, but also shorten the operation time and reduce the pain and recovery period of patients. It can also monitor the patient's physiological parameters in real time during the operation, provide more comprehensive patient status information for doctors, and ensure the smooth operation. In addition to neurosurgery, medical AI is also widely used in other surgical fields, such as hepatobiliary surgery and gastrointestinal surgery (Xiao et al., 2009). Through the study and analysis of a large number of surgical cases, AI can summarize the key factors of successful surgery and provide valuable surgical advice for doctors. At the same time, it can also help doctors to make more scientific surgical strategies by predicting the risk of surgery and the probability of complications. The development of medical AI is inseparable from the support of big data. Massive data resources such as medical image data, gene sequencing data and patient electronic medical records provide rich learning materials for AI. The continuous analysis and calculation of these data enables AI to continuously improve its diagnostic and therapeutic capabilities and provide more accurate and reliable decision-making assistance for doctors. At present, the most reliable and outstanding one is "Da Vinci Surgery AI (an advanced laparoscopic surgery system)", which allows surgeons to perform complex surgery through minimally invasive surgery. The system consists of surgeon's console, bedside manipulator system and imaging system. The development of Da Vinci surgical robot witnessed the evolution of medical robot technology. From the early "Lenny" to today's "Da Vinci X" system, each generation has made remarkable progress in technology. It has been widely used in the top three hospitals in major cities in China, mainly in urology, gynecology, thoracic surgery and other surgical fields. According to statistics, as of 2023, hundreds of Da Vinci surgical robots have been put into use in China, and the market demand is still growing. In contrast, China has also made some progress in the research and application of surgical robots. For example, the "Miaoshou S" surgical system independently developed by Weigao Group and Tianjin University has obtained the medical device registration certificate issued by National Medical Products Administration, becoming the first

approved domestic surgical robot. In addition, the Honghu orthopedic surgical robot developed by Shanghai Minimally Invasive Medical has also become the first domestic surgical robot system certified by FDA, which shows that the development prospect of AI participating in treatment is worth looking forward to.

3.3. The Application of Artificial Intelligence in Personal Health Monitoring and Management

The core value of AI in personal health monitoring and management lies in providing customized health management solutions for individuals through advanced data analysis and pattern recognition technology. It can predict health risks and recommend preventive measures by analyzing personal health data, such as physiological parameters, living habits and medical records, so as to help individuals better understand and manage their health status. The application of AI in personal health monitoring is mainly reflected in wearable devices. These devices can monitor users' heart rate, blood pressure, sleep quality and other physiological parameters in real time, and analyze these data through machine learning algorithms to predict potential health risks. For example, smart watches can predict the risk of heart attack by analyzing the heart rate variability of users. In addition, AI can also provide personalized health advice by analyzing users' living habits, such as diet and exercise, to help users improve their lifestyles and prevent diseases. It is worth mentioning that AI is more and more widely used in the management of chronic diseases. Because of its long-term and complexity, chronic diseases need continuous health management and regular medical intervention. AI can provide doctors with more accurate diagnosis information by analyzing patients' medical records and real-time monitoring data, and help them formulate more effective treatment plans. It can also communicate with patients through natural language processing technology to understand their condition changes and adjust treatment plans in time. This not only improves the efficiency of treatment, but also reduces the workload of doctors. In terms of disease prevention, AI application collects personal life information such as users' eating habits, exercise cycle and medication habits, and uses artificial intelligence technology for data analysis to quantitatively evaluate users' health status, helping users to understand their physical condition more comprehensively and accurately, and providing a basis for correcting unhealthy behaviors and habits. For example, the Risk Matrix, the core product of Lumiata, a risk prediction and analysis company, can draw the trajectory of personal illness risk changing with time, and the Medical Graph, its core engine, can map the current and future personal health trajectory and provide detailed clinical basic principles. As a bridge of communication between doctors and patients, AI can record the indicators and food intake of the day for users by analyzing semantics and understanding instructions. When the patient's data changes, AI can find problems in time and invite doctors or pharmacists to intervene manually. For example, the diabetes management system can use insulin pump and big data to predict the

blood sugar trend of patients, and give an early warning to patients three hours before the onset of hypoglycemia, so as to reduce blood sugar fluctuations and hypoglycemia events more effectively (CAI & Jia, 2021). In the field of sports management, AI uses sensors and their algorithms through sports management wearable devices to capture sports data, provide data about vertical pelvic oscillation, help adjust the tendency of pelvic rotation and excessive stride caused by sedentary, and support the identification and correction of pelvic decline. In terms of sleep monitoring, AI can measure the mechanical activities of heart and other body functions, and monitor users' daily sleep habits, including snoring, sleep time, resting heart rate, breathing rate and so on. The application of AI in the elderly care system mainly collects data through sensors installed at home. Once abnormal behaviors or unexpected situations are detected, the system will immediately inform family members or friends to take necessary measures (Xiang & Wang, 2020). This system is a sensor-based and cloud-based perceptual system, which can learn the lifestyle of the elderly, establish a baseline of life, and give a prompt in case of unexpected behavior.

4. The Application Risks and Legal Issues of Artificial Intelligence in the Medical Field

The vigorous development of the application of artificial intelligence in the medical field is bound to produce certain risks, which any new student, especially something related to science and technology, can't avoid and overcome its own predicament. From the perspective of traditional law, this kind of problem will be deconstructed into the lack of legal level or the blank of supervision level. However, in the common context of the perspective of behavioral law and the application of artificial intelligence in the medical field, we should not only pay attention to the study of static legal regulation, but also analyze the risks derived from the behavior law contained in the application behavior itself, so as to get rid of the stereotype that legislative response always lags behind the real situation and find out the problems in the dual framework of dynamic and static.

4.1. The Application Risk of Artificial Intelligence in the Medical Field

4.1.1. The Autonomy of Medical Subjects Is Limited

Although the application of AI in the medical field has greatly improved the efficiency and quality of diagnosis and treatment, it has also caused concern about the limited autonomy of medical subjects (mainly including the main subjects involved in the medical process, doctors and patients). Through deep learning, AI algorithm gradually presents some characteristics of "autonomy", which constantly erodes the autonomy of patients and medical staff. Constrained by the "information cocoon room", the existing cognition of both doctors and patients is further strengthened by the algorithm. People's choice depends more and more on re-selection based on algorithm selection (Wang, 2022).

From the doctor's point of view, the introduction of AI has changed the traditional medical model. It can quickly analyze a large number of medical data and provide doctors with auxiliary diagnosis, treatment plan and prognosis evaluation. However, this may also limit the autonomy of doctors' clinical judgment. Doctors may rely too much on the diagnosis results provided by AI, thus reducing their professional judgment, thus weakening their ability to control medical behavior to some extent. Unclear legal responsibility of medical AI is also a key factor. When the medical advice provided by AI system leads to adverse consequences, the attribution of responsibility may be unclear, which may limit the autonomy of doctors when adopting AI technology. Doctors may be too cautious when using AI for fear of potential legal liability, which limits their space for innovation and exploration by using AI technology. Legal liability is a traditional legal problem from the perspective of general research, and the limitation of doctors' autonomy caused by unclear legal liability is a behavioral motivation problem from the perspective of behavioral law. In addition, because AI has the nature of "deep learning", that is, it can learn from data by self-extraction, self-processing and self-processing, which makes some simple, highly repetitive disease types that are hardly changed by individual physical differences can be diagnosed and answered through AI, which greatly reduces the independent practice of medical staff in related positions, and some of the main characteristics of medical care in the past will also be lost (Li, 2021).

From the patient's point of view, the application of AI also has an impact on its autonomy. AI technology can provide personalized health management scheme, but patients may lack sufficient understanding of the decision-making of AI system, and thus feel that their choice is limited when receiving treatment. At the same time, if AI fails to properly protect patients' privacy in the processing of medical health data, it may cause patients' concerns about the safety of personal data, and then affect their trust and acceptance of medical services. The development and application of AI technology need a lot of medical data support, which involves the collection and use of patients' personal information. If the data is not handled properly, it may lead to privacy leakage and increase patients' concerns about using AI technology. Because they may worry about personal privacy, their acceptance of AI system is reduced, which limits their independent choice of using AI technology services to some extent.

4.1.2. Lack of Transparency in the Medical Process

The transparency of the medical process not only means that patients have the right to know their own condition, diagnosis results and treatment plans, but also includes all possible risks that should be revealed. Medical institutions should provide easy-to-understand, detailed and complete medical information to ensure that patients fully understand and make independent decisions.

However, when doctors and patients don't understand the principle of AI in the medical process, it may lead to information asymmetry, which will affect the transparency of medical decision-making. For doctors, the "black box" feature of

AI system is a major problem. AI algorithms are generally regarded as unexplained, because they involve a large number of parameters and complex decision-making paths, both analyzing data and predicting and speculating data or information to some extent (Hong, 2020). As a result, it may be difficult for doctors to understand how AI comes up with specific diagnosis or treatment suggestions. This incomprehension will lead to distrust of AI system to some extent, thus affecting their willingness and efficiency of integrating AI into clinical practice. In addition, if the AI system is misdiagnosed or failed in treatment, doctors may not be able to provide clear explanations to patients or regulatory agencies, which may lead to unclear legal and moral responsibilities. Similarly, for patients, their lack of understanding of the working principle and decision-making process of AI system will affect their acceptance and trust in treatment suggestions. In the medical field, trust is the core of the doctor-patient relationship. If patients don't trust AI, they will most likely refuse the diagnosis or treatment plan based on AI, thus missing the potential treatment opportunity.

4.1.3. The Algorithm Difference of Medical Scheme Selection

Algorithm difference has always been a prominent problem in the field of AI. The training of AI algorithm depends on a large number of data. If there are deviations in the training data (such as gender, race, age, etc.), then AI algorithm may learn these deviations and produce discriminatory results in practical application. In addition, due to the opaque decision-making process caused by the "black box" feature, it is difficult for medical professionals to evaluate the security and effectiveness of the algorithm. AI algorithms are usually trained on specific data sets, which may lead to their poor performance on new and unseen data, and may be affected by many factors in practical application. For example, the differences in the performance of hardware devices, doctors' operating habits and patients' individual differences may affect the accuracy and stability of AI algorithm (Tong et al., 2019). These factors make it possible for the same algorithm to produce completely different results in different environments, which further increases the complexity of algorithm differences. In the application of medical field, this means that the algorithm may not be well adapted to the needs of different people or different medical environments. In addition to these, we have to face up to the reality of uneven distribution of medical resources. Medical instruments equipped with artificial intelligence have the characteristics of high precision, high cost and high maintenance cost, which makes it difficult to fully promote "AI + medical care", and there are significant differences in data quality and quantity among different medical institutions. Some large hospitals have rich case resources and advanced information systems, which can provide a large number of high-quality training data for AI, thus training more accurate models. However, due to the limited number of cases and uneven data quality in some small hospitals or primary medical institutions, the performance of their AI algorithm is difficult to compete with that of large hospitals. This data gap not only limits the popularity and application of AI in the medical field, but also

aggravates the uneven distribution of medical resources.

4.2. Legal Issues of Artificial Intelligence in the Medical Field

4.2.1. The Legal Status of Medical Artificial Intelligence

AI is widely used in clinical diagnosis and surgery, but its legal status is rather vague. Whether AI has the subject qualification is still controversial. Some scholars believe that although AI technology has certain autonomy, it is still regarded as a tool in law and does not have the qualification of legal subject. This shows that once the AI technology has problems in the medical process, the responsibility should be borne by the medical institution or doctor who uses AI. However, the problem of the right ownership caused by the independent decision-making behavior of medical algorithm will further lead to the difficulty of defining the subject qualification. In the digital society, human beings empower machines, so machines gain certain rights (power) and even surpass human beings in intelligence, thus destroying the subjective framework and producing "human rights exceptions". In short, AI can be completely independent of the control of doctors in medical decision-making, and even can give a diagnosis and treatment plan only by the patient's instruction output. In this case, whether it should still be considered as a tool remains to be considered. Only when the subject is clear can the rest of the problems have a standard premise for discussion.

4.2.2. Legal Liability When Causing Medical Damage

With the application of AI in the medical field, from auxiliary diagnosis to surgical operation to chronic disease management, when medical AI causes medical damage, the unclear attribution of legal responsibility brings challenges to the current legal system.

Since the above-mentioned current medical AI does not have the legal subject status in law, if medical AI causes medical accidents, the responsible subjects may still be developers, producers and users rather than AI itself. In addition, the autonomy and uncertainty of medical AI increase the complexity of responsibility attribution. The characteristics of "technical black box" and "autonomous learning" make it difficult to explain its decision-making process, which may lead to a dilemma for doctors when using AI to assist decision-making, and they are not sure whether they should adopt the advice of AI. If it leads to misdiagnosis or missed treatment opportunity after adoption, the attribution of responsibility becomes blurred. For example, in 2015, the first robotic heart valve repair operation was performed in Britain, but it failed unfortunately. The robot "Da Vinci" used in the operation failed during the operation, which caused the patient's heart to be stitched incorrectly and punctured the aorta, and finally the patient died one week after the operation. Researchers at the University of Washington found that the model of AI detecting Covid-19 may have instability and errors, leading to misdiagnosis; some online medical platforms have seen the phenomenon of AI prescribing. In some cases, the platform may skip the

traditional prescription issuance and review, and the prescription is automatically generated by AI software, which may violate the drug management system and bring risks to patients' medication safety. Multi-responsibility subject is also a problem that AI needs to consider in medical damage. The identification of medical damage liability needs to be carried out from two aspects: the principle of imputation and the way of bearing legal responsibility. This may include many factors, such as hardware failure, program loopholes, misjudgment after deep learning, etc. There may be multiple responsible subjects behind each factor, and these problems need to be clearly defined at the theoretical level.

4.2.3. Challenges of Medical Data and Personal Information Protection

AI needs to process a large number of sensitive medical data in the medical field, especially in personal health testing management, including but far from being limited to patient's medical records, diagnosis results, treatment plans and genetic information. The collection and analysis of these data is very important for improving the accuracy of medical diagnosis and making personalized treatment plans, which also means that the security and privacy of medical data are facing unprecedented challenges. According to Nature magazine, medical data leakage has been on the rise in the past few years, and hacking and internal leakage are the main reasons. In addition, the complexity and opacity of AI algorithm make it more difficult to encrypt the privacy of medical data. When AI system makes disease prediction and treatment recommendation, it may inadvertently reveal sensitive information of patients, which will bring risks to patients' privacy. Secondly, the development of AI technology also brings the challenge of personal information protection. When AI makes disease prediction and treatment recommendation, it needs to deeply analyze the personal information of patients. Although comprehensive data can improve the accuracy of diagnosis and treatment and the integrity of the whole scheme, the extracted data covers the uninformed information of patients and even the contents closely related to personal information such as living habits, family status and family social relations, which has caused quite a controversy. The collection and use of this information need to find a perfect balance point, which puts forward a higher level requirement for the improvement of relevant laws and regulations.

5. The Risk Avoidance of Artificial Intelligence in Medical Application and the Perfection of Legal Regulation

The problems of artificial intelligence in medical field, especially the risk in application, follow the behavioral foundation construction of demand-motivation-behavior. At the macro level, the demand of the whole human society for scientific and technological progress to improve life and the people's expectation for higher quality medical care to ensure health have given birth to the vast world of artificial intelligence in this field, and then the specific medical subjects have the motivation to participate in the medical process with the help of artificial intelligence, and finally the above-mentioned risks are caused in the application

process. The dynamic formation of risk needs to analyze every link in the whole conduction chain from the perspective of behavioral law, and put forward the risk avoidance scheme; The static persistence of risk leads to the need of legal regulation and self-improvement.

5.1. The Risk Aversion of Artificial Intelligence in Medical Applications

5.1.1. Balance the Autonomous Relationship between Artificial Intelligence and Medical Subjects

Defining the role of doctors-unlike humans, the autonomy of AI is purely technical. Although the medical AI algorithm technology has unique operating logic, it is still human beings who have the autonomy to use the algorithm. We should adhere to the embedding of algorithm tool attributes in the underlying design logic and governance logic of medical AI, and make it clear that AI should be used as an auxiliary tool rather than a substitute for doctors. Maintain the control of doctors on medical decision-making, and make full use of the information and analysis results provided by them.

The rapid development of AI has provided unprecedented auxiliary efficiency for doctors. Although AI has shown great potential in data analysis, pattern recognition and prediction model, it should still be regarded as a physician's assistant rather than a substitute. Doctors' professional knowledge, clinical experience, emotional wisdom and ethical judgment are valuable resources that AI cannot completely replicate. Doctors' comprehensive understanding of patients, including their individual differences, psychological state, social background and communication ability with patients, are the key factors to make accurate medical decisions. In addition, medical decision-making involves not only technical aspects, but also ethical and legal responsibilities. Doctors have direct responsibility for patients, which AI cannot bear. The application of AI in the medical field can improve the accuracy and efficiency of diagnosis, optimize the treatment plan, predict the risk of disease, and even assist in identifying abnormalities in images under the research of radiology and pathology. However, the limitations of AI are also obvious. It may be insufficient in the face of rare cases, complex medical situations or the need for deep humanistic care. Therefore, doctors' professional judgment is very important to deal with these complex situations. They need to verify, explain and integrate the information provided by AI in order to make the most appropriate medical decisions. On this basis, doctors should make full use of the information and analysis results provided by AI to enhance their decision-making ability. In this way, doctors can manage patients more effectively and improve the quality and efficiency of medical services. As a problem-solving party in the medical subject, doctors can keep their role as decision makers unchanged in the practical application of AI, which can avoid the problem of partial loss of autonomy to the greatest extent, on the contrary, they can also maintain their independent practice ability and "feed" AI with more practical data for continuous in-depth learning.

5.1.2. Improve the Transparency of the Medical Process

On June 28th, 2021, the World Health Organization (WHO) issued the guide "Ethics and Governance of the Use of AI in Health Care". This guide, with more than 160 pages in total, expounds the application of AI in the medical field, applicable laws and policies, key ethical principles and corresponding ethical challenges, responsibility mechanism and governance framework. It defines six core principles, the third is to ensure transparency, interpretability and understandability, and how to develop specific principles is the key to improve the transparency of medical process.

For the designers and developers of medical AI, we should establish ethical constraints that are compatible with legal ethics and medical ethics to standardize the relationship between rights and obligations when designing and developing medical AI. The value goal based on digital medical care, whether government regulation or self-regulation, aims at improving the quality of medical services and ensuring the safety of medical services (Hu & Chen, 2022). Medical transparency is one of the common inspection standards of medical service quality and medical service safety. Constrained by certain ethics, the ethical principles and norms are made public, and the ethical norms are embedded in the relevant data files of the underlying architecture of AI training. Through the "bottom-up" case training mechanism, the machine's understanding of ethical elements and moral connotations can be cultivated, which can form systematic values to guide the machine's behavior and increase the public's overall cognition of AI. This is also reflected in the "moral Turing test" advocated by the Moji people colin alen and wendel walach, who found that the artificial intelligence that passed the test can be regarded as an "artificial moral actor" and has the sensitive ability to identify moral facts. It is believed that artificial intelligence can simulate human moral behavior through individual case study in empirical situations, thus indirectly obtaining universal abstract moral norms as a guide for future behavior decision-making, and even forming social emotional relationships similar to human beings on this basis. Therefore, the risk of lack of medical transparency can be reduced from the behavior of design and development and the learning "behavior" of AI itself.

The training of digital skills should be strengthened for medical subjects (mainly doctors) who use AI. This includes understanding the basic principles of AI, such as machine learning, deep learning and other basic framework principles, in order to better evaluate the output of AI system, and properly interpret and apply the results, which increases the burden on doctors themselves. However, considering the greater convenience that AI can bring in the future and the overall medical efficiency of patients, the increased learning cost will be compensated in the long run. In addition, doctors should also understand the ethical and legal issues related to AI, including data privacy, patient consent and legal responsibility of AI system, so as to ensure that the application of AI technology conforms to ethical standards and can conduct appropriate legal and ethical re-

view when necessary. For health care workers, the workload and fatigue they face mean that comprehensive training in AI is a major challenge. Therefore, continuous education and professional development opportunities should be provided to help relevant personnel keep up with the latest progress of AI technology (Tseng et al., 2019). At the same time, the medical field should promote cooperation with law, computer science and technology, communication engineering and other majors to jointly develop and optimize AI medical solutions. Through practical cases and simulation training, doctors can better understand the specific application of AI in clinical practice, thus improving their trust and acceptance of AI tools. Strengthening doctors' digital skills training and enhancing the transparency of medical process are essential to ensure the effective and safe application of AI in the medical field.

5.1.3. Eliminate Algorithmic Discrimination in Medical Scheme Selection

In the choice of medical scheme, the difference of AI algorithm has an important impact on medical decision-making. Several common algorithms (the main algorithm types include machine learning algorithm), deep learning algorithm (Natural language processing algorithm and reinforcement learning algorithm). there are also differences in the practical application process. In the future, the choice of specific algorithms should be left to the physician's own choice, but the first problem to be solved is how to avoid the algorithm discrimination of each algorithm, which leads to the provision of large differentiated solutions in the same situation. It needs to ensure that the data set used to train the AI model is sufficiently diverse and representative. This means that the data set should cover patients with different gender, age, race and health status to avoid the algorithm being biased towards a specific group. For example, due to the deviation of relevant data sets in automatic face recognition, the accuracy of face recognition system for dark-skinned individuals (especially women) is relatively low; (Mantelero, 2018). Health data of people living in remote and poor areas ("healthy deserts") are rarely seen in health databases.[1] In addition, the fairness evaluation of the algorithm is also essential, which involves the continuous monitoring and review of the algorithm decision-making process-adjusting the algorithm parameters, retraining the model, or replacing the more advanced model. To identify and correct possible prejudices, the application of medical AI is a dynamic process, and its performance needs to be constantly monitored and improved according to feedback.

In addition to technical improvement, formulating corresponding industry standards is also an important means to ensure the fairness of AI algorithm. These specifications can provide clear guidance for the application of AI in the medical field, prevent the abuse of algorithms, and protect the rights and inter-

[1]Article on "Machine learning for clinical decision making: pay attention to what you don't see" by Sherri Rose, Ph.D., associate professor of health care policy at Harvard Medical School and co-author of the first book on machine learning for causal inference-"Targeted Learning". Article published by STAT on 12 December 2019.

ests of patients. The deep participation of medical professionals can not be ignored, and their clinical experience and professional knowledge are very important to guide the development and optimization of AI algorithm. In addition, public education and awareness-raising are also the keys to reduce algorithm differences. By educating patients and the public and improving their understanding of the application of AI in medical care, it can help build trust and reduce resistance to AI decision-making. Providing feedback and complaint mechanism for AI algorithm users can collect users' opinions and suggestions in time and provide valuable first-hand information for improving the algorithm. At present, the large-scale application of AI is highly mismatched with the degree of social understanding of it. Learning to publicize and popularize behavior should be paid attention to outside the technical level, which is also in line with the way of dynamically eliminating risks from behavior.

5.2. The Laws and Regulations of Artificial Intelligence in the Medical Field Are Perfect

The legislative progress of artificial intelligence in the medical field is gradually advancing, with governments and relevant institutions around the world actively introducing policies and regulations to promote and regulate the application of AI technology in the medical industry. For example, the National Health Commission of China released the "Guiding Principles for the Planning of Medical Institutions (2021-2025)" which clearly stated that it will promote the deep integration of artificial intelligence, big data and other new technologies with medical services, and promote the construction of smart hospitals and hospital information standardization. At the same time, the clinical application of medical AI also faces legal challenges, such as the legal status of medical AI, the allocation of medical liability and the protection and utilization of medical data, which need to be resolved through strengthened interpretation and the improvement of legislation. In addition, the research output level of medical AI has already reached the forefront of the world, and the integration of AI technology with the healthcare field is deepening continuously, becoming an important driving force to improve medical services. Despite the challenges, with the support of policies and the improvement of laws, the prospect of artificial intelligence in medicine is broad, and it is expected to achieve higher quality medical services and health management in the future.

5.2.1. Clarify the Legal Status of Medical Artificial Intelligence

Judging from the definition and regulatory choice of medical AI in the world's major developed economies, medical AI products in the United States are usually classified as medical devices, which need to be approved by the FDA. The FDA's supervision of medical AI products mainly depends on the existing regulatory framework of medical devices, including the safety and effectiveness of products and whether they meet the requirements of the definition of medical devices. The supervision of medical devices in the European Union is similar to

that in the United States in terms of risk-based classification and supervision framework. Its Medical Device Regulation (MDR) defines medical devices as all kinds of instruments, instruments, software, etc. (including medical AI, of course) used for a series of medical purposes. All medical devices must pass the conformity assessment and obtain the CE mark, and all medical devices must comply with the General Data Protection Regulations (GDPR) to protect the safety and privacy of personal data. In Japan, the supervision of medical AI products is the responsibility of the Drug and Medical Device Bureau. The Subcommittee on Artificial Intelligence and Its Application in the Medical Field under the Bureau put forward specific specifications and suggestions for AI-assisted medical imaging diagnosis and AI surgical robots, including the requirements for the plasticity of medical AI technology, the validity and reliability of data sets, and data quality issues. It can be seen that all the above developed economies define AI as a tool and of course deny its legal subject status.

There are no laws and regulations in China to define the legal status of AI. At present, medical AI is mainly used as an auxiliary tool in the medical field. It helps doctors and medical professionals to improve the efficiency and quality of diagnosis and treatment through data analysis, image recognition and pattern prediction. Although AI shows great potential in processing a large amount of data and executing complex algorithms, its role as a tool is defined by its technical dependence, the need for human supervision, and legal and ethical restrictions. The application of AI in medical treatment includes auxiliary diagnosis, treatment planning and disease risk assessment, but it only provides suggestions, and the final decision-making power is still in the hands of medical professionals. At the present stage of development, it still plays the role of assistant to medical professionals, rather than an independent decision-making entity. Therefore, the medical AI at this stage should not have the legal subject status and still belong to medical devices. Not only does it not have the subject qualification to produce civil legal relationship, but it can not be the subject to bear criminal responsibility, so it is difficult to bear legal responsibility independently (Liu, 2019).

5.2.2. Rules of Legal Liability When Causing Medical Damage

As mentioned above, medical AI does not yet have the subject qualification of legal relationship and of course cannot bear legal responsibility independently. In this case, there is the problem of multi-subject responsibility in each link. Designers and users of medical AI need to be responsible for their actions in the medical process. When there is misdiagnosis or other medical accidents in AI system, the attribution of responsibility should be clearly defined. Generally speaking, developers, medical institutions and doctors of AI systems should bear corresponding responsibilities. Developers need to ensure the security, accuracy and reliability of the AI system; Medical institutions and physicians need to use the AI system correctly and intervene in time when necessary to ensure patient safety.

1) Legal responsibility of medical AI producers

If there are defects in the design, manufacture or warning of medical AI products, resulting in damage to patients, the producer shall bear the producer's liability for compensation stipulated in the Tort Liability Part of the Civil Code, even if it is impossible to prove that the producer is at fault, even if the legal interests of others are damaged due to product defects. In addition, producers also need to fulfill the obligation of informing, and those who fail to inform the users that they need formal training before they can use medical AI should be deemed to be at fault. At the same time, ensure that the medical AI system is properly maintained and updated, and conduct sufficient clinical trials to prove the safety and effectiveness of the products. In some cases, if producers still produce and sell products knowing that they are defective, they may face punitive damages. At the same time, the state should provide the basis for defect judgment, set up the product standard of medical AI algorithm, and improve the standardization and scientificity of medical AI algorithm technology. Medical algorithm plays a major role in patient health management and disease prediction. After being identified as a product defect by relevant standards, the principle of no-fault liability shall be used in accordance with the provisions of product liability. Following National Medical Products Administration's release of YY/T 1833.3-2022 "Quality Requirements and Evaluation of Artificial Intelligence Medical Devices Part 3: General Requirements for Data Labeling" and other 18 medical device industry standards in the second half of 2022, a few days ago, The Inspection Guide of Beijing Artificial Intelligence Medical Device Production Quality Management Standard (2024 Edition) issued by Beijing Drug Administration specifies in detail the key links of the quality and safety of artificial intelligence medical devices in the whole life cycle, including demand analysis, data collection, algorithm design, verification and confirmation, update control, etc., which sets an example for the industry and lays the foundation for the birth of a national chess game rule. In addition, the liability insurance system can provide relief for victims, reduce the burden on producers and disperse accident risks (Deng & Liu, 2019).

2) Legal responsibilities of medical AI users

In the clinical application of medical AI, if medical damage is caused, the legal responsibility of medical AI users is the focus of common concern of legal and medical circles. According to the current law, medical AI users (that is, medical personnel or medical institutions) should bear corresponding legal responsibilities if they are at fault in diagnosis and treatment activities, which leads to patient damage. The Civil Code of People's Republic of China (PRC) and Judicial Interpretation of Medical Damage Liability of the Supreme People's Court stipulate that medical institutions and their medical staff are at fault, or fail to fulfill the obligation of diagnosis and treatment corresponding to the medical level at that time, and should be liable for compensation. In addition, if the medical staff is seriously irresponsible, causing death or serious damage to the patient, it

may constitute a crime of medical malpractice and bear criminal responsibility. As an auxiliary tool, medical AI data analysis or judgment is only for medical staff's reference. When using AI system, doctors should take a reasonable and cautious attitude to verify the results provided by AI, instead of relying solely on AI's judgment to make a diagnosis. If the physician fails to use the AI system to avoid medical errors, or fails to use the AI system according to the operating specifications, resulting in patient damage, the physician may be liable for negligence. At the same time, if the AI system has been proved to have a significant effect in a specific field, doctors may have to bear corresponding responsibilities if they refuse to use the AI system and cause misdiagnosis. However, due to its "black box" characteristics, the opacity and unpredictability of medical AI algorithms may make it difficult for medical professionals to fully understand the decision logic of AI. In this case, if the doctor fails to adopt AI's advice and causes misdiagnosis, and the logic behind the advice is not foreseeable, the doctor should not be considered to be at fault. Therefore, when medical AI causes medical damage, the legal responsibility of medical personnel needs to comprehensively consider whether it is at fault, whether it has fulfilled its reasonable duty of care, and the transparency and predictability of AI advice.

3) Improve the protection of medical data and personal information.

In the context of the rapid development of medical AI, the protection of medical data and personal information is particularly important. The Law on the Protection of Personal Information, which has been implemented in China, provides a legal framework for the handling of personal information and ensures the legality and compliance of personal information handling. At the same time, the classification and regulation of medical data should be clear, and personal information, sensitive personal information and general medical big data should be distinguished so as to take different protection measures. It is crucial to ensure the security of patient data. To this end, healthcare organizations should take a series of comprehensive measures: Firstly, encrypt medical data to ensure the security of data during storage and transmission. Secondly, implement strict access control policies to limit access to sensitive information only to authorized medical personnel. Thirdly, anonymize and de-identify data to protect patient privacy. Fourthly, regularly backup data to prevent data loss or attacks. Fifthly, conduct security audits to check the compliance of data access and processing, and promptly detect and fix security vulnerabilities. Sixthly, train employees on data protection and privacy regulations to enhance their awareness of data security. Finally, strictly adhere to relevant data protection laws and standards, such as HIPAA or GDPR. By taking these measures, healthcare organizations can effectively protect patient data, maintain patient privacy, and enhance the security and trustworthiness of medical services. In addition, we should follow the principle of data minimization, and only collect and store personal information necessary to achieve specific medical purposes, which is also an effective means to reduce potential risks. Medical institutions and medical AI enterprises should

strengthen self-discipline to ensure strict compliance with relevant laws, regulations and ethical standards in the process of data collection, storage, processing and sharing. In terms of supervision and law enforcement, strengthen the construction of supervision institutions, improve their supervision ability and technical level, and ensure the effective implementation of laws and regulations. Education and training cannot be ignored. Medical workers and data processors need to be trained in privacy protection awareness and skills to improve their understanding of the importance of personal information protection. Strengthening cross-disciplinary cooperation is also one of the key points to solve the problem of medical data protection. Experts in different fields such as medical care, law and AI technology are encouraged to cooperate to jointly study and solve new problems faced by medical data protection. Finally, patients' right to know and decide is guaranteed, so that they can know about the collection and use of personal information and have the right to ask for correction or deletion of inaccurate information. In medical services, the form of patients' consent should be strictly limited to written form to ensure full disclosure and informed consent before obtaining information (Han, 2024). For medical behavior in emergency, doctors should be allowed to obtain necessary information without the consent of patients, so as to protect patients' right to life and health.

6. Conclusion

Artificial intelligence (AI) has brought revolutionary changes to the field of medicine, where it uses technologies such as image recognition, machine learning, and data analysis to provide doctors with powerful assistance tools. AI not only improves the accuracy and efficiency of diagnosis, but also drives the development of personalized treatments and accelerates the research and development of new drugs. Additionally, smart wearable devices and remote monitoring systems utilize AI technology to enable real-time monitoring of patient health and timely intervention. AI also plays an important role in surgical assistance, medical data analysis, and patient communication, bringing unprecedented progress to the field of medicine. The application of artificial intelligence in the medical field is different from its characteristics in composition and document processing, and has a higher degree of practical essence. Practice is bound to be accompanied by behavior, its causes and risks, which gives this paper the possibility of studying from the perspective of behavioral law. Because of the strong practical logic, in fact, in the whole process of artificial intelligence applied to the medical field, we should comprehensively analyze the behavior itself and the risks it brings. Preventing the loss of autonomy of medical subjects by clarifying the status of artificial intelligence in medical activities, embedding ethical regulations and burdening doctors' learning behavior to improve the transparency of medical artificial intelligence, and eliminating discrimination of medical AI algorithm through technical behavior are all dynamic improvements to the problems in the field of artificial intelligence medical care by using behavioral laws.

Behavior-promoting laws, which derive static and persistent risks, need to be improved by laws and regulations. In the context of the application of artificial intelligence in the medical field, it is mainly to define the subject qualification of medical artificial intelligence, clarify the legal responsibility for medical accidents and improve the protection of medical data and personal information. Generally speaking, embracing the convenience of life brought by science and technology is still the main theme of social development. Through the continuous analysis and improvement of the application of artificial intelligence in the medical field, it is expected that the application of artificial intelligence in the medical field will be more profound, thus supporting the development of healthy China.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

Cai, C., & Jia, W. P. (2021). Application and Challenge of Artificial Intelligence in Diabetes Whole-Course Health Management. *Science Foundation of China, 35,* 104-109.

Deng, M. P., & Liu, C. L. (2019). Research on Medical Damage Liability of Surgical Robots. *China Health Legal System, No. 1,* 189.

Han, C. F. (2024). The Dilemma of Personal Health Data Protection in the Field of Medical Artificial Intelligence and Its Solution. *Science and Technology and Law (English and Chinese), No. 1,* 54-60.

Hong, L. X. (2020). Misunderstanding and Right Path: Dilemma, Cause and Improvement of Legal Artificial Intelligence Algorithm. *Journal of Sichuan Normal University: Social Science Edition, 47,* 58-70.

Hu, M. J., & Chen, M. (2022). Construction of Digital Medical Rule of Law Based on Meta Regulation. *Journal of University of Chinese Academy of Social Sciences, 42,* 66-82.

Hu, Y. L., Yu, D. L., & Wang, J. (2022). The Development of Health Medical Big Data under the Background of "Healthy China". *Social Scientist, No. 3,* 79-87.

Li, R. S. (2021). On Coping Strategies and Regulatory Approaches to the "Black Box" Problem of Medical Artificial Intelligence. *Journal of Southeast University: Philosophy and Social Sciences Edition, 23,* 83-92.

Liu, J. L. (2019). Legal Challenges and Countermeasures of Clinical Application of Medical Artificial Intelligence. *Oriental Law, No. 5,* 133-139.

Mantelero, A. (2018). AI and Big Data: A Blueprint for a Human Right, Social and Ethical Impact Assessment. *Computer Law & Security Review: The International Journal of Technology Law and Practice, 34,* 754-772. https://doi.org/10.1016/j.clsr.2018.05.017

Rao, A., & Zhang, H. T. (2002). Application of Management Methods in Behavioral Law. *Social Science Research, No. 1,* 88-91.

Report of the IX Academic Advancement Conference: Artificial Intelligence (AI) と Healthcare, June 2018 (pp. 12-14).

Sun, Q. G., Wang, C., Wang, J. Y., & Ye, B. (2021). Social-Technological Analysis of Medical Artificial Intelligence Development and Its Implications. *Studies in the Philosophy of Science and Technology, 37,* 48-53.

Tong, Y. Y., Zheng, W. T., Huang, S. R. et al. (2019). Health Equity: Bias and Governance in Medical Artificial Intelligence. *Medicine and Philosophy, 45,* 36-41. (In Chinese)

Tseng, H. T., Ke, X. T., Wu, L. Q. et al. (2019). Application Status and Effect Range of Artificial Intelligence in Medical Quality Management. *China Hospital Management, 43,* 21-26. (In Chinese)

Wang, J. (2016). Some Issues in Behavioral Law Research. In Decision and Information Magazine Society, School of Economic and Management, & Peking University (Eds.), *Proceedings of the "Decision Forum—Academic Symposium on Local Public Decision-Making Mirror" (Part 2)* (p. 1). China University of Political Science and Law.

Wang, T.-E. (2022). Human Evolution Effect of Artificial Intelligence Algorithm Development. *Journal of East China Normal University: Philosophy and Social Sciences Edition, 54,* 21-30.

Xiang, Y. H., & Wang, X. H. (2020). Remodeling and Aggregation of Health Management for the Aged in the Era of Artificial Intelligence. *Journal of Wuhan University (Philosophy and Social Sciences), 73,* 101-112. (In Chinese)

Xiao, J. D., Peng, X.-Z., & Mo, P. (2009). Da Vinci Entered the Field of Hepatobiliary Surgery in China. *Health News,* 2009-01-14(002).