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Research on the Ethical Characteristics of Intelligent Medical Technology and Equipment

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Abstract

Intelligent medical technology and equipment play an important role in the maintenance of human health and enhance the ability to prevent and cure diseases, at the same time, it has brought profound changes to the doctor–patient relationship, and the medical ethics is facing many unprecedented challenges. This article analyzes the ethical characteristics of intelligent medical technology and equipment status, intelligent medical technology and equipment application, which aims to explore the relevant measures to deal with the new situation and new problems, provide a reference for the 'Internet plus' under the environment of building a harmonious doctor–patient relationship, and gives the new idea of ethical supervision about the intelligent development of medical technology and equipment and system construction.

Keywords: intelligent medical treatment, medical equipment, medical ethics, doctor–patient relationship, ethical characteristics

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1. Introduction

The progress of medical science and technology can promote the development of medical technology and its application, and enrich the methods and means of human disease prevention and control. Because of the characteristics of medical technology itself and the particularity of its service object, thus, the management of medical technology has always been an important part of medical management. Meanwhile, ethical management is an indispensable link in medical technology research and application.

Integrating into more artificial intelligence step by step, sensor technology and other high-tech intelligent medical technology and its related medical equipment to make the medical services to the true meaning of intelligent. In 2012, the Chinese Ministry of Health issued the "Strategic Research Report on China's health in 2020", which is to macroscopically promote the development of intelligent medical technology and

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equipment market in China. In 2016, the State Council issued the guidance on promoting the healthy development of the pharmaceutical industry. It put forward specific requirements for the application of new technology about carrying out intelligent medical services, accelerating the digitization and intelligentization of medical products, focusing on the development of wearable and portable mobile medical instruments and auxiliary products, and promoting three-dimensional (3D) printing technology and biochip et al. A large number of applications of intelligent medical technology and equipment play an important role in promoting the human disease prevention, protecting human life and health and improving the quality people's life. However, intelligent medical equipment and technology have challenged the law, ethics and social norms. The ethical characteristics presented also bring profound changes to the doctor-patient relationship, which makes the medical ethics face many unprecedented conflicts and deserves to be discussed and studied in depth by the medical device industry and medical industry.

2. Medical Technology and Intelligent Medical Technology

2.1. Definition of medical technology

Medical technology refers to the diagnosis and treatment measures taken by medical institutions and their medical personnel for the purpose of diagnosis and treatment of diseases, judgments and elimination of diseases, alleviation of illness, alleviation of pain, improvement of functions, prolongation of life, and recovery of patients.

2.2. Medical technology classification

Because of the demands of research and application and management, there are many kinds of classification methods in medical technology:

1. In accordance with the medical technology on the human body without trauma, it is divided into invasive medical technology and non-invasive medical technology. For example, in prenatal diagnosis, amniocentesis and villus sampling are invasive techniques, while ultrasonic inspection belongs to noninvasive technique.

2. According to the research and application stage of medical technology, it is divided into three stages: preclinical research, clinical research and clinical application. Preclinical research is laboratory research, such as animal experiments;

clinical research, which involves the human body's medical technology research; clinical applications involves the use of human body's medical technology.

3. According to whether the medical technology is the cutting-edge technology application, it is divided into the medical high technology and the medical non - high - tech. For example, medical technology includes organ transplantation, modern genital, genetic engineering and other technologies. It should be pointed out that: intelligent medical technology does not necessarily belong to the medical high-tech.

4. According to the development degree of medical technology and the application, it can be divided into three different categories, exploring the use of technology, restriction on the use of technology and the general diagnostic and treatment technology.

5. According to the safety, effectiveness and risk of medical technology, it can be divided into the first, second and third categories.

2.3. Intelligent medical technology

The generalized "intelligent medical technology", which is from the beginning of the electronic prescription, it can effectively avoid the medical accident and realize the control of the cost of the medicine. Doctors use a computer or a digital handheld device, through an encrypted network will be directly transferred to the background of the prescription, unified registration and query sharing through the hospital management data platform of network sharing in pharmacies and health authorities. The intelligent medical technology can be used to detect the hospital or home patient physiological indexes of medical device through portable and practical, and send the resulting of physiological parameters through the network to the nursing or related medical units. Medical units will provide life-long health management service for patients.

Narrow sense "intelligent medical technology" is widely used in surgical equipment, clinical laboratory equipment, intensive care unit, hospital care and family care. Intelligent medical combination of wireless network technology and RFID bar code technology, networking technology, big data technology, data fusion technology, the medical treatment process will further enhance the service efficiency and service quality, comprehensive change and solve the modern digital diagnosis model, hospital information system, health management problems and difficulties. Carrying out real-time payment and online diagnosis, pathological analysis, online interoperability can be achieved

by intelligent medical communication technology and application platform; and the implementation of family safety monitoring, getting various information of patients in time, and the realization of self service.

Today, the intelligent medical networking technology has the following features based on "Internet plus" environment: the authorized doctor can readily access patient records, patient history, treatment measures and insurance details, and patients can also choose to replace the doctor or hospital. Integrate medical information storage and sharing of medical information and medical institutions for the record and the building of a professional medical network (Alexandrov et al., 2016). Sense, process and analyze major medical event in time to make rapid and effective response. Supporting township hospitals and community hospitals are seamlessly be connected to the Center Hospital, so that you can get expert advice, arrange referral and receive training in real-time, improve knowledge and process handling capacity. Further promote clinical innovation and research; so the practitioner can search, analyze and refer to a large number of scientific evidence to support their diagnosis (Mishonova et al., 2017).

3. Intelligent Medical Technology and Equipment Development Status and Trends

3.1. Current market situation and trends

Under the background of "Internet+", digital development is developing towards to intelligent technology and equipment. The next few years, China's Intelligent medical market will be more than ten billion Yuan (RMB), and drive a wide range of related industries. The enablement of intelligent medical technology and equipment market not only influence the medical service industry itself, but also will directly touch the interests chains including network suppliers, system integrator, wireless equipment providers, telecommunication operators, thus affecting the existing layout of the communication industry.

Digital, visual model will be used in the field of intelligent medical technology, which can make the limited medical resources to allow more people to share (Kostadinova et al., 2016). From the current development of medical information, along with the increasingly obvious development trend of community health and the health care, make real-time tracking and monitoring by radio frequency instrument and other related devices signs in the family, which can achieve real-time diagnosis and health alert to patients or sub-health for hospital, so as to effectively reduce and control

the disease with the occurrence and development. In addition, the Internet of things technology plays an important part in drug management and drug application process.

In addition, the rapid development of intelligent terminals and mobile Internet is conducive to stimulating the intelligent needs of medical and health equipment. There will be more than 50% mobile phone users use mobile medical applications to 2017, users can measure and transmit health data effectively by smart hand-held terminals and sensors, such as smart wristbands, smart health capsules, intelligent detection products will be widely used.

Finally, due to the guarantee of large data technology, domestic and foreign internet giants layout health cloud service platform, which has a great role in the specification and promotion for industry. The improvement of the big data and cloud services technology are useful to provide value-added services for users and improve the user experience, so as to further promote the development of medical health intelligent hardware market.

3.2. An example of intelligent equipment in hospital

TABLE 1: Intelligent devices for hospitals.

Sequence number	Application name (device name)
1	Multimodal molecular imaging instrument
2	Novel magnetic resonance imaging system
3	Novel X - ray computed tomography
4	New generation ultrasound imaging
5	Low dose X - ray imaging
6	Composite endoscopic imaging
7	Virtual reality technology 3D laparoscope
8	New microscopic imaging
9	Medical robot (diagnosis robot, surgical operation assistant robot, rehabilitation robot)
10	Medical active implantable device

3.3. Smart wearable devices

Except for monitoring vital signs, Smart wearable devices can also aid to the treatment of disease, collecting the human physiological data through sensor (such as blood glucose, blood pressure, heart rate, blood oxygen content, body temperature, respiratory rate, etc.) and transmit data to the central processor wirelessly. The central processor

will send the data to the medical center, so that the doctor can make comprehensive, professional and timely analysis and treatment. Table 2 illustrates the intelligent monitoring of vital signs can be used in wearable devices, and Table 3 lists the typical application of smart wearable devices for disease treatment.

TABLE 2: Wearable devices for the vital signs monitoring.

Application name	Characteristic
Maxim vital signs measurement T-shirt	The company (Maxim Integrated) launched T-shirt to monitor the vital signs, called "Fit shirt", the T-shirt can measure ECG, body temperature and activity data, for medical institutions to monitor the patient's physical condition. This highlight of the T-shirt is that it is implanted sensor for ECG in the sleeve at the embedded.
IMEC wearable headset	IMEC wearable electroencephalogram (EEG) headphones and electrocardiogram (EKG) patch can be recorded in the brain and heart activity.
Body Tel family diagnostic system	Tel Body provides family diagnostic equipment for patients with chronic diseases. Products of Body Tel including Gluco Tel, Pressure Tel, Weight Tel and Weight Tel Pro, which are equipped with Bluetooth module and automatically send the measured data of the body to the hospital's database. When the data is above or below a preset threshold, doctors can take measures to help them in time.

Intelligent wearable health devices also have the following problems:

1. There is a certain gap between the test data and the medical level;

2. The operation of the product is not convenient enough, and the elderly people use inconvenient;

3. The content of products and data services is not rich enough, the user stickiness is insufficient;

4. The ability of data analysis is weak, the medical profession is slightly less, and more are in the conceptual stage.

3.4. Intelligent medical services

Through the integration of online and offline high-quality medical resources, standardizing medical networking and application of health management program (APP), we can carry out online health consultation, appointment, waiting reminder, charge, diagnosis report query and other convenient services. The integration of regional health service resources, the establishment of health care information service platform, to carry out internet health care information services. In addition, intelligent medical

TABLE 3: Typical applications of smart wearable devices for the treatment of diseases.

Application name	Characteristic
Control instrument of wrist type blood sugar	Based on the Bio-MEMS technology, it is composed of the micro pump, which is extracted from the blood, electrodes with blood glucose sensor and micro pump with pressure difference. Its working principle is to detect blood glucose concentration by micro needle, and then by the micro pump to inject drugs to maintain the normal blood glucose level.
monitoring equipment of Wearable Biosensor bedside bed	Wearable Biosensor like a miniature monitoring device beside bed, patients can also be in the doctor's monitoring range even at home. It will send the collected data to the cloud server called IntelliVue Guardian, and compared with the database of the disease. If the user has the early symptoms of the disease, the server will send a warning to the doctor's cell phone or panel computer. The data that Wearable Biosensor can monitor includes: ECG (heart rate, irregular heartbeat), skin temperature, body posture and activities. This patch cannot be charged, non-repeated use.
Wearable defibrillator	It has been used in clinical, mainly composed by the Camisole type electrode belt and defibrillator. The electrode belt contains the sensing electrode and the defibrillation electrode, while defibrillator is made of pulse generator, detector and alarm. When an anomaly status is detected, the alarm will notify the medical staff defibrillate or defibrillate automatically.
Wearable alternating electric field to treat brain tumors	The research team of Israel science and engineering institute will wear a device on the head of brain cancer patients that is composed of a small battery and insulated electrode bandage with wire, making use of electric field prevent cancer cell growth and division, the survival time of patients with brain tumors increased 1 times
Ionotherapy remedy for headache	With the birth of the design of switched power supply and high performance micro controller, iontophoresis has entered the era of wearable, patients can use the self-service iontophoretic patch for headache, sickness, wrinkles and other treatment.
Intelligent glasses auxiliary therapy Senile dementia patients	Japanese scientists have invented a smart glasses that can identify 60 kinds of daily necessities, and remembered the place where the wearer to see the bag, keys, mobile phones, music players and other daily necessities last time. There are a miniature camera and small mirror in the lens, the wearer can take the goods with it, the first camera focus on the object, the wearer to tell the names of goods, the name will be saved to the small intelligent computer processor, if the wearer find the article again, just read out the name, the intelligent glasses will display its last place on the screen. This function bring convenience to their life for the patients with Alzheimer's disease.

services include: informatization in the use of medical institution, intelligent technology and equipment, facing to grassroots, remote and underdeveloped areas, to carry out remote pathological diagnosis, imaging diagnosis, expert consultation, guidance, monitoring operation guidance and other remote medical service.

4. Ethical Characteristics of Intelligent Medical Technology and Equipment Application

4.1. The weakening of humane care and technology guidance

The application of intelligent medical technology makes medical staff almost "omnipotent". The development of PET/CT imaging technology and testing technology makes tumor early detection and diagnosis gradually become a reality. In the invention and application of the life support system, the patients could be pulled back from the brink of death. The invention and use of a surgical robot and other sophisticated equipment makes the previously difficult to diagnosis and treatment of the disease can be cured. But in the rapid development of intelligent medical technology, medical personnel may put too much emphasis on the role of technology, but ignore the fundamental requirements of the" bio psycho social "medical model, and the process of diagnosis and treatment of patients with the care and respect. It leads to human spirit become weaken continuously under the impact of the intelligent medical technology storm. Nowadays, medical ethics' no harm principle of physical disease in the diagnosis and treatment has been fully reflected, but the psychological harm to the patient has been ignored in the process of diagnosis and treatment.

4.2. Communication barriers, doctor-patient emotional fade

The establishment of the relationship between doctors and patients cannot be separated from effective communication, the principle of respect whose core elements is the effective communication among the principles of medical ethics. However, with the wide application of intelligent medical technology and medical equipment, medical personnel can obtain patient data in the computer terminal without directly contacting with the patient, and as a basis for diagnosis, treatment and nursing. Doctor used to face to the computer to write medical records, open checklist, see report, but rarely directly face to face patients when patients in the inspection process. Nurses get used to observing various data and operation state from monitoring instruments, but rarely directly observe the patient's state of life. Many of these phenomena make the contact decrease between the patients and medical staff, and gradually form a bad relationship between "doctors-medical instrument-patients", which seriously impede the ideological and emotional communication between doctors and patients and affect the establishment of normal ethical relationship between doctors and patients.

4.3. Depending on equipment, the relationship between the doctor and patient materialization

With the continuous emergence of intelligent medical technology and the extensive application of related equipment, advanced inspection methods and diagnosis and treatment technology to make people's understanding of the human body and disease, from the overall, cell level to the molecular level. The human body in the eyes of many doctors shall be regarded as a machine. The doctor is responsible for different departments in different parts of the maintenance, repair or replacement. The use of large intelligent medical equipment for inspection and diagnosis has become an indispensable process in the diagnosis and treatment of diseases. The behavior to make the auxiliary examination as a routine and habit and have excessive dependence on it, ignoring the social nature of people, there is no longer respect from each other between doctors and patients, which formed a "relationship between a repairman and machine repair and be repaired".

4.4. The cost is expensive, and the doctor-patient relationship is intensified

The opportunity to obtain health benefits in society should be equal, which is the objective requirement of the principle of justice, one of the four principles of medical ethics. But some high-grade intelligent medical technology costs are expensive, resulting in a lot of cases to determine whether the patient's treatment is the premise of the patient can bear the cost of the medical check. According to the statistics of Chinese Ministry of health, from 1995 to 2015, the average medical expenses of outpatient and discharged patients in China's comprehensive hospital showed an increasing trend year by year. When the intelligent medical technology improve the level of diagnosis and enhance the treatment effect, meanwhile, it also led to the rise in medical costs. The medical expenses greatly affected the fairness of medical care, resulting in "no money for treatment", and "poverty caused by disease" cases have occurred. In this case, the contradiction between doctors and patients is more likely to be intensified, and its root cause lies in the destruction of the fairness of the medical treatment.

4.5. Information leakage, privacy security worrying

Through the application of intelligent technology and medical equipment, large amounts of data can be collected by medical institutions or research institutions, so as

to carry out cluster and association analysis and dig out valuable new information. Such information is not only of great value for medical research and public health research, such as: correlation between gene and disease, prediction of infectious disease and so on, but also has great economic value for commercial operation, such as: precision marketing can bring enormous business opportunities and profits. The problem what we should pay attention to is that a large number of medical data mining will inevitably lead to the abuse of personal security, privacy leaks and other problems. Because the intelligent health information spread fast and has a wide range, the privacy was difficult to control once it was leaked, so it does a great harm to patients (user). Once the patients knew their privacy is compromised, they will reduce the level of trust to the information collector (mainly medical institutions).

5. The Ethical Supervision and System Construction of the Intelligent Medical Technology and Equipment Development

The protocol process to technology of ethics is not only a reverse protocol, that is, the technology to adapt to the original ethical norms, but also should include a positive statute, it is the technical transformation of the original ethics. In the conflict between new and old ethical concept, human initiative to change the ethical concept in order to adapt to the development of intelligent medical technology and equipment, and make full of ethical arguments for intelligent medical technology and equipment, establishing corresponding ethical norms, reducing ethical friction intelligent medical technology and equipment technology progress. In order to make use of the guiding role of normative ethics of intelligent medical technology and equipment, to promote the development of systematization and organization, the use of intelligent medical technology and equipment meet the medical ethical principles that is currently recognized.

5.1. Strengthen the cultivation of humanistic quality

Under the guidance of medical humanistic spirit, the intelligent medical technology can only be separated from the bound of the technology theory, and establish the correct ethical relationship between doctors and patients. First of all, to enhance the understanding to life of medical personnel, only to understand the life, they can respect for life and its natural state of existence, to associate with the human life, health

and the surrounding social, psychological and environmental factors. The second is to cultivate ethical thinking of the medical staff, to guide them to recognize and treat the effect of application of intelligent medical technology to patients and society, and make the correct ethical choice, to let intelligent medical technology serve the patients more effectively. In addition, it also should improve the skills of medical personnel and patient communication. Carrying out the education and training of doctor-patient communication skills, so that medical personnel can get rid of the siege of intelligent medical equipment and have effective communication with patients.

5.2. Enhance social responsibility consciousness

We should constantly strengthen the social responsibility consciousness of the hospital and medical staff during the application of intelligent medical technology and equipment. On the development ideas to the hospital, we should clarify the role of positioning and social responsibility to avoid the pursuit of economies of scale and economic benefits. In the introduction of large-scale intelligent medical technology and equipment, it must be combined with the current situation of hospital development and the actual needs of patients to prevent the rush to recover costs or avoid equipment idle and lead to excessive examination and excessive medical treatment. At the same time, the education and management of medical staff should be strengthened, by conducting a variety of public welfare activities to close to the grassroots and the common people, letting the medical staff understand the suffering of the patients, improve emotions between medical staff and patients and ensure the effective incentive mechanism. So as to guide them to use medical technology and equipment rationally and bring benefit to patients.

5.3. Carry out intelligent medical technology education

The information asymmetry between doctors and patients is an important factor to induce the contradiction between doctors and patients. For patients, intelligent medical technology seems to be a mysterious field, it also a highly asymmetric field of information between doctors and patients. Therefore, o carry out the propaganda and education of intelligent medical technology and equipment, to a certain extent, it can reduce the information asymmetry caused by the doctor-patient contradiction. For medical staff, they also need propaganda and education, so that they can accurately grasp the application of intelligent medical technology to adapt to improve the application of

targeted and effective. In the doctor-patient communication, to strengthen the notice of the application of intelligent medical technology to inform, so that patients have the ability to judge correctly and the right of voluntary choice in front of intelligent medical technology. Only the realization of patients' independent choice based on the correct judgment and the appropriate use on the intelligent medical technology and equipment for medical personnel, it can make the diagnosis and treatment activities in line with the basic requirements of medical ethics.

5.4. Strengthen the concept of green medical

The use of intelligent medical technology must be based on the patient's health benefits, from the actual needs of the patient's diagnosis and treatment, and effectively grasp the scope of the indications. This is the basic requirement of medical ethics, which is no harm principle and the advantage principle. Therefore, to follow the principle of optimization in the selection and application of intelligent medical technology and equipment, starting from the disease, according to the green health concept, and strive to achieve the best indications, the best efficacy, minimal damage. Specifically, it must follow the order from low to high in the clinical application of intelligent medical technology, if it can achieve the same effect with low technical means, there is no need to choose a high level of means. In the case of a considerable effect, to select the smallest damage, the highest safety factor means, and reduce the damage to the minimum to ensure patient safety.

5.5. Standardize patient data usage

If the analysis and utilization of data caused by the intelligent medical technology and equipment can bring great benefit to the health of patients, medical research and public health, at the same time, it can make the potential damage of privacy being controlled to a minimum through the adoption of data security measures, and perform the informed consent procedures as well as remove identifiable information, then use the sharing patient/user data to make it be able to defend the ethics. Therefore, a reasonable approach should generate the data to be standardized management, ethical health information and data usage and sharing should follow the principle of informed consent.

5.6. Promote the reform of health system

The urgent problem "medical treatment is difficult and expensive" should be solved in the reform of the medical and health system. The intelligent medical technology is convenient and intelligent, it can be a way to solve this aspect of the ethical conflict from a certain level. Fundamentally speaking, the promotion of intelligent medical technology and equipment must be combined with the medical and health system reform, from the macro to optimize the configuration, to strengthen regulation and control, it should not only focus on treatment effect, but also to consider the economic burden, not only to see the advanced intelligent medical technology, but also to see the feasibility of popularization, not only to understand the application of its benefit, we should also take into account the related technology and material basis.

5.7. Grasp the direction of scientific development

In the process of promoting the development and application of intelligent medical technology, we need to take a cautious attitude to it. Life science and technology is a huge change to the "natural state", which faces many ethical problems, we must have a strong sense of historical responsibility for the present and the future of mankind. The nature of medicine is the respect for life and love, so if we really want to solve the ethical conflicts in the application of intelligent medical technology and equipment, it is necessary from the beginning of the intelligent medical technology and equipment research and development, from the perspective of ethics to grasp the direction of scientific development.

6. Conclusion

Intelligent medical information platform is a versatile data information platform, through the integration of various types of technology to achieve the interaction between medical personnel, medical institutions, medical equipment. Information exchange and processing to achieve a high degree of intelligence. In the future, the medical industry will emerge more based on artificial intelligence, sensor technology, networking, cloud computing, artificial intelligence expert system for embedded system, intelligent medical technology and equipment, making intelligent medical services to the real meaning of intelligence, promoting prosperity and development of medical service. In the background of the Chinese new medical reform, intelligent

medical is going into the lives of ordinary people, in modern biomedicine and information technology management mode, to make comprehensive health care services to everyone from the social, psychological and biological perspectives, at the same time, the ethical problems brought by intelligent medical technology and equipment will be solved.

References

[1] Alexandrov, A. S., Vassileva, P., Momchilova, A., Tsonchev, Z., Kirilova, Y., Ivanova, R., & Orozova, M., A new approach using nanomembrane-based therapeutic plasmapheresis for treatment of patients with multiple sclerosis and neuromyelitis optica. *Comptes rendus de l'Académie bulgare des Sciences*, 2016, *69*(3).

[2] Kostadinova, A., Georgieva, I., Topouzova-Hristova, T., & Tzoneva, R., Effect of electrical field and miltefosine on actin and actin-associated protein z0-1 organization in cancer and non cancerous cells. *Comptes rendus de l'Académie bulgare des Sciences*, 2016, *69*(5).

[3] Liu Qi, Management ethics problems and solutions in the application of remote medical technology [J]. Chinese medical ethics, 2000, volume (3): 3-5.

[4] Mishonova, M., Dimitrov, O., Sazdova, I., Dimitrova, D., & Gagov, H., Nitric oxide synthases and semicarbazide-sensitive amine oxidase activity in rat liver and kidney. *Comptes rendus de l'Académie bulgare des Sciences*, 2017, *70*(11).

[5] Sun Rongguo, Discussion on medical technology and ethical management in China [J]. Health soft science 2014,28 (3): 152-154.

[6] Wang Jian, The characteristics of modern technical ethics rules [J]. Natural dialectics research, 2006,22 (11): 54-58.

[7] Zhao Rong, He Ping, Research on personal privacy protection system in medical large data applications [J]. Journal of China health information management, 2016,13 (2): 191-195.

[8] Zhou Sicheng, Zhai Yaomei, Privacy protection in the context of electronic health care [J]. Chinese medical ethics, 2016,29 (4): 681-685.