



# Using artificial intelligence to improve medical services in China

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**Abstract:** Artificial intelligence (AI) is one hotspot of research in the field of modern medical technology. Medical AI has been applied to various areas and has two main branches including virtual and physical. Recently, Chinese State Council issued a guideline on developing AI and indicated that the widespread application of AI will improve the level of precision in medical services and achieve the intelligent medical care. Medical resources, especially the high-quality resources, are deficient across the entire health service system in China. AI technologies, such that virtual AI and telemedical technology, are expected to overcome the current limitations of the distribution of medical resources and relieve the pressure associated with obtaining high-quality health care.

**Keywords:** Artificial intelligence (AI); medical resource; health care; China

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## Introduction

Artificial intelligence (AI) is one hotspot of research in the field of modern medical technology; it has been applied to the medical industry in various areas, including medical statistics, aiding in diagnosis and therapy, robotic surgery, medical imaging and studies of human biology (1-4). Recently, on 8<sup>th</sup> July, 2017, the Chinese State Council issued a guideline on developing AI that indicates that AI plays a significant role in multiple fields, including health care. At present, there is a severe deficiency in medical resources across the entire health care system in China, and high-quality health services are often available only at large hospitals, which many patients have difficulty accessing (5). As AI technology continues to improve, it can imitate and replace the primary work of human doctors and may even go beyond human ability, potentially compensating for a lack of traditional medical expertise (1,6). Overall, advances in medical AI are expected to reduce the difficulties faced by

patients in obtaining high-quality health care and to better disseminate medical services in China.

## Shortage of medical resources in China

Traditional educational programs aimed at producing high-quality doctors require a long training cycle (7). In China, the “5+3” model is the main training model used to educate medical students: after five years of medical undergraduate education, residents undergo three years of standardized training and acquire their medical qualifications after passing a rigorous examination, thus the minimum time required to become a doctor is eight years (8). According to data from the World Bank, China had only 1.8 doctors per 1,000 residents in 2010 (9). Physicians have suffered a high-level of workload with low salary and poor working conditions in China (10). Most physicians work more than 40 hours per week and the average numbers of outpatients

are up to 40 in clinics per day (11). In addition, the Chinese population and its health-care expectations are growing rapidly, resulting in a serious shortage of medical resources (12). Thus, medical resources are deficient across the Chinese health service system.

Although China has undergone constant health care reforms to alleviate the pressure caused by the lack of medical resources, an uneven distribution of medical resources still exists, and high-quality resources are still concentrated in developed cities and large hospitals, such that primary hospitals lack qualified doctors (5,13). Taking ophthalmology as an example, fewer than 36 % of the estimated 28,000 ophthalmologists in China perform cataract surgery, and the quality among those who do operate remains problematic, especially in rural areas (14). In addition, a reasonable hierarchical diagnosis and treatment system is still absent in China. A large number of patients are unwilling to seek health services in primary hospitals and instead seek out experts in large hospitals, indicating that a shortage of high-quality resources is a main cause for the difficulties associated with obtaining hospital services. Thus, in the traditional medical service industries, both experts and patients are in short supply, creating a bottleneck that restricts social development. Although bureaucratic reforms are urgently needed as part of the solution, this type of reform is a time-consuming and costly process (15). One option for reducing disease burden and significantly improving the quality and duration of human life is the application of modern medical technology. Due to improvements in technology, human life expectancy increased from 61.7 years in 1980 to 71.8 years in 2015 (16). Therefore, AI technology in particular is expected to usher in major breakthroughs in health care (17).

## Two branches of medical AI

AI has been used in various areas of medicine and has two main branches in this context: virtual and physical (18). The virtual branch is represented by machine learning, which utilizes direct experience to expand knowledge, and includes informatics approaches ranging from information management to control of health management systems (including electronic health records) to active guidance of physicians in their diagnosis and treatment decisions (19-21). For example, an AI generated through deep convolutional neural network (CNN) algorithms can effectively screen skin disease and classify skin cancer as dermatologists (22). Other examples include pathology, analysing radiographic

exams, diagnosing retinal diseases, glaucoma or cardiovascular diseases (23-27). Moreover, an ophthalmic AI agent called CC-Cruiser was recently shown to have the capacity to diagnose and provide risk stratification and treatment suggestions for congenital cataracts, a rare disease (28). Indeed, this AI system has provided breakthroughs for exploring health management system for rare diseases.

The physical branch is best represented by AI robots, which have been increasingly applied in the medical industry (29). It is expected that AI robots will replace much of the primary work of human doctors. These robots are more capable than human doctors in many areas and may one day eliminate the need for humans to perform surgery (1). Based on their function, medical robots can be divided into clinical medical robots, auxiliary rehabilitation robots, hospital service robots and medical teaching robots. Clinical medical robots include surgical robots and diagnostic and therapeutic robots. The Da Vinci system is a representative surgical robot (3). Surgical robots can assist doctors in performing operations, can greatly improve surgical accuracy, and can even be used to perform long-distance telesurgery (30,31). Diagnostic and therapeutic robots, such as capsule robots and nano-robots, are intelligent micro-tools that can access different regions of the human body for medical exploration and treatment (32). Rehabilitation robots can be divided into auxiliary and therapeutic robots (33). The earliest application of an auxiliary robot was that of the Handy 1, which helped users eat meals, drink water, shave, brush their hair, and complete other simple daily activities (34). Current research examining rehabilitation robots has mainly focused on rehabilitation robot arms, intelligent wheelchairs, prostheses, rehabilitation therapy robots, among others (29). Hospital service robots include telemedicine robots, article transport robots and pharmacy service robots. These robots can be utilized to deliver blood, drugs, surgical supplies, and patient care according to user-specified instructions and with high efficiency (35). Moreover, medical teaching robots are simulation robots that can be used in clinical teaching. These robots can imitate different diseases and operation models to produce clinical simulations that help to train medical staff in clinical skills and to enhance their ability to identify responses (36).

## The ability of AI to improve medical services in China

Medical AI provides the advantages of high efficiency,

surgical accuracy, flexible action and the ability to adapt to a variety of complex external environments (37,38). AI can also assist human doctors by improving diagnosis and treatment efforts, thereby elevating the quality of medical services (39). To alleviate medical resource shortages, the application of medical AI in China can improve responses to medication, decrease costs and offer more efficacious interventions (15).

The virtual AI described above can be used for open-source sharing of medical records and new findings, and aggregated data can be displayed for open-access by physicians and scientists (1,40,41). Taking CC-Cruiser as an example, a collaborative cloud platform for data integration and patient screening can be developed to share patient information and data from individual hospitals, reducing the need for additional resources. The creation of a collaborative network to manage rare diseases and a cloud-based AI platform to provide medical suggestions for non-specialized hospitals are expected to improve the quality of care for patients with rare diseases (28). The advantages of using an AI platform are not limited to providing care for rare ophthalmic diseases. For example, patients with other serious conditions who are living in less-developed and remote areas can receive an initial diagnosis and testing in a local primary hospital and then use an online platform to obtain second opinions from experts at top-level hospitals (42,43). In this way, patients can overcome geographical obstacles to obtaining high-quality care as long as they have internet access. To some extent, this access can relieve the pressure associated with obtaining high-quality health care and facilitate the distribution of the high-quality resources that are currently only available at large hospitals in China.

Telemedical technology of AI also has significant advantages for overcoming current deficiencies in access to medical resources. Telemedicine can provide health services in extremely isolated environments and has great potential for impacting many areas of health care, including consultative, diagnostic and treatment services, as well as surgery through robotic telesurgery (44). Surgeons in large hospitals are expected to exchange medical information from one site to another and provide direction via long-distance telementoring to offer health care or education to patients or health care providers, thereby improving patient care (45). Furthermore, telemedicine clinics, which can provide high-quality outpatient service from top-level hospitals, can solve the difficulties of rural clinics where patients face long waits to see specialists (43). This

increased access would lead to improvements in time- and cost-effectiveness and enable a higher level of medical care than is currently provided in Chinese primary hospitals (46,47).

The above-described applications offer the chance to make rapid breakthroughs in overcoming the current limitations associated with medical supply and demand, with the aim of providing innovative medical services and increasing clinical value to patients. In this way, intelligent medical care may be achieved in China in the near future.

### Limitations of medical AI technologies

It should be noted that many AI technologies are still in the exploration stage, and various limitations must still be resolved. First, the real-world clinical applications of AI are still lack of. The outstanding performance of medical AI in experimental stage with using specific dataset with high-quality cannot represent its real-world performance (48,49). The quality, performance, safety, and reliability of AI systems must be guaranteed by establishing a set of standards and validated with rigorous clinical trials. Second, relevant laws, regulations, ethical guidelines and accountability should be formulated; for example, laws regulating information security and privacy must be established to ensure that patients' medical data are protected (18,50). Third, the widespread use of AI may also result in changing the traditional doctor-patient relationship, which could negatively influence the health care environment. These issues require both updated guidelines and new regulations regarding AI applications. In taking these measures, smarter and more reliable medical AI can be developed in the future.

### Conclusions

The current lack of medical resources in China, especially high-quality resources, has created an urgent need for innovative AI technologies. The most important benefits of medical AI include increased time- and cost-effectiveness, an elevated level of medical care, and a greater distribution of resources (44). Medical AI should be extended to the management of a greater number diseases, and additional efforts are needed to explore the feasibility of broader clinical implementation. The development of smarter and safer AI systems is expected to bring meaningful improvements to the entire Chinese health care system. The widespread application of AI will

improve the level of precision in medical services in China, leading to comprehensive improvement of the quality of human life.

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