



The path of low-carbon development in the healthcare industry under the “Double carbon” target

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Abstract

"Accelerating the green transformation of development" is not only an important content of the 20th National Congress report but also a concrete embodiment of the spirit of the 20th National Congress. The medical and healthcare industry is providing medical services in the carbon emission, and how to innovate the low-carbon development path of the medical industry is an important issue in response to the spirit of the 20th National Congress. To achieve sustainable development in the healthcare industry, we must explore low-carbon development paths. In view of this, this paper analyzes the current situation of the development and carbon emission of the healthcare industry under the goal of "Double carbon", and proposes the development path of medical informatization, standardization of treatment, and low-carbon transformation by combining the theory of "social-technological" system transformation.

Key words: medical and health industry; Low carbonization; Development path; "Double carbon" target

Introduction

In the context of the "Double carbon" strategy, low carbon economy involves all walks of life in social development, the health care industry is an important support industry for social health development, its role is indispensable, but also means that the health care industry is relatively concentrated in people, money and materials, energy consumption is large. Affected by the new coronavirus pneumonia epidemic, energy consumption in the healthcare industry is even greater, and it is more important to follow the concept of sustainable development actively advocated by low-carbon, and actively explore the transformation path in terms of system, management, and technology. In addition, the healthcare industry has a greater responsibility to strictly implement low-carbon development. In China and around the world, the healthcare industry can play a leading role through the implementation of disaster prevention and carbon reduction strategies. The healthcare sector has the ethical, political, and economic influence to achieve specific goals that are consistent with the "dual carbon" goals and health objectives. In this regard, this paper focuses on the development of a low-carbon healthcare industry under the "Double carbon" strategy and analyzes the following aspects: first, it analyzes the background of the "Double carbon" strategy, and analyzes the significance of the low-carbon development of the health care industry. The second is to analyze the current situation of

development and carbon emission in the healthcare industry from the perspective of low carbon development, pointing out that the current development of the healthcare industry has high energy consumption and other characteristics; the third is problem-oriented, combined with the theory of "social-technological" system transformation in the "double carbon" target. Thirdly, we analyze the effective low-carbon development path of the health care industry under the "Double carbon" target by combining the "socio-technical" system transformation theory.

1. Background of the “Double carbon” strategy and the significance of low carbon development in the medical industry

1.1 “Double carbon” strategy proposed background

Human activities since the industrial revolution have emitted large amounts of carbon dioxide into the atmosphere, leading to a significant increase in the concentration of greenhouse gases in the Earth's atmosphere. In particular, developed countries have emitted into the atmosphere the carbon dioxide produced by their massive consumption of fossil energy in the process of industrialization, which has undoubtedly aggravated the global climate change with warming as the main characteristic. Facing the global climate change caused by the cumulative emission of greenhouse gases, all countries

cannot be left alone, and all countries will be adversely affected by climate change, which also means the value of building a community of human destiny. Global climate change is causing serious health problems, and the deterioration of air quality will lead to more than 6 million deaths per year, which is twice as many as AIDS, malaria, and tuberculosis[1]. At the same time, academic research has strongly demonstrated a significant link between air pollution and neurodevelopmental problems in children and neurodegenerative diseases in the elderly over the past decade^[2]. Direct climate impacts, such as the spread of vector-borne diseases, high temperatures, droughts, severe storms and floods, and mass movements of climate-related refugees, pose health security risks that are more profound over time for vulnerable and marginalized populations. Indeed, climate change is harming human health and will have an even greater impact in the future. It is projected that climate change could push more than 100 million people into extreme poverty by 2030, and a large portion of this will be due to health issues brought on by climate change^[3]. In summary, the healthcare industry will take on greater social responsibility in the context of global climate change, which will also increase the burden on healthcare.

The risks posed by climate change are the most serious international crisis facing humanity in the next decade. Even if mitigation actions are taken, long-term global warming will inevitably increase by 1.5-2°C, which will also have a series of impacts on ecosystems, health, and agricultural production. Humanity needs to unite for a self-transformation to build an ecological civilization and a beautiful planet. In September 2020, Chinese President Xi Jinping solemnly declared at the 75th session of the United Nations General Assembly that "China will increase its independent national contribution, adopt more vigorous policies and measures, strive to peak CO₂ emissions by 2030, and strive to reach the peak by 2060. emissions will peak by 2030 and strive to achieve carbon neutrality by 2060". The "Double carbon" target is to achieve carbon peak by 2030 and carbon neutrality by 2060. Carbon peak refers to the peak of total carbon dioxide emissions within a certain period of time and then enters a smooth decline process, that is, the historical inflection point of carbon dioxide emissions in a certain region from increasing to decreasing. Carbon neutrality refers to the balance between greenhouse gas emissions and sinks entering the atmosphere in a certain area, and the achievement of "net zero" carbon emissions.^[4] . China is taking action to achieve this goal and has entered the "Double carbon" era. The "Double carbon" strategy will affect a series of economic and social changes, which will be profound, systematic, and epoch-making.

1.2 The significance of low-carbon development in the healthcare industry

"The realization of the "dual carbon" strategy is not a quick fix, and will certainly go through a "painful period" in the process of achieving this strategic goal. The "dual carbon" strategy will be implemented continuously in all sectors of the economy and society, requiring systematic planning from economic, social, energy, employment, and security

perspectives. As an important part of society, the healthcare industry is a pivotal area in human society, and as an important part of society, the realization of the "dual carbon" strategy requires the participation of the healthcare industry, which is obliged to achieve low carbon development.

(1) Social significance

The medical and healthcare industry plays an important role in the sustainable development of human social health, and the implementation of low-carbon development has important social significance. With the continuous advancement of global industrialization, global climate change caused by greenhouse gases will become more and more serious, and the resulting health problems of people's livelihood will not only seriously affect the stable development of society, but also seriously threaten the living space of human beings. China has provided the international community with Chinese solutions and wisdom to address the global climate change issue and is striving to achieve the "Double carbon" strategic goal based on building a community of human destiny and sustainable development strategy. Climate change is a common challenge for all mankind and requires the joint efforts of many parties. As an important part of society, the healthcare industry is an important participant. The healthcare industry has to take the responsibility of guarding life and health and should be more climate and environmental changes caused by health problems, which means that energy consumption in the healthcare industry has a tendency to increase. The low-carbon development approach is that the healthcare industry takes up the heavy responsibility of coping with climate change and protecting the global climate, exploring low-carbon management to achieve the goal of energy saving and emission reduction. At the same time, low-carbon development is an effective means to solve the problem of expensive medical care for patients by optimizing the allocation of resources and optimizing the process of access to medical care in order to reduce medical costs and bring down the cost of medical care for patients.

(2) Economic significance

One of the connotations of decarbonization in the healthcare industry is to reduce energy consumption and improve energy efficiency, thereby reducing greenhouse gas emissions. From the perspective of economic efficiency, a decarbonized development approach will help improve the operational efficiency of the industry, which is mainly reflected in the improvement of the operational efficiency of hospitals and the medical material supply chain. Specifically, exploring a low-carbon development path for the healthcare industry will result in energy savings and efficient use, leading to lower operating costs, increased hospital operating efficiency, and ultimately sustainable hospital development. Through low-carbon management on one side of the hospital, energy waste is reduced by saving human, material, and financial resources, while the hospital can also optimize its internal management, thus achieving overall hospital operational efficiency. This not only can promote the hospital to achieve low-cost and high-efficiency development, internal optimization of management and operation system, optimization of patient access process,

tracking the carbon footprint, and other methods are also conducive to patients to reduce the economic cost of medical pressure. In this way, because the country strongly advocates the development of a low-carbon economy and the realization of the “Double carbon” goal in all aspects, the implementation of low-carbon development in hospitals can obtain preferential policies and also win a good social image for the hospital, which will enhance the influence of the hospital and improve the competitiveness of the hospital. The low-carbon development of pharmaceutical enterprises, such as medical resource providers, will help them transform their sustainable development. In the production process, the requirements of low-carbon transformation will force enterprises to innovate technology, optimize production processes and update production standards. Green medical products are more conducive to the market influence and competitiveness of pharmaceutical enterprises, and in the long run, the low-carbon transformation can only adapt to the changes in the market.

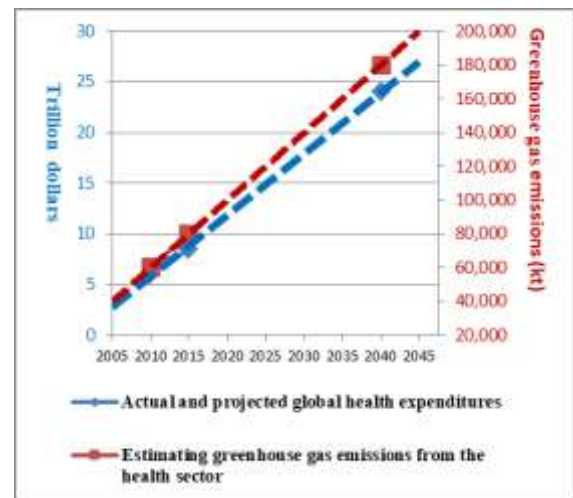
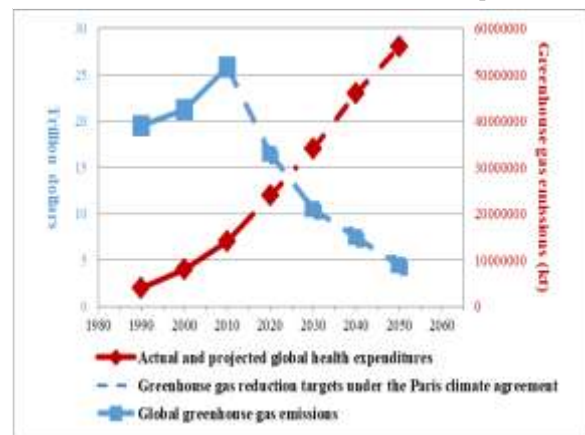
(3) Academic significance

The realization of the “Double carbon” strategic goal requires extensive attention from the academic community and more academic results to support it. Although the academic research related to the “Double carbon” goal has been a hot topic in recent years, there is little research related to the development path of low carbon in the healthcare industry. The lack of awareness of low carbon in the healthcare industry is one of the reasons for the lack of research in this area. Combining low-carbon concepts with health care can give new scientific content and provide a new perspective for achieving the “Double carbon” goal.

2. The development of the healthcare industry and the status of carbon emissions

There are significant differences in the scale of the healthcare sector between countries, and the provision of healthcare services often comes at the cost of carbon emissions due to the release of greenhouse gases. The fact that the healthcare sector procures medical materials from energy-intensive supply chains cannot be ignored as the healthcare sector contributes to carbon emissions through energy consumption, production and transportation of medical materials, and use and disposal of medical waste. According to a rough figure published by the World Bank, in 2011, the health sector generated 2.6 billion tons of carbon emissions, compared to 52 billion tons of global carbon emissions for the year, making the health sector's carbon emissions 5% of global emissions in that year^[1]. Currently, there are only a few countries in the world that have conducted healthcare carbon footprint traces. Specifically, the U.S. healthcare sector's carbon emissions have reached a staggering 655 million tons (9.8% of the nation's total carbon emissions), which means that the carbon emissions of just one sector are already greater than the carbon emissions of the entire U.K.^[1]. In contrast, the UK health sector's carbon footprint in 2015 was 26.6 million tonnes of carbon dioxide equivalent, which, although

low, is 39% of the public sector's carbon emissions^[5]. Why is there a need to focus on decarbonizing the healthcare sector? The reason is that the growth of the healthcare sector has led to a doubling of the healthcare carbon footprint. Global health spending is growing at a rate of 3.8% per year and is projected to increase from just \$9.2 trillion in 2014 to \$24.2 trillion in 2040^[6]. It is clear that if the growth of the health sector is not integrated with carbon reduction concepts and carbon reduction actions are neglected, the carbon footprint of health will double by mid-century, as shown in Figure 1. In addition, if the health sector aligns health growth, development, and investment with global climate-carbon reduction goals, a portion of the world economy that health contributes can be redirected to carbon reduction and environmental protection.



Source: HCWH

Figure 1 Illustration of the urgency of carbon reduction in the healthcare sector

China's healthcare sector also has a large carbon footprint, with emissions of about 361 million tons, about the total emissions of France^[1]. This is due to the rapid development and expansion of China's healthcare industry on the one hand, and the large population in China on the other hand, which results in a large load of healthcare services. The current characteristics of China's healthcare industry in the context of the “Double carbon” target are reflected in the following aspects:

2.1 High energy consumption characteristics

The healthcare industry will take up a lot of social resources, as hospitals, for example, with the continuous expansion of secondary and tertiary hospitals, coupled with the increase in China's aging population, the demand for medical services increased at the same time, the carbon consumption is also increasing. To support the operation of a hospital with 500-800 beds, the annual consumption of energy (water, electricity, oil, gas) costs up to 6-10 million yuan, of which the total capacity of electricity more than 5000kW, energy costs account for 3%-5% of the hospital's total revenue, high energy consumption characteristics are obvious. Subject to industry health standards, medical gloves packaging is too tight resulting in 6% of the gloves in the open scattered on the floor, resulting in pollution, can not be used, resulting in unnecessary waste^[7]. Therefore, both hospitals and medical supplies suppliers must abandon the traditional economic growth model, the pursuit of technological innovation, vigorously carry out new technologies, new projects, innovative production of new standards, to take the low-carbon development of the road.

2.2 Lack of funding affects low-carbon development

Affected by the new crown pneumonia epidemic, the hospital bears the heavier task of operating funds to provide safe and effective medical services, but also to assume a certain degree of social responsibility, it is difficult to support the realization of low-carbon transformation. For example, in the renovation of old buildings, if the rate of 120 yuan per square meter, a building area of 50,000 square meters of secondary hospitals, about 6 million yuan of renovation costs; or the renovation of outdoor public lighting facilities, converted to solar energy saving, etc., but the cost of a solar street lamp is about 7,500 yuan, the price is higher. Hospital funds are also limited, which will reduce the hospital's enthusiasm for low-carbon retrofit. In fact, every hospital has space to achieve low-carbon transformation. In the case of the General Hospital of the Chinese People's Liberation Army, for example, the hospital added 45 power-saving devices in the renovation of the plumbing and heating project, which was later tested to save about 2.4 million kWh of electricity per year and 1.44 million yuan in electricity costs^[8].

2.3 Imbalance and inefficient use of medical resources

Despite the growth of health resources in recent years, there is a large imbalance between urban and rural areas, which is directly related to the use of health services (equity, accessibility) and thus to regional health disparities. On the other hand, the implementation of the "two-way referral" model in hospitals is not as effective as it could be, as there is no standard among healthcare providers, resulting in a lack of mutual recognition of medical diagnoses between providers. The root cause of the problem is the lack of scientific design of regional health planning, which makes the use of medical services inefficient and contrary to the purpose of achieving energy saving and emission reduction. In the process of medical development, regional health planning faces new problems and requirements such as resource sharing, emergency cooperation, and multi-point practice.

2.4 Inefficient and uncoordinated operation within the medical service system

Many large urban hospitals are overcrowded, but at the grassroots level, township health centers are cold and empty. The large amount of money in the medical field is mainly spent on large medical institutions, while the internal operation of medical institutions is inefficient, resulting in a huge waste of resources. The waste in this process is mainly manifested at two levels: first, the medical resources of medical institutions are idle leading to the waste of medical resources; second, some medical institutions are equipped with too many resources for medical services, leading to the waste of medical services. The current health service system, mainly disease prevention and control, hospitals, community service centers, township health centers, etc., under the existing system, due to the compartmentalized administration, which divides each department or unit into multiple departments, the health plan of each region is not implemented, and the collaboration mechanism of each organization is not sound, resulting in the low efficiency of the system operation, for example, the two-way referral mechanism in China is not sound, and the residents' On the other hand, it is difficult to maximize health output because each organization aims at maximizing the output of each organization instead of the overall goal of maximizing health output, which leads to phenomena such as induced demand and forms a needless consumption of social health This leads to phenomena such as induced demand and unnecessary consumption of social health resources. The waste and consumption of health care resources are contrary to the goal of "Double carbon".

3. The healthcare industry low carbon development transformation path

With the advent of the "dual carbon" era, the healthcare industry should innovate low-carbon development paths and build health service systems, management, and operational mechanisms that meet the requirements of a low-carbon economy. The "socio-technical" system transformation theory outlines the evolutionary elements and interactions among the macro-environmental, meso-institutional, and micro-beneficial levels in the transformation process of various systems.^[9]. In this paper, we choose the "socio-technical" system transformation theory combined with problem orientation to analyze the transformation paths, see Figure 2.

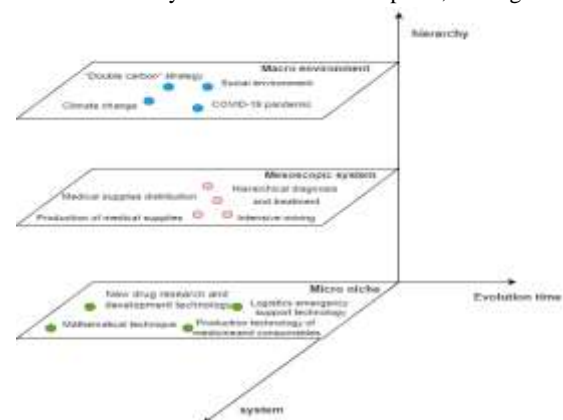


Figure 2 Low carbon transformation path based on choice

3.1 Medical informatization

At present, China is actively developing community health care, which is difficult to create and develop. If information systems can be incorporated into social health care and its resources can be effectively integrated, it will greatly improve the overall efficiency of work and reduce carbon emissions in the primary health care industry. In addition, the establishment of information systems such as "paperless office" and the implementation of "clinical pathways" can significantly reduce consumables and energy consumption, and achieve the goal of "green hospital", as well as it is also possible to achieve standardization of medical services. Specifically, the implementation of clinical pathways requires the embedding of electronic medical record systems and hospital prescription systems. If a physician does not diagnose according to the "clinical path", the electronic medical record system based on the clinical path will strictly control the physician's unreasonable diagnosis and treatment behavior. Through the information management of the clinical pathway, the diagnosis and treatment work of the hospital can be standardized, so that the treatment level of physicians can be improved, and the hospitalization time of patients can be significantly shortened, medical costs can be reduced, the disease burden of patients can be reduced, and the carbon emission can be largely reduced.

Due to the vast geographical area of China, the natural conditions and the degree of socio-economic development vary greatly, there is a serious imbalance in the distribution of medical resources. Some of the poor rural health resources are seriously insufficient so that patients cannot get quality health care services in time. Telemedicine is the use of modern electronic technology to build an "electronic hospital" on the Internet, which realizes cross-regional and cross-temporal medical services and can, to a certain extent, solve the difficulties of patients in poor areas to seek medical treatment, shorten the "threshold" of medical treatment and shorten the quality of medical treatment. The problems such as the gap in medical quality can be solved to a certain extent. Through the implementation of telemedicine, medical costs can be reduced, the efficiency of medical facilities can be increased, the medical burden on the state and patients can be reduced, and the carbon emissions generated in the process of medical treatment can be effectively reduced, which effectively supports the low-carbon development of the medical and health industry.

3.2 Diagnosis and treatment standardization

Standardization of diagnosis and treatment can effectively improve the efficiency of medical resources utilization and support the development of decarbonization. With the development of healthcare and medical technology, various advanced diagnostic and treatment equipment has been introduced into various hospitals, bringing convenience to physicians' diagnosis and treatment while greatly increasing the cost of patient care. How can we make medical equipment meet clinical needs without putting heavy financial pressure on patients due to excessive diagnosis and treatment? First, to

ensure that every diagnosis and treatment should be accurate, especially through certain costly equipment in the diagnosis and treatment need to be more cautious; second, hospitals above the second level should implement a mutual recognition system within the validity of the examination report to prevent duplication of examination; third, all medical institutions in the region shall not duplicate the purchase of large medical devices; fourth, in the purchase and sale of medical equipment to firmly eliminate improper transactions, to avoid the purchase of medical equipment due to Fifth, reduce the price of large instrument examination or implement free examination, etc. Sixth, optimize the process of patient access to medical treatment to avoid unnecessary carbon emissions in the process of access to medical treatment, which can also hinder the full utilization of medical resources. Accurate diagnosis and treatment results in the process of medical treatment can lead to a significant reduction in the cost of medical treatment in China, and the economic pressure on patients will be reduced.

In the treatment work, doctors must achieve the standard operation. Reduce or eliminate negligence in the process of diagnosis and treatment, and resolutely prevent unnecessary harm to patients. The treatment process is reasonably arranged to minimize the use of disposable medical materials and to avoid the waste of medical resources due to improper operation in the process of use. In the selection of treatment plans, the right to information and choice of patients and families should be fully considered, while scientific and effective treatment plans should be recommended for patients to ensure the achievement of treatment results. By using minimally invasive or non-invasive surgical techniques to reduce surgical trauma, it is beneficial to reduce drug use and shorten postoperative recovery time and hospital stay. It not only reduces the harm caused by surgery to patients, but also improves their quality of life, and facilitates the reduction of carbon emissions during the treatment process.

3.3 Low carbon throughout

Pharmaceutical supplier companies should implement low carbon requirements in all aspects of production, R&D, distribution, and sales. For the procurement of medical supplies, a carbon footprint can be added as one of the criteria to force the supply chain to achieve low-carbon development transformation, and the innovation of R&D technology and pharmaceutical products will enhance their market competitiveness; in the distribution chain, a distribution coordination center will be set up in a certain area to coordinate distribution vehicles, routes, and orders, which can reduce carbon emissions while reducing the distribution costs of suppliers. On the construction of hospital logistics support, in order to strengthen hospital catering management, monthly electronic reports on catering management are established from raw material procurement, warehouse management, ordering and delivery, and checkout, and relevant statistics are automatically generated at the end of the month, an evaluation system is established, and a feedback response mechanism is set up. We standardize the catering process with information technology; improve the connotation of logistics guarantee by

using technology; and optimize the logistics management system by giving full play to its advantages.

In addition, all staff in the health care industry should develop a sense of energy conservation and reduce the waste of various resources such as water and electricity. Pay attention to emission reduction and reduce the solid, gas, and liquid emissions from buildings to pollute the environment. Strengthen sewage treatment and medical waste treatment to avoid secondary pollution. Strengthen the management of the hospital environment so that patients can enjoy a healthy, comfortable, and efficient space in the environment they use. Establish the hospital "humanistic care" complex functions, which are very different from ordinary public buildings. As far as energy supply is concerned, the normal use of medical equipment and resources directly affects the survival of patients and therefore has a high degree of security and high-quality demand for energy supply. With the large-scale hospital construction projects in recent years, more and more medical institutions are pursuing high standards, large scale, and high level, leading to an increase in building energy consumption. Hospital energy saving can be done from five points of view: architecture, suction and ventilation, water supply, and drainage, power, and electricity, throughout the whole process from overall layout, architectural design to daily operation, constantly emphasizing the improvement of details, and transforming energy saving awareness into an organizational culture through refined management We will continue to emphasize detailed improvements and transform energy conservation awareness into part of the organizational culture through refined management.

4. Conclusion

The provision of healthcare services is accompanied by carbon emissions, and the realization of the "Double carbon" goal requires the healthcare industry to fully understand the concept of low-carbon development and continuously explore innovative low-carbon development paths. Based on the "social-technological" system transformation theory and problem-oriented, this paper analyzes the current situation of healthcare industry development and carbon emission, designs the low-carbon transformation path from three levels: macro environment, mesosystem, and micro-niche, and proposes the development paths of medical informatization, standardization of treatment and low-carbon whole process to drive the low-carbon development transformation of healthcare industry. The transformation of low-carbon development in the healthcare industry is driven. Of course, low-carbon development is a consciousness, so that patients can feel the hospital "care", "love" and "sincerity" at all times. The hospital's "care", "love" and "sincerity" are always felt by patients. To make medical institutions run efficiently with fine management. Hospitals are public buildings with special structures and big project that requires long-term persistence and continuous efforts of the healthcare industry to actively learn about low-carbon operation and management, continuously improve the low-carbon path, and contribute to the sustainable development of society while promoting the good development of the industry itself.

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