

Analysis of the Strategic Management of the Chinese Government in the R&D and Use of COVID-19 Vaccines

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Abstract: After the outbreak of COVID-19, the Chinese government quickly decided to develop vaccines. In terms of vaccine research and development, China has carried out strategic planning and management, including route selection, scientific research resource organization and mobilization, diversified research and development, and team research, and has introduced international cooperation to achieve results in the development of multiple vaccine varieties. China has accelerated construction and management optimization in the vaccine production industry chain, and formed a huge production capacity. With various technical means, the Chinese government helps promote universal vaccination, and rapidly completes the construction of an immune barrier. The Chinese government's "going out" strategy for international cooperation in vaccines has played a role in the global fight against COVID-19.

Keywords: vaccine, virus, immunization, strategy

1. Introduction

Since 2020, COVID-19 has become a global epidemic, the World Health Organization has declared the disease a global health concern, and the Chinese government has classified it as a notifiable infectious disease. Countries have developed drugs and vaccines to fight against COVID-19. In contrast, the development of vaccines is faster and brings people a stronger sense of security. After the outbreak of COVID-19 in China, the Chinese government has centralized various resources to accelerate the research and production of COVID-19 vaccines. So far, multiple vaccine varieties have been developed. The Chinese government supervises the production of vaccines and has spent huge sums of money to vaccinate more than a billion people for free, as well as booster shots to those in need. Vaccines produced in China are also exported to many countries across the world, providing a good example for the world in preventing and controlling COVID-19. This reflects the power of the major strategy formulated by the Party Central Committee with Comrade Xi Jinping at the core to fight COVID-19 and protect people's life safety and health in response to the call of the times. Based on this, this paper mainly discusses China's specific strategic thinking, implementation principles and action strategies for COVID-19 vaccine in terms of research and development, production, and application, to completely defeat COVID-19 and provide a reference for future emergency responses.

2. Analysis of the value and role of strategic management

Strategy originally refers to military commanders' science and art of using strategic means to achieve military goals in wars, which involves goals, policies, plans, actions, decisions, and allocations.^[1] That is, strategy is a kind of thinking that solves the problems that exist now and in the future. After the birth of management science, the idea and value of strategy have been valued. Management guru Drucker once said, "Strategy is not the study of what to do in the future, but the study of what we do today to have the future."^[2] Correspondingly, management science believes that strategic management is a series of management decisions and actions for an organization to formulate and implement strategies, an overall management of the activities and development of an organization, and the most important and highest-level management activity in an organization, which pursues the overall effect of the organization.^[3] It achieves continuous improvement through preparation, analysis,

planning, implementation, monitoring and evaluation. The fight against COVID-19 is like a war, and the governments and their leaders are like the commanders on the battlefield, who need to identify the surrounding environment, judge threats and opportunities, establish strategic visions and goals, allocate resources, and diagnose the crux in the implementation of strategies, to achieve good results.^[4]

3. Chinese government's strategic management in the development of COVID-19 vaccines

3.1 Key research strategies in the selection of vaccine varieties

When COVID-19 began to appear, some scientists at home and abroad confirmed that it was a new kind of virus that human beings had never encountered before, which belonged to the same coronavirus as the SARS virus that had been epidemic in the past, and was very destructive to human health. Experts had different opinions on how to control this virus. Some experts considered drugs more effective, while others believed that vaccine development should be prioritized.^[5] Chinese government has adopted the strategy of carry out drug R&D and vaccine R&D synchronously, and seeking from existing biotechnologies to speed up new drugs and vaccines R&D. China once organized some scientific researchers to conduct virological and pharmaceutical research after the SARS broke out in 2003, so the Chinese government decided to convene these scientific research institutions and scientists to conduct vaccine research based on their experience. The Chinese government believed that it's feasible to carry out the research and development of inactivated vaccines for the COVID-19, since China had accumulated rich experience and complete technologies in developing inactivated vaccines in recent years, which could ensure a high success rate for development. In addition, the development of inactivated vaccines took a short period of time, and the required viral pathogens and strains were accessible in China. The earlier the vaccine was developed, the faster the virus spread could be reduced. However, there were also some different opinions on the technical route of vaccine R&D. In some developed countries, scientists believed that inactivated vaccine is generally an old technology, while developing a new genetic technology vaccine, mRNA vaccine, and transforming the human immune system with the vaccine will, will provide stronger resistance to COVID-19 and be more attractive. In China, there were also scientists working on mRNA vaccine technology. In the end, the Chinese government decided to focus resources on the R&D of inactivated vaccines first after weighing the scientists' recommendations and China's vaccine R&D capabilities, and it also encourages scientists to develop other kinds of vaccines, with a mode of approving and vaccinating any mature ones, to develop a vaccine as soon as possible and solve the problem that people were not immune to COVID-19. This strategic decision was successfully implemented later. First of all, Chinese scientific research institutions and infectious disease hospitals cooperated to extract specimens from patients infected with the COVID-19 and cultured them in the laboratory, and became the first to isolate the original strain of the virus in the world in a very short period of time, and then purified and attenuated the strains to complete the culture in the laboratory, the whole process of which took less than 2 months. Then, Chinese scientific research institutions and pharmaceutical companies cooperate to study on transforming laboratory research results into products to solve technical problems such as how to increase the production of vaccine stock solutions and how to ensure the purity of vaccine stock solutions. Two Chinese companies, Sinovac and Sinopharm, have successfully trial-produced China's first batch of inactivated COVID-19 vaccines based on their own technical characteristics.

3.2 Multi-blooming vaccine development strategy

Due to the rapid development of biotechnology, the global science community has different views on the types and roles of COVID-19 vaccines, and has adopted different R&D strategies. Multinational pharmaceutical giants Pfizer, Moderna, and AstraZeneca have also launched vaccines, dominated by mRNA vaccine. Chinese pharmaceutical companies have no ready-made experience in the development of such vaccines, but they have a certain technical foundation and talent pool. The Chinese government also encourages scientific research institutions to conduct diversified vaccine development and provides scientific research funds. After technical research, China's Walvax Biotechnology and Taikang Biology combined independent research and international cooperation to solve the key technologies in the research and development, adjusted the R&D of the protein editing position of the virus according to their own technical expertise, and developed mRNA vaccines and put into clinical trials. Meanwhile, Chinese scientists have also made use of some new scientific research advances to design different types of vaccines, including the recombinant protein vaccines by Zhifei Biological Products, the adenovirus vector vaccines and nasal inhalation vaccines by CanSino

Biologics, which are characterized by convenient use, few injections and strong safety, and can be a useful supplement to traditional vaccines. Such diversified vaccine development allows medical institutions and the public to have more choices; meanwhile, separate R&D can also reduce risks and avoid wasting time. At present, China's vaccine R&D has made progress to varying degrees: some vaccines have been approved and put into use safely, and some vaccines are in the clinical trial or approval stage with prospects. This also proves that the Chinese government's route management in vaccine R&D and the research organization strategy have worked.^[6]

3.3 Mutually beneficial multi-national cooperation R&D strategy

While actively developing its own vaccines, China also maintains active cooperation with institutions such as the World Health Organization and other countries. The Chinese Center for Disease Control and Prevention uploads and shares information such as the virus genome sequence in real time to help scientists around the world conduct research. Our country has also carried out extensive international cooperation in clinical trial, an inevitable step in vaccine R&D. Chinese pharmaceutical companies have successively cooperated with Turkey, Brazil, Indonesia, Chile, the United Arab Emirates, Pakistan, Mexico and other countries to recruit local volunteers for vaccine clinical trials. This kind of cooperation not only aims to verify the safety and efficacy of vaccines, but also to resolve the requirements of medical clinical trials for a wide range of subjects and coverage of different groups, as well as to demonstrate the rigorous working methods, excellent quality of test data and credible vaccine effects of our country's vaccine R&D institutions, which enhances the trust in China's vaccine production, and lays a good foundation for the World Health Organization and some countries to approve the official launch of our country's vaccines.

3.4 The coordinated researching strategy of national mobilization

Vaccine development is a huge and complex biological system engineering. The difficulty of the development of COVID-19 vaccines lies in the lack of ready-made experience, which needs to race against time. From the R&D of the above-mentioned vaccines, we can not only feel the scientific spirit of Chinese scientific and technical workers who are not afraid of difficulties and have the courage to tackle key problems, but also appreciate the role played by China's increasingly mature scientific research and innovation system. For a long time, our country has been a big producer of vaccines, but it's not a power producer of vaccines in the true sense. In the R&D of COVID-19 vaccines, our country has shown a high level of planning, coordination and organization in terms of the selection of R&D routes, the organization of scientific research forces to focus on key problems, and the rapid transformation from medical laboratories to production lines. Disease control departments, clinical hospitals, scientific research institutes, and enterprises have changed the practice of fighting alone, put aside local interests, and launched a vaccine "battle". In February 2020, the Scientific Research Team of the Joint Prevention and Control Mechanism of the State Council established a special class for vaccine R&D, and the Ministry of Science and Technology established a special fund for vaccine research at the beginning of the epidemic to support the R&D work. The virus databases established by the disease control departments provide information support for vaccine development. Research teams across the country keep tracking and reporting the mutation of the virus to provide scientific and technological support for vaccine development. Pharmaceutical companies and scientific researchers work closely together to transform theoretical results into real products as soon as possible.^[7] It can also be seen that in recent years, the researching strategy for major scientific and technological problems and bottleneck products has also benefited the vaccine industry.^[8]

4. Strategic analysis of our country's COVID-19 vaccine application

4.1 Strict and efficient vaccine approval strategy

As a biological product, vaccine as a certain degree of unknown risk while exerting an immune function, particularly the COVID-19 vaccine has just come out for a short time, and there is no precedent for its use in the world. Therefore, our country has adopted a very strict attitude on when the vaccine is put into use and which groups are used. The Chinese government has put forward strict approval requirements for the official use of vaccines, and required ensuring efficiency at the same time. As for the strict approval strategy, according to the provisions of the Medicinal Product Administration Law, the Measures for the Administration of Drug Registration, and the Vaccine Administration Law,

the State Food and Drug Administration of China requires companies applying for vaccine marketing to conduct complete Phase I and Phase II trials of vaccine products to collect a large number of data, and requires carrying out a certain scale of clinical human trials for the vaccines at home and abroad, to collect a large amount of evidence on the safety and preventive effect of the vaccine. These trial data are required to be open and transparent, and published in international academic journals for the scientific community to study and discuss. As for the high efficiency strategy, after receiving the vaccine marketing application from pharmaceutical companies, the State Food and Drug Administration immediately starts the approval process, reviews various data, organizes expert review and demonstration, and conducts on-site review. According to the requirements of relevant regulations, after completing the approval process, a decision on conditional launching or emergency use approval is made for the domestically developed COVID-19 vaccines, which is a safe approach. On the one hand, during the use of the vaccines, relevant responsible units are required to closely collect the data information and adverse reactions of clinical use of vaccines and submit them to the drug registration review agency for final review. On the other hand, it can be adjusted in time according to the different situations of different types and different production batches of vaccines during the vaccination process of different groups to minimize medical side effects.

4.2 Precise and convenient vaccination strategy

After preparations for vaccine R&D, finalization, approval, and large-scale production, by the end of 2020, China gradually had the conditions to vaccinate its citizens against the COVID-19. The Chinese government made a major decision after extensive understanding of the people's conditions and consultation with experts, to vaccinate the people of the whole country with vaccines produced at home as soon as possible. Moreover, to reduce the economic burden of the public and increase the vaccination rate, vaccination was free of charge. With a large population and a vast territory, deciding on this strategy required great determination and rigorous economic arguments. To ensure the realization of this goal, the Chinese government adopted various dispatching, monitoring and encouraging measures. In terms of vaccination schedule, the relevant state departments of the country carried out careful deployments based on safety and priority, forming a strategic arrangement to advance in stages with urgent before less urgent, key groups before all the people, routine vaccination before orderly strengthening to ensure long-term effects, with comprehensive organization, and efficient and precise strategy arrangements. For each type of population, a vaccination plan is formulated based on the results of drug clinical trials, with full reference to professional opinions and different practices of vaccination at home and abroad. It has been demonstrated many times whether patients with chronic diseases, allergic symptoms and surgical patients can be vaccinated to ensure that the side effects are minimized. Meanwhile, some emergency plans and health observation tips are formulated at the vaccination site and before and after vaccination. For example, it is not advisable to drink alcohol before and after vaccination, and the vaccinated people shall be observed for 30 minutes after vaccination. A very rigorous attitude was taken to the vaccination for the elderly and children, taking into account factors such as the age of vaccination, the dose of vaccination, and adverse reactions. In addition, China has also launched the "Spring Seedlings Program" in some countries, to give priority to vaccination for Chinese citizens engaged in business and educational activities overseas, which reflects the strong national strength of the motherland and the concern of the Chinese government for overseas compatriots.

The precise strategy is also reflected in the extension of the protective effect of the vaccine.^[9] According to the physical monitoring of COVID-19 vaccine recipients in some countries, after vaccination, some people's antibody level declined, and the protective effect of the vaccine weakened. As the spread and mutation of the COVID-19 had not yet ended, the Chinese government, after scientific verification, decided to provide additional protection to the people who had been vaccinated with two inactivated vaccines in two ways: one was the booster shot of the inactivated vaccine six months after the completion of vaccination, and the other was to inoculate the inactivated vaccine first, followed by other types of vaccines in sequence to strengthen immunity. These measures were promoted across China, making the vaccine protection even stronger.

The convenient strategy is reflected in the speed and breadth of vaccination coverage in our country.^[10] From 2021, our country started to set up vaccination sites in various regions across the country, and firmly relied on hospitals, disease control centers, community health service stations and other health facilities, as well as various types of government agencies, enterprises, institutions, communities, and public cultural and sports facilities, to carry out all-weather, full-coverage vaccinations, with weekly vaccinations reaching more than 10 million. In the publicity and mobilization of vaccination, our

country actively popularized scientific knowledge and demonstrated the safety and reliability of vaccines with facts and data to dispel the concerns of some people. Vivid and rich publicity was also adopted in various places, such as arranging songs, slogans, text messages, We Chat push and other methods, to attract the public to get vaccinated. In the dynamic monitoring of vaccination, governments at all levels used big data resources to combine centralized databases and decentralized mobile data application terminals to monitor the progress of vaccination, find groups of people that may be missed, and dynamically present the vaccination process through the health code and other methods.

4.3 Actively “going out” strategy for vaccines to go overseas

To let domestic vaccines go international, our country has effectively promoted vaccines to be recognized globally according to the relevant vaccine promotion plans launched by the World Health Organization. At the end of 2020, two inactivated vaccines for the COVID-19 produced in our country applied to the World Health Organization for evaluation, and immediately, the WHO expert team inspected the production facilities of Sinopharm and Sinovac. In May 2021, the COVID-19 inactivated vaccine produced by Sinopharm China Bio-Beijing was officially included in the “emergency use list” by the World Health Organization, and was promoted globally according to temporary use recommendations. In June 2021, the inactivated vaccine of Sinovac was approved for use by the WHO, and in May 2022, the COVID-19 adenovirus vector vaccine “Convidecia” produced by CanSino was also included in the emergency use list.

As a responsible country, our country has actively participated in international public health cooperation and provided assistance within its capacity to other countries in their fight against the COVID-19. At present, there are very few countries in the world that can develop and produce vaccines, and most countries and regions can only meet the needs of their citizens by purchasing vaccines. If the vaccines are expensive, many low- and middle-income countries may not afford them. Chinese government leaders announced on diplomatic occasions that vaccines should be used as global public health products, and people in all countries can fully enjoy the health protection brought about by vaccination. To this end, on the one hand, the Chinese government provides much-needed vaccines to more than 100 countries and international organizations in the form of gifts and affordable sales; on the other hand, the Chinese government carries out technology transfer and production cooperation with countries such as Egypt and the United Arab Emirates, where Chinese companies provide vaccine stock solution, fill and pack in local places, and then inoculate in local places.

5. Outlook

In the more than two years since the outbreak of the COVID-19, under the strong leadership of the party and the government, our country has explored different strategies of focusing on fighting the epidemic, accurately preventing and controlling the epidemic, and normalizing the epidemic prevention and control. In this process, vaccines have become important weapons for epidemic prevention and control, and strong guarantees for the implementation of various major policies. China is the only country in the world to develop and produce safe and effective vaccines in a short period of time, and complete more than 3 billion vaccinations for more than one billion people. This feat itself fully demonstrates our country’s strategic insight, strategic analysis ability, strategic decision-making ability, and strategic planning ability in the management of major public affairs. At the same time, the Chinese government has provided many countries with more than 2 billion vaccines through donations, cooperative production, etc., at the global leading stage. In the face of complex and ever-changing internal and external challenges, it is extremely important to carry out a holistic, sustainable and future-oriented strategic management. Regarding the strategic planning of the COVID-19 vaccines, our country has not stopped, and is now promoting the follow-up related research of the COVID-19 vaccines that have been marketed in an orderly way, especially the research on the impact of the mutant strain of Omicron virus on the effect of the vaccine. Meanwhile, some pharmaceutical companies are also conducting clinical trials of improved vaccines against mutant strains, making efforts to develop longer-acting vaccines. With the previous work foundation, we are now in a position to make the strategic planning and implementation, strategic adjustment and control of the COVID-19 vaccine R&D more formalized and systematic, providing fresh cases for other public crisis management and even state governance activities.

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