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The Emergency Management Capabilities of Emerging Infectious Diseases: A Case Study in China

ZHAN Jianxiang

Doctor of Management

Supervisor:
PhD Alexandra Fernandes, Associate Professor,
ISCTE University Institute of Lisbon

May, 2023

BUSINESS SCHOOL

Marketing, Operations and General Management Department

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Abstract

Purpose – This essay aims to explore the effective pathway to achieve the emergency response. The essay includes 2 case studies: severe acute respiratory syndrome (SARS) epidemic in 2003 and coronavirus disease 2019 (COVID-19) epidemic in 2019 in China. We developed a 3 constructs framework including human resources of CDCs (Centers for Disease Control and Prevention), emergency management capabilities and achievement of emerging infectious diseases prevention and control for SARS in Guangdong Province. Then we evaluated how Guangdong Provincial government learned from SARS, and explored situational variables with Chinese characteristics during COVID-19 epidemic.

Design/methodology/approach – Systematic review, expert interview, case study, comparison study.

Findings – Emergency management ability set up institutional system after SARS. During COVID-19 epidemic, CDCs human resources affected achievement of emerging infectious diseases by mediating effect of emergency management capability positively. Both anti-epidemic motivation and public response are the mediating role of emergency management ability between human resources and epidemic control performance.

Practical implication – Abundant CDCs human resources and strong emergency management ability are key factors to prevent and control emerging infectious diseases. The government's motivation and determination of saving lives combined with the positive participation of the public would contribute to the significant achievement.

Originality/ value – The summarization of Emerging Infectious Diseases prevention and control in Chinese experience could provide a model framework and lessons for emerging response even worldwide for the future.

Keywords: Emergency management capability; Human resources of CDCs; Emerging Infectious Diseases; Control achievement; COVID-19

JEL: H83, M12, I18

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Resumo

Objetivo – Este ensaio tem como objetivo explorar o caminho eficaz para alcançar a resposta de emergência. O ensaio inclui 2 estudos de caso: epidemia grave da síndrome respiratória aguda (SARS) em 2003 e epidemia da doença de coronavírus 2019 (COVID-19) em 2019 na China. Para o controle epidêmico de SARS na província de Guangdong, desenvolvemos uma estrutura de 3 construtos incluindo recursos humanos de CDCs (Centros de Controle e Prevenção de Doenças), capacidades de gerenciamento de emergência e realização de prevenção e controle de doenças infecciosas emergentes. Para a epidemia de COVID-19, avaliamos como o governo provincial de Guangdong aprendeu com SARS e exploramos variáveis situacionais com características chinesas.

Desenho/metodologia/abordagem – Revisão sistemática, entrevista de especialistas, estudo de caso, estudo comparativo.

Resultados – As capacidades de gestão de emergências foram estabelecidas no sistema institucional após a pandemia SARS. Durante a pandemia da COVID-19, os recursos humanos dos CDCs afetaram a realização de doenças infecciosas emergentes, mediando o efeito da capacidade de gestão de emergências. Quanto mais forte a motivação da prevenção e controle, mais recursos humanos dos CDCs poderiam afetar a capacidade de gerenciamento de emergências. Por fim, tanto a motivação antiepidêmica quanto a resposta pública regulam o papel mediador da capacidade de gestão de emergências entre os recursos humanos dos CDCs e o desempenho no controle epidêmico.

Implicação prática – Existem dois fatores-chave para prevenir e controlar cientificamente doenças infecciosas emergentes: recursos humanos abundantes de CDCs (incluindo quantidade e estrutura de talentos) e forte capacidade de gerenciamento de emergências. A motivação e determinação do governo em salvar vidas aliadas à participação positiva do público contribuiriam para a realização significativa e excelente da prevenção e controle.

Originalidade/valor – A síntese da experiência de prevenção e controle de doenças infecciosas emergentes em chinês, poderia fornecer um quadro modelo e lições para a resposta de doenças infecciosas emergentes para a China e até mesmo para o outro país ou região que sofrem com a epidemia emergente de doenças infecciosas no futuro.

Palavras-chave: Capacidade de gestão de emergências; Recursos humanos dos CDC; Doenças infecciosas emergentes; Realização do controlo; COVID-19
JEL: H83, M12, I18

摘 要

目的：本论文旨在探讨达成传染病防控成效的有效路径是什么？这其中有哪些中介变量和情境变量？本论文基于两个案例研究展开。第一个案例是2003年的SARS疫情，基于SARS在中国广东省的起始、控制过程，探索三个变量之间的关系，即广东省疾控中心的人力资源、流行病控制成效、应急管理能力三者之间的关系。第二个案例是2019年年底开始全球流行的COVID-19病毒，广东省是如何复制SARS疫情期间构建的应急管理体系，并发掘中国特色的情境因素。

设计/研究方法：系统综述、专家访谈、双案例研究方法、类比方法等。

发现：有四个主要发现：第一，中国应急管理能力是在SARS期间探索培养的能力，并形成了制度体系。第二，在COVID-19流行期间，广东省疾控中心的人力资源通过应急管理能力中介效应的发挥，显著正向影响了流行病控制成效。第三，在疾控中心人力资源与应急管理能力之间，抗疫动机(即生命至上)起着调节作用，即抗疫动机越强，疾控中心人力资源越是显著影响应急管理能力；在应急管理能力与流行病控制成效之间，中国老百姓的响应水平起着调节作用，即中国老百姓越是响应政府的对策，应急管理能力越是显著影响流行病控制成效。第四，中国政府的抗疫动机和老百姓的响应水平都对疾控人力资源对疫情防控绩效的作用起调节效应，同时也调节应急管理能力在两者间的中介作用。

实践启发：在突发急性传染病防控过程中，必须进行科学防疫，首先要有强大的疾控中心人力资源(包括人才数量和人才结构)，其次需要有强大的应急管理能力，疾控中心人力资源通过应急管理能力才能有效控制传染病的暴发或流行，第三需要有政府保护生命的决心和动机，配合民众的响应水平，这样，传染病防控的成效才会越加显著。

学术价值：总结中国特色的防疫经验，为中国乃至全球急性突发传染病的预防控制提供一个现实的理论框架和防控借鉴。

关键词：应急管理能力；疾控人力资源；急性突发传染病；控制成效；COVID-19

JEL分类：H83，M12，I18

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I still remember the excitement of speaking as a student representative at the entrance ceremony in September 2018. Now I will enter the graduation defense stage. Reviewing the years of study, it is difficult to express the ups and downs. Along the way, I got a lot of help and harvest, and all my efforts are worth it! Here, I want to extend the most respectful respect and the most heartfelt gratitude to all my teachers and friends who help, care, and support me.

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Contents

List of Tables

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List of Figures

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List of Abbreviations

SARS: severe acute respiratory syndrome

WHO: World Health Organization

COVID-19: coronavirus disease 2019

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Chapter 1: Introduction

1.1 Research background

1.1.1 Emerging infectious diseases

As a governance problem that has plagued human society for centuries, global public health emergencies have always played the role of “cow’s nose” in the governance system of countries around the world. Under the background of economic globalization, social complexity, population aging and continuous changes in the ecological environment, the continuous emergence of emerging infectious diseases and the resurgence of existing infectious diseases in recent years have increased the risk of various public health emergencies, which brings uncertainty and adverse effects to public health and economic and social development.

From the history of cholera and plague to the outbreak of atypical pneumonia caused by severe acute respiratory syndrome (SARS) in China in the early 21st century, the 2009 influenza A(H1N1) influenza epidemic that spread worldwide, the “Ebola” virus was found in West Africa in 2014, the Zika virus spread indiscriminately in the Americas and Europe in 2016, and the new type of outbreak at the end of 2019. As a result of the Coronavirus Disease 2019 (COVID-19) pandemic, China and even the world are experiencing a transformation of public health emergencies from the abnormality of occasional and infrequent occurrences to frequent occurrences. The previous public health emergencies of international concern are shown in Table 1.1.

Table 1.1 Public health emergencies of international concern

Year	Events
2003	Acute respiratory infectious disease caused by SARS coronavirus
2009	H1N1(swine flu) originated in Mexico and spread to the United States
2014	Polio has resurfaced in Afghanistan, Pakistan and Nigeria
2014	Ebola virus infection has spread in Guinea, Sierra Leone and Liberia
2016	The Zika virus epidemic has caused microcephaly and other neurological disorders in the Americas
2019	The COVID-19 pandemic

Source: Z. Liu (2022)

The context of globalization has promoted the close exchanges of personnel, capital and trade between countries. While promoting the rapid development of the global economy, it has also provided a mobile carrier for the spread of pathogens, enabling them to spread across borders and constantly break through the restrictions of geographical space. The cross-border spread of pathogens poses a great threat to human life and health. In the face of global public health emergencies, no country can stay out of the situation (X. Han, 2022).

1.1.1.1 The outbreak of SARS in 2003

SARS was a global epidemic that first occurred in Foshan City, Guangdong Province, China in November 2002, began to spread in Guangzhou at the end of January 2003, and then spread to most parts of the country, Southeast Asia and even the world. The source of infection of SARS was patients, and the transmission routes were respiratory tract, digestive tract, direct transmission and other ways. The population was generally susceptible and highly infectious, and most of the patients were young and middle-aged. During this epidemic, epidemic cases were found in 266 counties of 24 provinces, cities and autonomous regions, 5327 cases were confirmed, and 349 deaths were reported. It was not gradually eliminated until the middle of 2003 (H. Zhang et al., 2014).

The World Health Organization (WHO) declared SARS a global public health event in March 2003. It was difficult to control and treat the outbreak because of the inadequate health system at the time, the lack of timely and transparent information transmission. At the same time, due to the transmission mode and long incubation period of the virus, many patients were not found and isolated in time, leading to the expansion and spread of the epidemic. There were about 32 countries and regions in the world, with 8422 cases and 916 deaths. The outbreak of SARS posed a serious challenge to the global public health system. The impact of the outbreak was not only in the medical field, but also in social, economic, political and other aspects.

1.1.1.2 H1N1 influenza in 2009

In May 2009, the first case of H1N1 influenza infection was found in China. Subsequently, the virus spread rapidly within China and attracted the great concern of domestic health authorities. The Chinese government quickly took a series of measures, including launching the public health emergency plan, strengthening the epidemic surveillance and information disclosure and transparency, strengthening the epidemic prevention and control and medical treatment. With the efforts of the government and the public, the H1N1 influenza epidemic in China has been effectively controlled and treated, and the epidemic has gradually eased (Ye, 2009).

On March 18, 2009, the first suspected cases of H1N1 were found in Mexico City, the capital of Mexico. On April 17, 2009, two children in Southern California of the United States were infected with a rare novel influenza A(H1N1) virus. On the evening of April 29, 2009, WHO announced in Geneva that it had raised the global influenza pandemic alert level from phase 4 to phase 5. WHO declared the outbreak an international public health emergency in June 2009 and issued an alert to countries around the world. This virus is highly contagious and highly lethal, posing a serious threat to global public health security. In response to the outbreak of influenza A(H1N1), WHO organized the national health departments for emergency coordination and response measures. At the same time, WHO also called on countries around the world to strengthen cooperation in surveillance, prevention and control, vaccine research and development to jointly respond to this global public health event (Y. Han et al., 2009).

1.1.1.3 Ebola outbreak in West Africa in 2014

In March 2014, cases of Ebola virus infection began to appear in several West African countries, and the epidemic soon spread to other regions, including Liberia, Sierra Leone, Guinea and other West African countries. Due to the lack of medical resources and poor sanitary conditions, many patients cannot receive timely and effective treatment. At the same time, due to the rapid spread of the virus, many medical staff cannot avoid infection, resulting in a shortage of medical staff. At the peak of the epidemic, large numbers of infections and deaths occurred in the African region. The outbreak of Ebola virus, a serious epidemic brewing economic and social crisis in West Africa, the high mortality rate has brought great harm to the life and health safety of people in West Africa. According to the report of WHO, infectious diseases are still the first killer of human beings, and continue to threaten human life and health (Zeng, 2015).

With the expansion and spread of the epidemic, it has attracted wide attention from all over the world. The epidemic prevention and medical forces of many countries have joined in the fight against the epidemic one after another and strengthened their assistance and support to the region. On 8 August 2014, WHO declared the outbreak a Public Health Emergency of International Concern. In addition, many international organizations and charities have also invested in the prevention and control of the epidemic. With the help of international cooperation, the spread of the epidemic has been gradually controlled and alleviated in Africa (Y. Zhang et al., 2014).

1.1.1.4 Polio epidemic in 2014

In 2011, Type 1 Wild Poliovirus (WPVI) was imported into Xinjiang Uygur Autonomous Region and caused local transmission. A total of 21 laboratory-confirmed polio cases were reported, distributed in Hotian Prefecture, Kashgar Prefecture, Bayingoleng Mongolian Autonomous Prefecture and Aksu Prefecture. After the outbreak of WPVI imported polio in Xinjiang, through a series of correct and effective response measures, the imported polio epidemic in Xinjiang was quickly controlled. In June and November 2012, WHO assessed that

China had successfully interrupted imported WPVI transmission in Xinjiang and maintained polio-free status. However, the situation of global polio eradication is not optimistic, especially in the neighboring countries with high incidence of polio, and the risk of WPV importation in China is increasing (W. Yu et al., 2013).

In 2014, a total of 358 wild polio virus (WPV) cases were reported in the world. After the polio epidemic was controlled in China, it tended to spread in other parts of the world. Pakistan, Afghanistan and Nigeria had local WPV epidemics, and 339 polio cases were reported in 3 countries, accounting for 94.69%. In addition, Somalia, Equatorial Guinea, Iraq, Cameroon, Syria, Ethiopia and other countries had imported WPV epidemics.

The global transmission of WPV has not been interrupted, and cross-border transmission of WPV has occurred in many countries. On 5 May 2014, WHO declared the international spread of WPV in 2014 as “public health emergency of international concern” (PHEIC) (Fan et al., 2015).

1.1.1.5 Zika virus in 2016

On February 9, 2016, the National Health and Family Plan Commission reported the first imported case of Zika virus infection in the mainland of China. The symptoms included moderate to low fever, rash, conjunctiva congestion, fatigue, headache and dizziness, and other common symptoms of Zika virus. Zika virus is mainly transmitted by arbovirus, mother-to-child transmission, sexual transmission and blood transmission. Although the imported cases of Zika virus in China are not many, due to the increase of international economic trade and tourism, the probability of imported cases of Zika virus infection in China has greatly increased (X. Liu et al., 2016).

Since May 2015, an outbreak of Zika virus infection has occurred in Brazil and other central and southern parts of the Americas, and the epidemic has been escalating. Zika virus infection remains a major challenge for countries. On February 1, 2016, the World Health Organization declared the Zika outbreak an "international public health emergency". Zika virus and dengue virus can be transmitted by the same vector, so Zika virus may spread to more than 100 countries in the future like dengue virus infection. As research progresses, both complications of microscopically and Guillotine-Barre syndrome caused by Zika virus may be definitively identified. As such, Zika virus infection will also become one of the most challenging and intractable global public health problems of our time (J. Cheng et al., 2016).

1.1.1.6 COVID-19 epidemic in 2019

The epidemic of COVID-19 occurred at the end of 2019. The epidemic spread rapidly in Wuhan city and even the whole of Hubei Province and affected all provinces and cities in China at the same time. By December 23 2022, a total of 9,558 million confirmed cases and 31,672 deaths had been reported in China (National Health Commission of the People's Republic of China [NHCPRC] , 2022). The main clinical symptoms of COVID-19 are fever, fatigue and dry cough. In severe cases, the disease progresses rapidly to acute respiratory distress syndrome, septic shock, intractable metabolic acidosis, and bleeding and coagulation dysfunction. The main route of transmission of COVID-19 is through respiratory droplets and close contact. COVID-19 is highly contagious, which has brought an extremely heavy burden to China's medical care and a huge impact on the society and economy.

Since the end of 2019, the COVID-19 epidemic, which has lasted for more than three years, has been a global pandemic with the widest impact on human beings in nearly a century. COVID-19 has posed a serious threat to the lives of people around the world, made the international social order more unstable, and the global economic development continued to be sluggish. As of December 23 2022, about 699 billion cases have been diagnosed worldwide, and more than 6.68 million deaths have been reported, with a case fatality rate as high as 0.95% (Our World in Data, 2023). These data warn that in the face of sudden global public health events, it is urgent to establish the concept of a health community, strengthen the capacity of international governance, and strengthen international cooperation in international public health governance.

1.1.2 Overview of the development of the disease control system

Since the 9/11 event in the United States in 2001, the management of public emergencies has become a major concern of governments around the world. The outbreak of SARS in 2003 posed great challenges to the governance framework and response capacity of the Chinese government. Although the SARS epidemic was brought under control after several months, it exposed the shortage of human resources in the existing disease prevention and control system. Thus, work reports of the Chinese government for two consecutive years thereafter (in 2005 and 2006) emphasized the need for a comprehensive disease prevention and control system and the strengthening of public health resources. China has therefore gained experience from the SARS epidemic and actions and has learned advanced disease control systems including system-building and team-building approaches from developed countries.

To improve system-building, China has promulgated and revised a series of laws, regulations, measures, and positions on public emergency responses, such as the Regulations on Emergency Response to Public Health Emergencies, National Overall Emergency Plan for

Public Emergencies, Law of the People's Republic of China on the Prevention and Control of Infectious Diseases, Opinions on Comprehensively Strengthening Emergency Management Work, Responding to Emergencies of the People's Republic of China Law, and Several Provisions on the Establishment of Disease Prevention and Control System.

Centers for Disease Control and Prevention (CDC) at the national, provincial, municipal, and county levels were established in China around 2000. Over the last two decades, China's disease control system has recruited top talents and now comprises many employees. It has improved its capabilities in disease surveillance, detection, epidemically investigation, and risk assessment as well as in experimental research and disease investigation. The U.S. CDC—the most advanced disease control system in the world—currently has 14,000 full-time employees and 10,000 contract employees. By comparison, at the end of 2018, China's disease control teams included 187,826 employees (7.8 times the number of the U.S. CDC), making it the largest center of its kind in the world.

Sixteen years after SARS, China has unexpectedly faced a new epidemic. The COVID-19 outbreak in Wuhan was recognized as a global pandemic by WHO (World Health Organization, 2022). In October of 2022, there have been nearly 630 million confirmed cases of COVID-19 in the world; the U.S. has the highest number with more than 90 million cases, while China has more than 250,000 cases. The caseloads of the two countries are disproportionate to the size of their respective populations. At the National Commendation Conference for Fighting the New Coronary Pneumonia Epidemic on September 2020, Chinese president Xi Jinping stated that COVID-19 is the most serious infectious disease pandemic that the world has experienced in the past century. It is also the fastest, most widespread, and challenging public health emergency since the People's Republic of China was founded. As the gatekeeper of public health, the Chinese CDC assumes the responsibility of limiting the transmission of SARS coronavirus 2 (SARS-CoV-2), the causative agent of COVID-19, and has been the major force driving efforts to control the COVID-19 epidemic in China.

Organizational resources are a combination of attributes that can help organizations remain competitive while achieving their vision, mission, strategy. According to resource-based theory, resource heterogeneity can lead to differences in performance (Peteraf et al., 2003). In terms of the quantity and quality of human resources for disease prevention and control, China lags the U.S. in the Global Health Security Index. Published in October of 2019, the index ranks countries according to their ability to prevent and control pandemics. The U.S. was first, whereas China was 51st, although it has since made significant progress (Nuclear Threat Initiative, 2019). China was able to control the COVID-19 epidemic domestically, with a rapid people's normal life return and economy recovery. In fact, China is the only country in G20 which expected to see the positive economic output in 2020 (Economic Daily, 2020). Thus, with more than 20 years of disease prevention and control team building, China achieves a good result during the COVID-19 epidemic even though the human resources are not the strongest in disease control and prevention system, which is the basis for topic selection in this thesis.

As a highly populated and economically developed coastal province, Guangdong—which experienced the SARS epidemic in 2003 as well as a COVID-19 outbreak in the winter of 2019—has achieved great success in the fight against COVID-19 at the end of 2020 (Shenzhen Special Zone Daily, 2020). Great efforts have been taken to fight against COVID-19, including establishing herd immunity, carrying out normalized community mass prevention and control, develop effective treatment and strictly observing the set precise prevention and control measures. As such, the way disease prevention and control teams in Guangdong ultimately brought COVID-19 transmission under control warrants a detailed case study.

1.1.3 The reality of the disease control system

Around the founding of the People's Republic of China, CDCs at all levels were set up. The national, provincial, municipal, and county-level disease prevention and control teams were established gradually. These teams played an important role in the response to major infectious diseases and public health emergencies and made great progress after the SARS outbreak. The progress can be seen in the following aspects: (1) the disease prevention and control system has been basically formed and continuously improved; (2) the corresponding legal system of health care has been established; (3) the population with guaranteed services has been gradually expanded; (4) the level of health science and technology has been rapidly improved; (5) the people's health status has been greatly improved. Studies show that from 1950 to 2010, the average life expectancy in China increased by 26.6 years, of which the contribution rate of disease control and prevention was as high as 77.9% (L. Li et al., 2020). Although China's disease prevention system has made great progress, many deficiencies of China's disease control system in epidemic early warning, emergency decision-making, emergency response, and reserve have been exposed in the response to COVID-19 (T. Song et al., 2021). At the same time, some problems of CDCs have also been exposed: (1) the insufficient number of staff, low professional quality, (2) lack of administrative ability, (3) insufficient financial security, (4) unclear function positioning and other problems.

As the main force in the prevention and control of infectious diseases, human resources for disease control determine the working capacity, service level and work efficiency of CDC. The shortage of personnel has always been a problem hindering the development of public health in China. In terms of quantity, the total number of personnel in disease prevention and control institutions at all levels in China is seriously insufficient and has uneven distribution (L. Li et al., 2020). Statistics show that in 2006, China had an average of 1.4 disease control personnel per 10,000 people, far less than 9.3 in the United States. From 2009 to 2017, the number of CDC personnel declined rather than increased (L. Guo et al., 2020; L. Li et al., 2020). In terms of personnel composition, from 2010 to 2012, the proportion of health technicians in CDCs at all levels showed a declining trend, and young people were insufficient. Educational background and professional title are important indicators to reflect the quality of health human resources. However, in 2016 less than 70% of the personnel with bachelor's degree or above were employed in nine provincial (municipality directly under the Central Government and autonomous region) CDCs, and the proportion of professional personnel in provincial (municipality directly under the Central Government and autonomous region) CDCs in China still lags the national regulations (Z. Cui et al., 2018). In addition, there are still many problems in the team of CDC personnel, such as less the limited size of institute bodies, difficulty in promotion of professional titles and insufficient assessment, incentive, and training mechanisms (Yao et al., 2020; M. Huang, 2020). Therefore, it is urgent to strengthen the construction of talent team for CDCs. The government should pay attention to the quality and quantity of human resources for disease control and prevention to improve the overall quality and level of the disease prevention and control team.

As a coastal area with high population density and developed economy, Guangdong province has always been the frontier of emerging infectious diseases. However, Guangdong province has achieved remarkable results in the epidemic prevention and control of several infectious diseases. Especially in the fight against SARS in 2003, dengue fever in 2014, and COVID-19, Guangdong has always taken the lead in China. In 2003, a sudden outbreak of SARS broke out in Guangdong and swept across China. In the face of unprecedented challenges, CDC personnel in all perfectly-level cities in Guangdong province all went out to fight against SARS, carried out an on-site investigation, sampling, and testing, controlled the outbreak within three months, and controlled the cumulative number of cases within 2000, providing valuable experience for the prevention and control of SARS for the whole country and even the world (L. Jiang & Chen, 2004). The most serious outbreak of dengue fever in the past 30 years broke out in Guangzhou in 2014. Guangdong CDC and relevant departments responded positively. The joint prevention and control mechanism was adopted, including comprehensive mosquito control measures, mainly focused on eliminating breeding sites and an epidemiological investigation was carried out, mosquito vector control and case search were carried out, which effectively contained the rising trend and spread of the epidemic, and it was estimated that 23,000 cases were avoided in Guangzhou alone (H. Lin et al., 2016). In the COVID-19 outbreak, under the powerful leadership of the government of Guangdong province, around the "non-proliferation in the external input," a series of powerful public health measures were adopted. Served as the main force, CDCs and personnel worked to fight overseas input outbreak and local outbreak. The small and under-control number of cases highlights the irreplaceable role played by CDC personnel (Xiao et al., 2021).

The prevention and control of sudden acute infectious diseases requires not only professional organizations such as CDC, but also the participation of all sectors of society, especially the strong leadership of the government and the positive response of the public. As a social public affairs management agency, the government is the main body of maintaining social order and people's life and property interests and sustains the responsibility of resolving the crisis and stabilizing the overall social situation. The COVID-19 prevention and control are based on “Put People and Their Lives First” of Chinese government (Hou & Wang, 2021). In 2003, to fight against SARS, it only took seven days and seven nights to build the "Xiao Tangshan Hospital". Since the outbreak of COVID-19, under the effective command of governments at all levels, crisis management measures have been initiated immediately, including initiating level I emergency response to public health emergencies and taking lockdown measures, which have effectively prevented the spread of COVID-19 (H. Sun, 2020). The positive response of the public ensured the speedy implementation of various policies and measures. Since the outbreak of COVID-19, the CDC and other departments in Guangdong province have worked together to fight the epidemic. Under the strategy of containment and "dynamic zero clearance", they have adopted regional and hierarchical management, reduced the number of people gathering, and advocated vaccination. People in Guangdong province have consciously complied with various policies and actively responded to the call, and successfully blocked the spread of the local epidemic (Z. Li, 2003).

1.2 Research questions

Because of its previous experiences with the SARS (2003) and COVID-19 (2020) epidemics, Guangdong province was selected as the focus of case analyses focusing on human resources for disease control and epidemic control performance. Study 1 is an inductive study that aims to summarize the analysis framework of human resources for disease control and epidemic control performance based on the Grounded Theory. Study 2 is a deductive study that will analyze the human resources for disease control and epidemic control performance in Guangdong Province in the management of COVID-19 to validate the analysis framework proposed in Study 1.

1. Study 1 of the SARS case will analyze the experience of Guangdong province in fighting SARS in 2003 and will address the following key points.

(1) There is an investigation of factors that influence human resources for disease control and epidemic control performance.

A preliminary examination of cases showed that emergency management capability is an intermediate variable between human resources for disease control and epidemic control performance.

(2) There is a precise definition of the concept and application of emergency management capability and explaining its mediating function.

(3) There is an examination of the situational factors that exist between human resources for disease control and emergency management capability (e.g., the government's motivation for fighting the epidemic) through Grounded Theory.

(4) There is an identification of Chinese situational factors that exist between emergency management capability and epidemic control performance (e.g., public response level).

2. In Study 2, a case study of the handling of the COVID-19 epidemic in Guangdong province will be carried out to validate the analytical framework proposed in Study 1.

(1) There is an evaluation of the positive effect of human resources for disease control on epidemic control performance.

(2) There is an assessment of the mediating role of emergency management capability between human resources for disease control and epidemic control performance.

(3) There is an examination of the modulating influences of anti-epidemic motivation and the public response level.

1.3 Research purpose

Resource-based theory was formally proposed by Pfeffer and Salancik in 1978 and has the following core assumptions. Firstly, organizations may have different resources; secondly, these resources are not reproducible across organizations. Thus, differences in organizational performance can persist over time because of inequalities in the number of resources available to one organization against another (Barney, 1991), and organizations that achieve superior performance have a competitive advantage over others because they have or maintain unique resources.

Human resources can be considered as important and unique resources that can have a direct effect on the control of an epidemic. As mentioned above, the U.S. CDC has 24,000 employees. By comparison, as of the end of 2018, the number of disease control workforce in China was 187,826. Based on population density, the U.S. CDC has the most abundant human resources in the world. However, according to the latest statistics released by Johns Hopkins University, there are more than ninety million confirmed cases of COVID-19 in the U.S., which is more than any other countries, with the infections increasing in 38 states and hospitalizations trending upward in 39 states, respectively (Reuter et al., 2022). This situation may be exacerbated with the advent of winter. Thus, the performance of the U.S. with respect to epidemic prevention and control is not commensurate with their available human resources for disease control, highlighting a considerable gap between the ideal emergency response and reality. The research problems in the present work are defined as follows:

(1) According to resource-based theory, in the effective management of an epidemic, human resources should be considered as the antecedent variable. There are intermediary variables between human resources for disease control and epidemic prevention and control performance, which affect epidemic prevention and control performance.

(2) There may be other variables that influence performance of epidemic control, including Chinese situation variables, such as anti-epidemic motivation and the public response level.

1.4 The structure of the dissertation

This essay focused on the acute emergent infectious diseases, the associations among human resources, emergency management and the effect of prevention, which were the thread of this essay. We used systematic review, expert interview, and case study to evaluate the associations, and explore the framework of the mediating effect of emergency management capabilities on CDCs human resources and emerging infectious disease prevention. We proposed that (1) human resources of CDCs have a significant positive impact on epidemic control performance. (2) Human resources of CDCs have a significant positive impact on emergency management capacity, which also has a significant positive impact on epidemic control performance. (3) Emergency management capacity plays a mediating role between human resources of CDCs and epidemic control performance. (4) Not only anti-epidemic motivation but also the level of public response regulates the significant positive impact between human resources of CDCs and epidemic control performance and mediating role of emergency management ability between human resources of CDCs and epidemic control performance. The overall framework of the essay is listed as Figure 1.1.

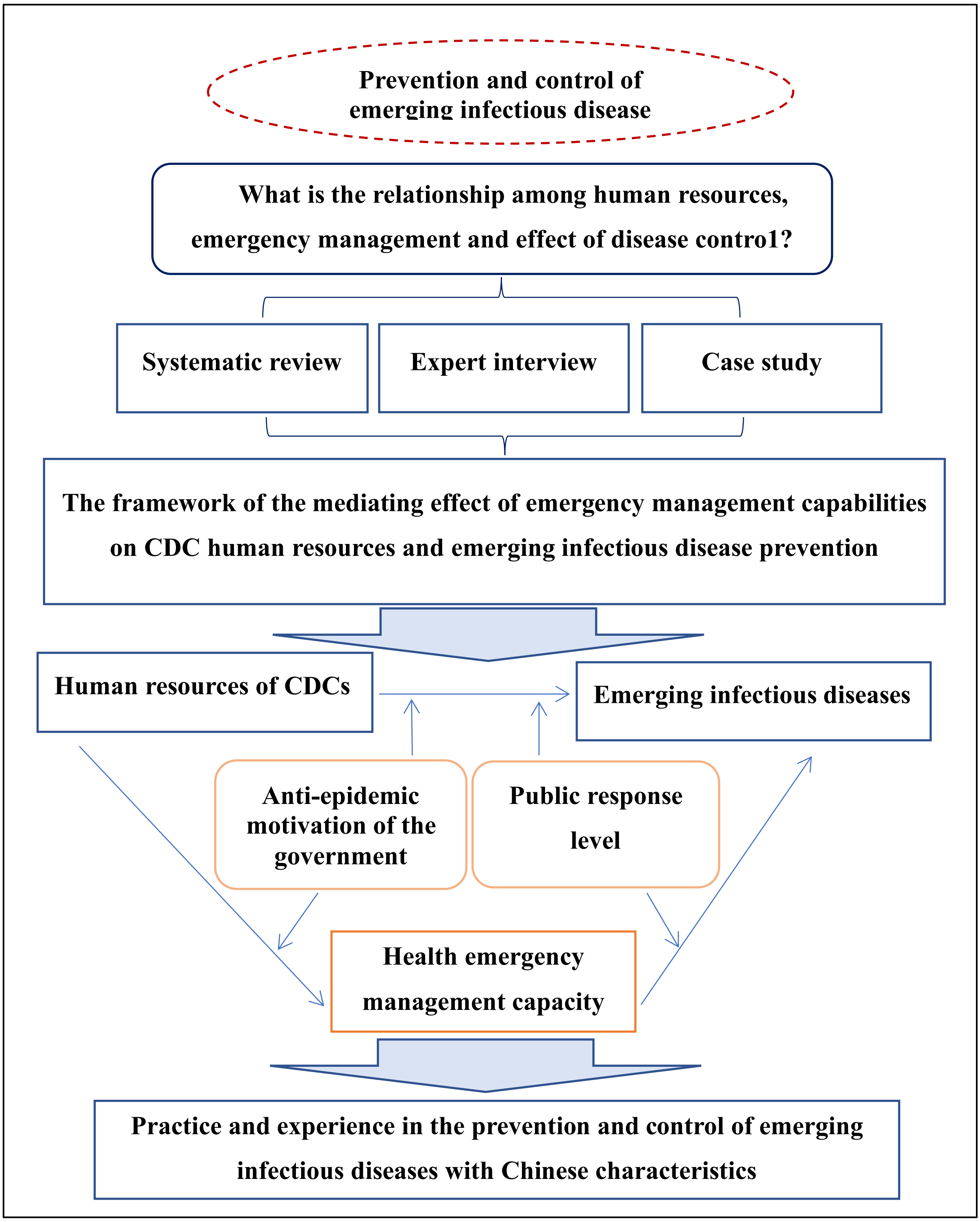

Figure 1.1 The proposal framework of this dissertation

Chapter 2: Literature Review

2.1 Emerging infectious diseases

2.1.1 Concept of emerging infectious diseases

Infectious disease is a disease caused by various pathogens that can be transmitted from person to person, animal to animal, or person to animal. Most of the pathogens are microorganisms, and a small number are parasites, which are also called parasitic diseases. For some infectious diseases, the epidemic prevention department must grasp the incidence of the disease in time and take countermeasures in time, so it should be reported to the local epidemic prevention department in time after discovery, which is called a statutory infectious disease (Chinese Center for Disease Control and Prevention, 2022).

In history, infectious diseases have seriously endangered human health and social and economic development, but with the development of social economy and the advancement of science and technology, as well as the long-term unremitting efforts of human beings, the incidence and mortality of infectious diseases in most countries in the world have dropped significantly, and the threat to human health has gradually transitioned from infectious diseases to non-communicable diseases. With the intensification of global population flow, climate warming, changes in the ecological environment and human behavior, many new and re-emerging infectious diseases continue to appear, posing a serious threat to human health and posing new challenges to global public health (Shi & Zhou, 2019). In recent years, various infectious diseases such as SARS, Middle East respiratory syndrome, avian influenza, influenza A, and the COVID-19 occurred globally. The widest scope of infection, and the greatest difficulty in prevention and control, have constantly posed new challenges to our country's ability to prevent and control infectious diseases, and at the same time prompted the country to continuously improve the relevant legislation for epidemic prevention and control, strengthen the construction of supporting systems, and improve punishment procedures. Strengthen public security guarantees, and build a systematic, scientific, standardized, and effective legal system for epidemic prevention and control (Xi, 2020).

Emerging infectious diseases was defined as diseases that appear in the population for the first time, or those that may have existed before but whose incidence rate or geographical scope is rapidly increasing by WHO (W. Wang et al., 2021). The U.S CDC considers it as follows: (1) new infections caused by changes or evolution of existing organisms; (2) Known infections spread to new geographic areas or populations; (3) Previously unidentified infections occur in areas undergoing ecological transformation; (4) Old infections reappear due to antibiotic resistance in known drugs or failure of public health measures (CDC, 2014).

In China, Emerging Infectious Diseases outbreaks are public health emergencies that are equivalent to occupational poisoning, food poisoning, and unexplained diseases, and are manifested as sudden occurrences that cause or may cause serious damage to social and public health (X. Li, 2021a). Specifically, emerging infectious diseases (EID) refer to the pestis and infectious atypical pneumonia (SARS) that seriously affect social stability, pose a major threat to human health, and need to take emergency measures, and also include new acute infectious diseases such as highly pathogenic avian influenza and diseases of unknown causes (The Central People's Government of the People's Republic of China [CPGPRC], 2005).The outbreak and prevalence of infectious diseases are mainly caused by pathogenic microorganisms such as viruses, bacteria, and parasites. For example, the SARS epidemic broke out in 2003; The outbreak of influenza A(H1N1) in Mexico and the United States in 2009; The outbreak of respiratory syndrome coronavirus in the Middle East in 2012; Epidemic situation of Ebola virus disease in West Africa from 2013-2016; The outbreak of COVID-19 in 2019. Emerging infectious diseases are currently the main cause of death and disability worldwide. Nowadays, emerging infectious diseases continue to emerge, becoming one of the important factors that threaten human health and affect social stability and economic development.

According to the “Law of the People's Republic of China on the Prevention and Control of Infectious Diseases”, there are many types of emerging infectious diseases. Among Class B infectious diseases, novel coronavirus infection, infectious atypical pneumonia and pulmonary anthrax shall be prevented and controlled by Class A infectious disease (CPGPRC, 2005).

2.1.2 Characteristic of emerging infectious diseases

Emerging infectious diseases usually have following characteristics.

Sudden and unexpected. Emerging infectious disease events generally have a short outbreak time, are unpredictable, and are difficult to identify early. If timely control measures are not taken after the occurrence, it will bring enormous harm to the public (M. Ding, 2014).

Preparation and prevention are difficult. Due to the suddenness of emerging infectious disease emergencies in public health, it is difficult for people to adopt appropriate methods to prepare in advance, and it is also unlikely to accurately determine the equipment, materials, personnel, and related processing techniques needed before the event occurs.

Spread rapidly and the range is wide. After a sudden occurrence in a short period of time, it can quickly spread among the population, causing widespread outbreaks and epidemics in provinces, countries, and even the world in a relatively short period of time, resulting in a large number of infected cases, posing a serious threat to public health and safety (L. Chen et al., 2017).

The outbreak is regional. For example, the incidence of infectious diseases in Zhejiang, Hubei, Chongqing, Sichuan and other southeast and southwest regions of China is higher than that in other regions of the country, and the incidence in rural areas is also higher than that in urban areas due to economic, health and environmental factors (X. Li, 2021a).

The outbreak was seasonal. The peak periods of acute infectious disease outbreaks are from March to June and from October to December. For example, avian influenza often occurs in the winter and spring seasons, while the new type of coronary pneumonia first appeared in Wuhan in December 2019, rapidly spreading throughout Hubei Province in the short term, and rapidly spreading to Zhejiang, Guangdong, Hunan, Sichuan, and other places (Cai et al., 2016).

Significant social harm. Sudden emerging infectious diseases are more harmful to society than other diseases. Due to their rapid spread, they are more likely to involve more people and neighborhoods, resulting in greater losses to society and not conducive to social development and progress.

Group influence. Sudden emerging infectious disease events can cause widespread public attention due to their rapid spread, become a hot topic in the public, and easily lead to public losses, public psychological panic, and chaos in social order. With the development of economic globalization, emerging infectious disease events have an increasingly wide range of spatial impacts, not only across multiple regions and countries, but also have a wide and global impact.

There is usually a lack of specific or effective prevention and control measures. Due to the mutability, sudden onset, and rapid transmission of pathogens, acute and sudden infectious diseases are often difficult to achieve targeted and effective prevention and treatment measures, which can easily lead to severe illness or death once they occur (National Health and Family Planning Commission [NHFPC], 2016).

Comprehensive response is required. The prevention and control of emerging infectious diseases requires the participation of professionals from all walks of life. It requires comprehensive use of various means to master more health prevention and control methods. It requires the government to coordinate the joint participation of multiple departments and coordinate the allocation of social resources in order to achieve emergency prevention and control of infectious diseases and reduce the social harm of sudden emerging infectious diseases (Cai et al., 2016).

The level of control of emerging infectious diseases in China has been continuously improved with the improvement of economic level and the growth of national strength, but there are still certain problems in the actual implementation process. First, the number of infectious diseases in public health has increased. Due to the increasing population base in China and increasing infectious diseases, among which the most common diseases include influenza, tuberculosis, viral hepatitis, AIDS. Second, the control of remote areas is weak. Because the development of China’s social and economic level is unbalanced, there are great differences in the level of medical services in different regions, and the prevention and control measures of infectious diseases in remote areas are relatively imperfect. Social factors affect epidemic control. Third, in recent years, the rapid development of urban and rural economy, a large number of urban and rural population agglomeration, resulting in an increase in the floating population, resulting in an increase in the inactivity of infectious diseases, creating good conditions for the floating population to epidemic and spread infectious diseases (Z. Zheng & Yuan, 2017).

2.2 The systems and emergency management between different countries

There are significant differences in systems between different countries. The following will take China and the United States as an example to compare the differences in systems and already managed aspects between China and foreign countries.

2.2.1 Political systems

In terms of party system, China implements the multiparty cooperation and political consultation system led by the Communist Party of China, which is a socialist party system with Chinese characteristics, while the United States implements the capitalist two party system. The differences in political party systems are also the main reasons for the differences in the governance styles, representative interests, organizational forms, and roles of the two countries.

China is a socialist society and upholds that all state power belongs to the people. It upholds the organic unity of the Party's leadership, the people's ownership of the country, and the rule of law. It upholds democratic centralism, and upholds the realization, maintenance, and development of the fundamental interests of the overwhelming majority of the people as the starting point and foothold of all work of the ruling party and government. China implements a unicameral system, where the People's Congress uniformly exercises state power, and other state organs are elected and accountable to the National People's Congress. This system pays attention to protecting the individual rights of citizens, while also paying attention to safeguarding the collective interests of citizens. State organs have their respective functions and powers, but they attach greater importance to coordination and unity.

The United States is a capitalist society, and its political system attaches importance to the rights of individual citizens, separating and balancing legislative, judicial, and administrative powers to avoid government abuse. This system plays an important role in opposing feudal autocracy, regulating the interests of various groups within the bourgeoisie, and maintaining the capitalist system. However, this system often ignores collective interests and power coordination, which not only fails to effectively represent the interests of the American people in its operation, but also brings about a crisis of public trust. In addition, the opposition between the two parties and the struggle between political parties cannot effectively address public demands in a timely manner (Y. Peng, 2014).

2.2.2 Emergency systems

Compared with western developed countries, China's emergency management construction started relatively late. After the founding of the People's Republic of China and before 2003, although we had relevant systems for emergency management, at that time, the main characteristics of emergency management were mainly single department emergency management, temporary high mobilization of the government, and establishment of emergency headquarters (Z. Peng, 2014). In view of the experience and lessons learned from the "SARS" in 2003, China has begun to attach importance to emergency management, paying attention to learning some advanced emergency management concepts and systems from foreign countries, and combining its own reality, vigorously promoting the construction of "one case, three systems" in emergency management. "One case" refers to the formulation and revision of emergency plans, and "three systems" refers to the establishment and improvement of emergency response systems, mechanisms, and legal systems. In response to infectious diseases and public health emergencies, China has promulgated and implemented the "Infectious Diseases Law of the People's Republic of China", "Emergency Response Law of the People's Republic of China", as well as the "Guidelines for Relevant Emergency Plans and Emergency Management Work" (X. Wang et al., 2020).

The construction of the emergency management system in the United States is earlier than that in China, and there were many relevant emergency rescue legal systems in the early years.

For example, the National Congress Act of 1803, the Disaster Relief Act of 1950, the Disaster Relief and Emergency Assistance Act, the Stanford Act, the National Emergency Management System, the Short-Term National Infrastructure Protection Plan, and the Short-term National Emergency Preparedness Goals. These laws and regulations specify in more detail the responsibilities, powers, and benefits of various federal departments in responding to natural disasters, clearly dividing the responsibilities between the federal government, state, and local governments, as well as the proportion of federal financial support, and the procedures for federal intervention in major natural disaster relief. These regulations in the United States have been effective in dealing with conventional, less severe natural disasters, as well as major disasters that can have sufficient preparation time. However, there are also some shortcomings, such as poor coordination ability, complex procedures, adherence to stereotypes, and so on (Xiong & Chai, 2009).

2.2.3 Government functions in emergency management

The current emergency rescue leadership system in China is implemented through unified decision-making by the central government and division of labor among departments. The corresponding disaster relief work management system is that of unified government leadership, hierarchical management from top to bottom, and division of labor among departments. The central government is responsible for decision-making and management of major disaster relief issues, and governments at all levels are responsible for disaster management in their respective administrative regions. In disaster relief work, the central government and local governments at all levels clearly exhibit the same structure of responsibilities (Xiong & Chai, 2009). During the disaster relief process, the superior plays a supervisory and control role over the lower-level government. When faced with disasters, lower-level officials must first report to the superior, strive for resources, and listen to the instructions of the superior.

The United States implements a vertical three-level management system of federal, state, and local governments (X. Wang et al., 2020). As shown in Figure 2.1, the responsibilities of governments at all levels are heterogeneous, that is, the responsibilities of federal, state, and local governments are clearly divided, and they act within their respective spheres of authority. The federal government cannot govern the state and local governments. The relationship between governments at all levels is not between management and being managed, but rather between guidance, cooperation, and constraints. Traditionally, disaster response efforts in the United States are generally undertaken by state and local governments, with the federal government often playing a supportive role. State and local governments always play a major role in disaster response. "Only when the disaster is so severe that the rescue operation exceeds the capabilities of the state and the affected local governments can the governor submit a request to the president to declare it a major disaster, and the federal government can initiate the rescue operation. Otherwise, the federal government cannot directly intervene in the relief work.". This set of disaster relief system in the United States clearly divides the responsibilities of governments at all levels, embodying the principle of checks and balances of power. However, when dealing with major emergency disasters such as Hurricane Katrina, it exposes its shortcomings of cumbersome procedures and poor coordination ability (Xiong & Chai, 2009).

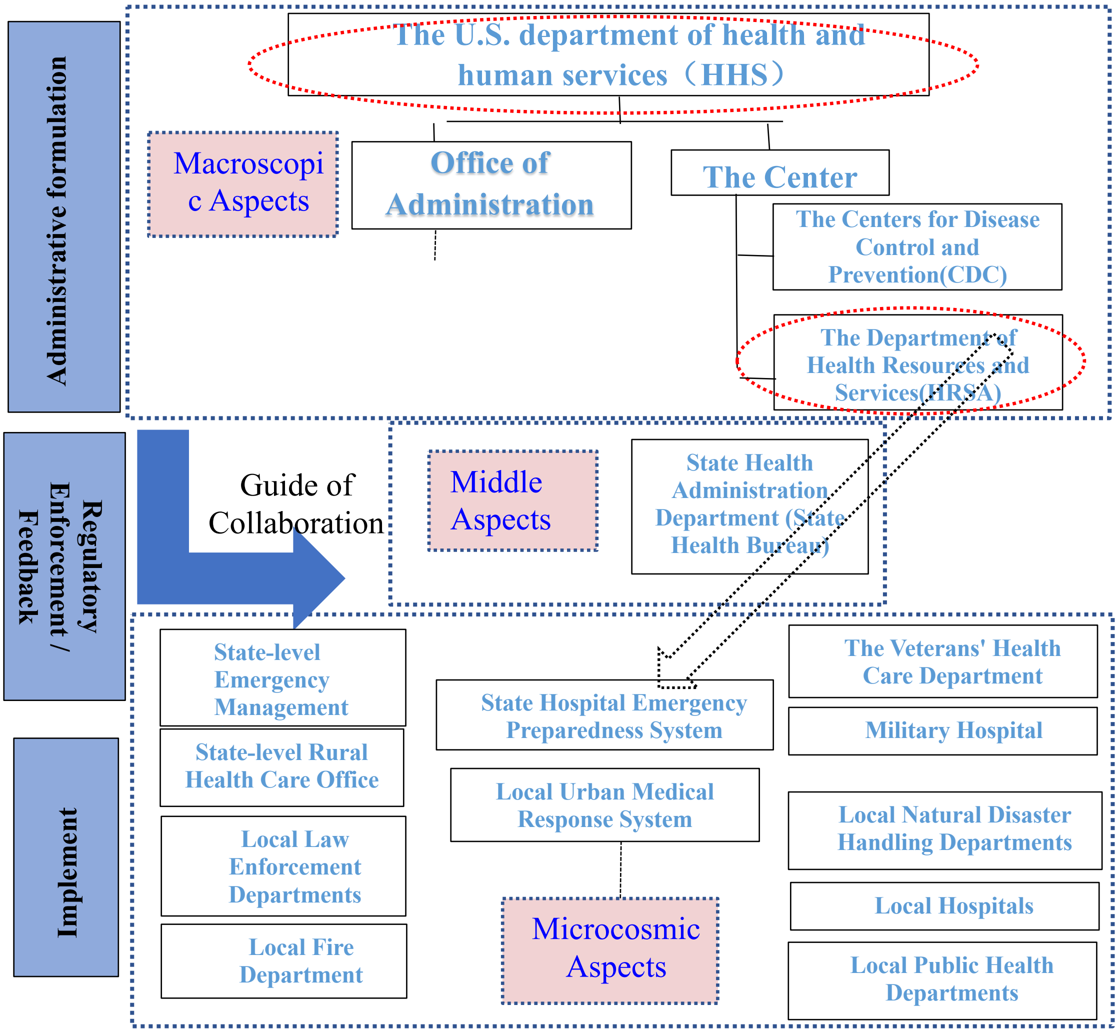

Figure 2.1 Organizational Structure for Emergency Management of Emerging Infectious Diseases and Public Health Emergencies in the United States

Source: X. Wang et al. (2020)

2.2.4 The construction of rescue teams

China's rescue teams are generally classified and managed according to the type of disaster. China's rescue teams only have a grading concept in more mature fields such as earthquake disasters, mine rescue, and fire protection, but some rescue teams have not yet formed a grading system (Y. Zhang et al., 2014).The research on the classification and grading system of rescue teams in the United States is relatively mature. The construction of rescue teams adopts a combination of professionalism and volunteerism and implements nationally consistent training and assessment standards for the selection and recognition of rescue teams. Subdivided into: emergency management team, participating in the emergency management team, who need to pass the training level by level and pass the assessment; Full-time emergency rescue teams such as fire, medical, police, and coast guard. Community emergency rescue team, with members from various community organizations, enterprises and institutions, who have received basic emergency rescue skills training and participated in emergency rescue activities in the region (J. Sui & Sun, 2013).

2.2.5 Emergency plans

China's national emergency plan is basically organized and prepared according to the categories of public emergencies and the administrative responsibilities of various departments. The national plan mainly consists of one overall plan, 25 special plans, and 80 departmental plans. However, there are still gaps in emergency plan preparation guidelines, emergency plan review guidelines, emergency capability assessment, and emergency drill guidelines. In addition, there are significant issues with the feasibility and operability of emergency plans. Many departments and enterprises have similar emergency plans, and when real major disasters occur, emergency plans often have low operability (F. Liu, 2022).

The U.S. national emergency plan is mainly composed of a basic plan, appendices, emergency support function attachments, and support attachments. State governments, local governments, the private sector, and non-governmental organizations have clarified their respective responsibilities and strengthened the sharing and coordination of information among governments (Sui & Sun, 2013).

2.2.6 Emergency support

According to different administrative divisions, relevant administrative departments are responsible for providing resource support for emergency resources in China. The United States uses the emergency support function appendix of the National Emergency Plan to clarify the resource assurance tasks, policies, organizational structures, and responsibilities of government departments, the Red Cross Society, and other institutions, and specifies corresponding coordination agencies, lead agencies, and support agencies. Through the "e-FEMA" strategy, a hierarchy model of emergency information systems has been established, which can timely update emergency information resources and promote information sharing among different systems (Sui & Sun, 2013).

2.2.7 Community disaster reduction emergency response and volunteer team

Building disaster reduction-oriented communities (DRCs) is a trend in the development of emergency disaster reduction in developed countries today. It refers to long-term community-based disaster reduction work. Facts have proven that grassroots communities are more likely to play a role in disaster reduction in the face of small and medium-sized disasters (Sha & Liu, 2010).

The United States has started early in the construction of community disaster reduction and emergency response, and currently should have complete laws and regulations and relevant practical suggestions (Luo & Li, 2013).While China has introduced many laws and regulations for individual disasters, as well as a series of national emergency plans, which have initially formed a legal system for disaster reduction in accordance with the law, many of the laws that have been introduced have only played a guiding role in the direction, and there are no supporting regulations for specific operational issues, especially at the community level. Therefore, it is difficult for communities to achieve legal compliance in disaster prevention and mitigation (Z. Guo & Dong, 2011). The United States has established a relatively complete emergency volunteer management system, with construction content such as emergency volunteer certification and protection system. From the perspective of the Wenchuan earthquake, the characteristics of volunteer performance in China are large numbers, proactive, and rapid response. However, there are also shortcomings and problems such as low level of organization, insufficient professional level, lack of legal protection, and financial support (Sui & Sun, 2013).

2.3 Emergency management capability

2.3.1 The emergency capability and emergency management capability

After the SARS epidemic in 2003, there was a surge in research on emergency management, but there is still no consensus on the definitions of emergency capability and emergency management capability (G. Chen, 2020). There are some differences between emergency capability and emergency management capability, the former term has a broader connotation than the latter, and refers to the ability of government, enterprises, social organizations, families, and individuals to prevent and respond to emergencies. Emergency management capabilities more specifically refer to the ability of governments and other public institutions to prevent and respond to emergency (W. Liu & Chen, 2011).

The definitions of emergency capability and emergency management capability are inseparable from the concept of emergency management, which was first established by the U.S. through the creation of the Office of Emergency Management, Federal Emergency Management Agency, and other such agencies. Emergency management refers to reasonable analysis, planning, and decision-making regarding available resources and preparation for, response to, mitigation of, and recovery from a crisis. The United Nations Office for Disaster Risk Reduction defines emergency management as the organization and management of resources and responsibilities for addressing all aspects of emergencies, especially preparedness, response, and initial recovery. It involves plans and institutional arrangements to engage and guide the efforts of government, nongovernment, voluntary, and private agencies in a coordinated manner to respond to the full spectrum of emergency needs (United Nations International Strategy for Disaster Reduction [UNISDR], 2009). In China, following the SARS epidemic of 2003, the Communist Party Central Committee and State Council established an emergency management system, the first time this was proposed at the official level. The basic mandate of this system is for the government and other public institutions to protect citizens' rights to life, health, and property by creating the necessary response tools using science and technology, as well as management regulations for the prevention of, response to, handling of, and recovery from emergencies to promote the harmonious development of society (M. Sun et al., 2018). Emergency management is the key point to understand the two concepts of emergency capacity and emergency management capacity. Emergency capacity is the basis of emergency management, and it appears in the process of emergency management (H. Zhang &

Tong, 2009). Emergency capacity is divided into actual capacity and potential capacity, both of which serve for emergency management, but the former is directly related to emergency management, while the latter is a supplement when the actual capacity cannot meet emergency needs (H. Zhang & Tong, 2009). Since the emergency capacity determines the quality of emergency management, the assessment of emergency capacity has become the subject of many scholars. On the other hand, emergency management capacity is more focused on management, which refers to the ability to intervene and control emergency events, through scientific and reasonable emergency management methods to achieve the goal of emergency management (Zhao et al., 2011).

As the present research focus on the prevention and control of emerging infectious disease, the concepts of emergency capability and emergency management capability will be defined in the context of public health. Emergency capability refers to the response to and prevention of public health emergencies; resource deployment for monitoring and early warning; emergency preparedness, handling, and aftermath; and achievement of an effective response because of these various measures (X. Wang et al., 2020). Emergency management capability is defined from three standpoints: disaster prevention and response, crisis management, and government capabilities (Xu, 2012). Given the focus on epidemic control performance in the present work, the concept of emergency management capability will be limited to the specific situation of emergency health incidents. Epidemic prevention and control capacity is the core capacity of public health emergency management, which needs to be adapted to the social and economic level. Epidemic prevention and control capacity reflects the governance capacity of a country (Deng et al., 2020).

Based on the concept of emergency management, emergency capability and emergency management capability are compared in the context of a public health situation (epidemic prevention and control), with emergency management capability selected as the main construct. Thus, in this study, emergency management capability refers to the ability of the government and related public institutions to use science, technology, management, and regulation in the prevention of, response to, handling of, and recovery from public health emergencies to protect the life, health, property, and safety of the public and promote the harmonious development of society. As an extension of this definition, emergency management capability is an attribute of the undertaker of practical activities — that is, governments and other public institutions at different levels (national, regional, and local). The objective of emergency management capabilities is identification of factors considered unsafe in people's practical activities that threaten public safety and could lead to a public health emergency.

2.3.2 Study on index system of emergency management capacity

The evaluation index system of emergency management capacity is applied to the evaluation of emergency management capacity. The purpose of the assessment is to identify deficiencies in the emergency management work system and thus provide a basis for improving the emergency management capacity. In the 1950s, the United States carried out emergency management capacity assessment, followed by many developed countries established emergency management capacity assessment systems (X. Wu & Gu, 2007). This kind of system has played an increasingly important role in emergency management. Therefore, the evaluation index system of emergency management capacity has become the focus of scholars' research.

The Delphi method and analytic hierarchy have been used to design and establish index systems for evaluating emergency management capabilities (Rong et al., 2018). The Delphi method has been adapted from public health emergency capability evaluations to construct an index system for the emergency management capability of disease control agencies; it was used to screen seven effective first-level evaluation indices and has been compared to the entropy method, with the analytic hierarchical process of subjective weighting found to be more suitable for evaluating the relevance of the emergency response capability index system to disease control agencies (T. Song & Dai, 2014). Other investigators have applied spatial analysis to the design of index systems yielding an emergency response capability index system for epidemic prevention space units at the levels of city, district, and community (P. Wang & Qiu, 2018).

Relatively reliable first-level indices for evaluating emergency management capabilities include emergency system construction; human resources; monitoring and early warning, emergency response, and emergency support capabilities; information communication and interdepartmental collaboration; and scientific research cooperation and information exchange. An emergency capability index matrix was established based on the three dimensions of medical treatment, prevention, and control; emergency safeguards and reserves; and emergency system construction (Y. Liu & Bian, 2019). Other investigators have recommended basic information as well as monitoring and early warning, on-site investigation and processing, laboratory testing, emergency support, education and training, and information release capabilities in the design of evaluation indices for evaluating the emergency response capability of disease control agencies, human resources was later added as another index (Shen et al., 2011; T. Song & Dai, 2014). The emergency response capability index system proposed did not include the important item of monitoring and early warning capabilities, while another system lacked indices for information release and communication as well as for scientific research and communication (Li et al., 2010; Lian et al., 2011). A municipal disease control agency's three-tiered emergency response capability index system included the basic situation, system construction, monitoring and forecasting, on-site treatment, evaluation, safeguards, and education and training in the first tier, along with 16 secondary and 43 third indices (Yan et al., 2015). National disease control agencies' emergency response capability index system comprised four first-level indices including, plan preparation; team building; resource safeguarding; monitoring, early warning, and response cooperation (Q. Zhang, 2017). The emergency response capability of county-level health personnel has also been assessed based on a three-level index system that includes emergency knowledge, emergency concept, and emergency skills (H. Sun et al., 2016; Q. Zhang, 2017). Another approach has been to design emergency indices for the three stages of response to public health emergencies — i.e., before, during, and after the event, including preparation, monitoring and early warning, response, and post-event actions (S. Wang & Zhang, 2013). The index system for evaluating rural/grassroots health emergency response capability was designed from the perspective of resources including human, financial, material, information, and technical resources and population health indices (L. Qiu & Ma, 2017).

The U.S. CDC public health emergency preparedness and capability indices were updated in 2018 for a total of 15 indices: (1) community preparation; (2) community recovery; (3) emergency action coordination; (4) emergency public information and warnings; (5) mortality management; (6) information sharing; (7) public care; (8) medical countermeasure distribution and management; (9) medical material management and distribution; (10) medical surge; (11) nonpharmaceutical intervention; experimental testing; (12) surveillance and epidemiologic investigation; (13) responder safety and health; (14) volunteer management. The emergency capability index system broadly comprises three dimensions: (1) organizational characteristics, (2) emergency response performance, (3) staff capabilities. The response to unexpected disasters has four aspects: (1) communication, outreach, and coordination; (2) resource mobilization; (3) organizational capacity building; (4) partnership development and maintenance. Some studies have addressed specific cases — for example, it was proposed that in response to emergencies, resources must be redistributed and dispatched, and adaptive feedback scales optimized to measure the stress resistance and emergency status of local health departments. A tool was developed to study emergency response capabilities that separate the advantages and disadvantages of written and operational assessments and their appropriate uses and proposes drills and embedded assessments. Other scholars evaluated emergency management capabilities of healthcare systems in three dimensions (input, process, and output) based on health and safety, communication, volunteer management, resource management, medical surge, accident management, emergency management plan, and other indices. By combining the analytic hierarchical process with fuzzy theory, an emergency capability evaluation system was established on three levels—i.e., objectives, rules, and indices—to improve decision-making, coordination, and hazard identification in different situations (S. Chen, 2009).

Based on the previous work, the key indices of the emergency management capability index system that will be analyzed in the present work are: (1) system construction, (2) monitoring and early warning, (3) emergency response, (4) departmental cooperation and safeguards, (5) scientific research cooperation, (6) training and education.

2.3.3 Influencing factors of emergency management capability

In the process of emergency management, to achieve the purpose of loss minimization, the intervention and control of emergencies must consume relevant resource elements, which affect the extent of emergency management. Governments and relevant public institutions applied scientific, technical, regulatory methods to respond to public health events in an emergency manner, maximizing emergency response capability requires corresponding support resources including human, financial, material, information, and technical resources. Financial security is the premise of emergency management, and the input of various emergency resources needs to be supported by financial resources. Capital sources mainly include financial support, social donation, and commercial insurance (K. Zhong, 2008). Emergency supplies management is an important part of emergency management, involving materials reserves, configuration, transportation, distribution, emergency supplies depend on the adequacy of the country's emergency capacity (K. Cui et al., 2021). For example, in Canada, the performance of epidemic control was affected by the shortage of surgical masks and detection kits due to the lack of emergency supplies production capacity (Silverman & Clarke, 2020). In the early stage of the outbreak, Hubei Province launched emergency procurement procedures to facilitate the rapid replenishment of epidemic prevention supplies (Long, 2021). Emergency management is based on information resources. Especially in the stage of crisis warning and monitoring, the acquisition, transmission and sharing of information affect the strategic timing of emergency management (Z. Peng, 2014). Open and shared data such as the number of new cases not only provides guidance for emergency managers but also provides useful information for the public to strengthen their understanding and support for emergency management (B. Ma & Mao, 2015; Y. Song & Ji, 2021). Big data is regarded as an important method to improve emergency management capacity, and the collection and analysis of big data can be applied to the whole process of emergency management, to improve the efficiency of emergency management and minimize the loss of emergencies. Health codes and travel cards implemented by smart phones in China during the epidemic become effective measures to track and identify confirmed cases (W. Liu et al., 2020). Emergency technical resources are a key factor limiting emergency management capabilities; it has been demonstrated that the level of technology is directly related to the level of emergency response. The improvement of government emergency management needs the support of information and communication technology to cope with the changes of emergency management in the new era (J. Tian et al., 2014).

Emergency resources are limited and there is an uneven distribution of resources at present. There is an imbalance in the distribution of medical assistance resources in response to public health emergencies in the western region of Liaoning, where tertiary hospitals are clustered and emergency management capabilities vary greatly, and investment in construction must be increased (W. Liu & Bian, 2020). A study of the emergency response capabilities of the Shanghai CDC showed that the municipal CDC was superior to the district CDC, and that the CDC in the city center was superior to that in the outskirts (Rong et al., 2018). A data envelopment analysis of the emergency response efficiency of county-level CDCs revealed a low emergency response performance and need for additional personnel and funding. In a study comparing weight application methods, the emergency response capacity of the Pearl River Delta in Guangdong Province ranked first among all provinces in Mainland China (Fang & Gu, 2021). By comparing the spatial distribution of the resource index of CDCs, it is concluded that the resources of CDCs in China cover most regions, but resource distribution is uneven.

As facing more challenges, dynamic emergency response capability becomes the focus of attention. Based on sufficient support of financial, material, and other emergency resources, human resources become the breakthrough for further improvement of emergency management. Human resources in emergency management mainly include, namely, emergency managers, rescue teams, expert groups (K. Zhong, 2020). The dynamic emergency response capability is to give play to people's subjective initiative and realize the organic combination of all kinds of resources by constantly strengthening decision-making, execution, and monitoring in emergency management, to form dynamic emergency response capability (J. Tian et al., 2014). An assessment of the emergency management capabilities of prefecture- and municipal-level disease control agencies found that the human resources were insufficient to meet the actual work needs of emergency management, while laboratory funding and equipment were also inadequate. In another study, data envelopment analysis was used to evaluate the balance between emergency human resource (input) and emergency management capability (output) of selected organizations based on the number of employees, the proportion of employees with a bachelor's degree or higher educational level, and participation rate in advanced studies within the prior three years. Input indicators, disease control performance output indicators, select monitoring and early warning and implementation capabilities, resource reserves, and call management capabilities were considered, and it was concluded that to maximize emergency management capability, disease control agencies must increase investment in human resources (H. Zhang & Zhang, 2018), given that the allocation of human resource for disease control affects the performance of public services in emergencies. In another recent study, population distribution was used to quantify emergency funding input and human resources. The Gini coefficient for specific team building and emergency support, processing, monitoring and early warning capabilities in an emergency showed that human resource equality had a greater influence than geographic equality on emergency management capability (Y. Zhang, 2020), indicating that inequalities in the allocation of human resources for disease control affect the performance of public services (W. Li, 2019) and their emergency management capabilities. As human resource is an important factor in emergency management capabilities, the research on human resources for disease control will be further discussed (Y. Peng & Xu, 2010).

2.4 Human resources of CDCs

In the face of increasingly complex epidemic prevention challenges, human resources, as an important factor in emergency management, are the breakthrough to further improve emergency management based on adequate support of financial and material resources. Facing COVID-19, Chinese CDC personnel have made great contributions to the fight against the epidemic. In terms of scale and scientific research level, China’s disease control teams are global leaders, so the outbreak in China was brought under control quickly. However, the problems of human resources restrict the improvement of epidemic prevention and control performance and emergency response capacity. In recent years, the human resources deficiency of disease prevention and control system has been exposed in China's emergency response. Therefore, it is necessary to strengthen the construction of the human resources system of CDC in China (Kui et al., 2017).

The establishment of human resource teams for disease control in China initially met the country’s needs, but the overall education level of the personnel was low, the age distribution was unreasonable (the age of intermediate title personnel was close to retirement age), and there was a lack of leadership. Following reforms of the disease control and health supervision systems in 2000, the Chinese CDC was established in 2002, and the health supervision function was eliminated. As a purely technical institution, it no longer assumes administrative functions and oversees disease control at the national, provincial, prefectural, and county levels. The first major crisis faced by the Chinese CDC was the 2003 SARS epidemic, which became a focus of research on human resources for disease control.

Research on human resources by disease control institutions has mainly centered on human resource allocation, personnel structure, professional title, and professional composition of the establishment, and has yielded contradictory findings. For instance, there is disagreement in terms of equality in human resource allocation. One study concluded that the staffing and staffing structure of disease control teams was generally fair and that resource allocation was reasonable for the permanent population, although the allocation of technical personnel varied by region. The overall fairness of human resource allocation in China's disease control institutions was found to be good according to the Theil index. A study showed that the fairness of human resources allocation in China CDC was poor, and the fairness in western China was the worst (Y. Jiang et al., 2020). According to the Gini coefficient, the overall fairness of human resources distribution by population is good, but the fairness of human resources distribution by region is poor. According to the study on human resource allocation based on population concentration, it can be concluded that the human resource distribution of CDC in eastern and western China is uneven, while the population fairness in central China is the highest other parts are lower (Q. Qiu et al., 2021). However, others have reported that human resources in Eastern China showed a declining trend and that human resource allocation in the western region was unfair (Y. Jiang & Cao, 2017). The Gini coefficient of disease control manpower allocated by geographic area was reported as ~0.55, indicating a high degree of inequity. These findings led the authors to conclude that human resource allocation in disease control institutions was inequitable and that the quality of personnel needed to be improved. Other studies showed that there was an imbalance in the age distribution of disease control agency personnel, with a low proportion of young employees (Kui et al., 2017). Additionally, in terms of academic qualifications, the proportion of personnel with higher education level was relatively small, although it showed an increasing trend. The number of personnel in disease control teams decreased by 2.5% from 2009 to 2014, while the total number of core health technicians decreased by 4.1%. Additionally, the number of human resources in China's disease control institutions is inadequate and their quality needs to be improved; this along with the aging personnel and developmental inequalities across regions are issues that need to be addressed.

Research on job title and the establishment of human resources for disease control has also yielded controversial findings. The fact that job title does not conform to a pyramid structure has resulted in disillusionment among personnel; moreover, higher vocational colleges have indicated that the proportion of personnel was too small or that the proportion of senior personnel was too high compared to that of junior personnel (Z. Li et al., 2010). A staff size of 22 at provincial-level disease prevention and control institutions was below the establishment standard in 2014. However, other researchers have demonstrated that the overall title structure is improving for reasonable increase in the number of senior professional titles (Kui et al., 2017). Research conducted in Zhejiang Province showed that the staffing of county-level CDCs was reasonably matched to the population density and area of jurisdiction; and the projected budget matched the actual work needs of the CDCs.

Considering frequent public health incidents and the heavy workload of personnel in disease control institutions, the issues of human resource compensation and brain drain have attracted attention. In recent years, there have been a significant loss of professional and technical personnel from state, provincial, municipal, and county disease control agencies, with the attrition rate increasing each year. The loss of young and middle-aged experts—most of whom come from a business mainstay (e.g., Thousand Talents Program, Outstanding Youth)—has had a serious impact on the performance of disease control institutions (K. Zhong, 2020). From 2012 to 2017, the net loss of personnel with middle and senior professional titles at Shanghai CDC exceeded the number of incoming personnel with junior and nonprofessional titles. The loss of young and middle-aged experts has a negative impact on the construction of the talent echelon in CDC. The main reason for the loss of young and middle-aged experts is the limited space for career development (L. Guo et al., 2021). Although there was internal promotion to professional titles, the remuneration package did not match that of other disease control agencies or the work input. Low salary leads to less attraction for the position, which is the most important factor for brain drain (L. Guo et al., 2021). The motivation of Chinese CDC staff is mainly influenced by economic incentive factors (L. Wang et al., 2014).

The per capital workload of Shanghai CDC staff was 2.49 times the annual legal working day, but the salary level from 2012 to 2016 was much lower than the market price and the annual growth rate was less than half that of medical institutions at the same level during the same period (F. Lu & Huang, 2018). In 2015, nearly half of employees of a disease control agency in Beijing had an income that did not meet the average wage set by the Human Resources and Social Security Bureau (Zou & Guo, 2021). Under these circumstances, a compensation system such as the performance-based incentive pay of the Chinese CDC did not provide the intended motivation (H. Chen & Xiong, 2017). The same was true for subsidies such as sanitation and epidemic prevention allowances (Xu & Jiang, 2016). In addition, the phenomenon of unable to attract or retain talents after introduction is also very prominent, one of the main factors is the difficulty of job appointment. If the vacancy of brain drain cannot be supplemented, the problem of insufficient talent in disease control will be further aggravated (Q. Wu et al., 2021). Especially during the epidemic period, the huge workload requires more staff to maintain the operation of the CDC, so it is necessary to pay attention to daily training of emergency personnel, to increase the reserve staff with professional emergency response capabilities.

Research on human resources of disease control agencies is not as extensive in foreign countries as it is in China, and mainly focused on the establishment of a human resource information system. The shortage of health human resources is the main obstacle to achieve health and development goals in most African countries. The U.S. CDC has led the development of human resource information systems in the health sector, expanding the workforce through South–South cooperation. To promote the development of health workforce planning and decision-making, health workforce system uniformity and standardization was evaluated. In an environment where resources are scarce, disease control agencies may adopt a comprehensive and appropriate disease and health strategy, but lack of financial support, coordination, and personnel training and poor experimental capabilities can hinder their performance (Phalkey et al., 2015).

There is no unified definition of human resources for disease control, but based on the above studies, resources include the number of personnel, personnel characteristics (sex, education, age.), professional title, professional composition of the establishment, human resource training, salary, treatment of personnel, and occupational health (Nie, 2016).

2.5 Research on the effectiveness of infectious disease prevention and control

2.5.1 The goal and significance of infectious disease prevention and control

Since the founding of China, the Government has attached great importance to the prevention and control of infectious diseases. The Law of the People's Republic of China on the Prevention and Control of Infectious Diseases (hereinafter referred to as the "Law on the Prevention and Control of Infectious Diseases") is the first major health law promulgated with the approval of the highest organ of state power since the founding of China for the prevention and management of infectious diseases, comprehensively stipulating the principles, principles and measures for the prevention and control of infectious diseases in the form of laws, and clarifying the responsibilities of citizens, relevant social organizations and relevant government departments in the prevention and control of infectious diseases, which is the main legal basis for the prevention and control of infectious diseases. The law aims to prevent, control and eliminate the occurrence and epidemic of infectious diseases, and to protect human health and public health. Implement the principle of giving priority to prevention, combining prevention and treatment, categorical management, relying on science and relying on the masses. By now 2023, 74 years have passed since China's infectious disease prevention and control.

In the early days of the founding of New China, the morbidity, illness and mortality of infectious diseases in China were very high, plague, smallpox, cholera and other virulent infectious diseases often broke out, infectious disease deaths accounted for the first place among all causes of death. The Chinese government has carried out vaccination work against diphtheria, pertussis, typhoid, cholera and plague, and taken a number of measures such as actively finding, treating patients and vaccinating patients, which has successfully reduced the morbidity and mortality of various infectious and venereal diseases (Li & Shen, 2006). Today, after several generations of efforts, large-scale outbreaks of infectious diseases have become rare, and the vast majority of infectious diseases that seriously endangered people's lives and health in the past have been maintained at extremely low levels, and China has successively eliminated smallpox, blinding tracheotomy, satyriasis and neonatal tetanus. Severe infectious diseases such as cholera and plague, which once seriously endangered people's lives and health, have become extremely rare. The AIDS epidemic has generally remained at a low prevalence level. During the COVID-19 epidemic, the Chinese government implemented a "people-oriented" policy and guidelines, established a square cabin hospital, isolated and treated patients, and in the early days of the COVID-19, " when one side was in difficulty, all sides supported", medical staff from all over the country rushed to Wuhan, and all kinds of materials were transported to Wuhan. Since the COVID-19 epidemic, due to correct and strict prevention and control measures, the life, health and safety of people, especially the elderly, have been guaranteed (W. Yang, 2019).

2.5.2 Major influencing factors of infectious disease prevention and control in China

2.5.2.1 Disease control measures

The global pandemic of the COVID-19 epidemic is a big test for countries around the world to test national capabilities, verify the advantages and disadvantages of the system, and evaluate the effectiveness of government. In this world championship related to national capacity, institutional merit and governance effectiveness, compared with the strained, slow and weak governance failures of Western countries in responding to the COVID-19 epidemic, and even the continuous spread of the epidemic and the widening losses, China has gathered a strong national capacity that integrates the ability of political parties, the government and the great power of the people in epidemic prevention and control, and built an epidemic prevention and control system under the strong leadership of the party and the strong intervention of the government, mass prevention and control, joint prevention and control, and scientific control and prevention and control according to law. Always adhering to the "people first" has demonstrated the essence of the people's nature of the socialist system with Chinese characteristics (Xu, 2022).

Since the outbreak of the COVID-19 epidemic, China's epidemic prevention and control process has been roughly divided into two stages: epidemic prevention and control and normalized epidemic prevention and control. In the first stage, China carried out emergency containment of the sudden epidemic, and under the general strategy of prevention and control of "external prevention of import, internal prevention of proliferation", it achieved a decisive victory in the defense of Wuhan and the strategic results of the national epidemic prevention and control war. In the second stage, according to the situation that the global epidemic is still at a high level, China adjusted the general strategy of epidemic prevention and control to "external prevention and internal rebound", and coordinated the promotion of epidemic prevention and control and economic and social development (Xu, 2022).

The practice concept of epidemic prevention and control in China is centered on "life" and "equality", and adheres to the value position of "life first". Life is the basic prerequisite for human survival and development, and a prerequisite for all other rights. Xi Jinping has repeatedly stressed that "putting people's life safety and health first" and "protecting people's life safety and health can be done at any cost". On the one hand, the essence of "life first" is to put the lives and health of the people first. In the stage of epidemic prevention and control and the stage of normalized epidemic prevention and control, the adjustment of China's general prevention and control strategy demonstrates the value position of the party and the state adhering to the "life first" from the policy level. On the other hand, "life first" implies the value of equality of life. Although in the process of epidemic prevention and control, due to the diversification and rapid characteristics of virus mutation, the difficulty of epidemic prevention has increased, and there are difficulties and twists and turns in the epidemic prevention process in individual cities and regions, but on the whole, China's epidemic prevention and control policies have guaranteed the life safety of the broadest masses of the people, especially the elderly and patients with underlying diseases and other relatively vulnerable groups. In the Western country, under the continuous influence of social Darwinist ideas, many countries that practice the capitalist system have chosen the "herd immunity" epidemic prevention policy, resulting in millions of people dying from the COVID-19 virus infection, of which the elderly and patients with underlying diseases account for the vast majority of deaths. Even so, these countries have always adhered to the "capital first" and put economic interests above the interests of life, and the "capital logic" of the capitalist system has been vividly exposed in the face of the epidemic, which is in sharp contrast to the "people's logic" of the socialist system with Chinese characteristics displayed by China's epidemic prevention and control policies (C. Chen & Xu, 2022).

2.5.2.2 Government human resource allocation

Taking the COVID-19 epidemic prevention and control measures in Shenzhen as an example, we will further refine the main practices of China's excellent examples of government human resource allocation during the COVID-19. First, government leaders have established an emergency command system with multi-department cooperation to break through the top-level design of epidemic prevention and control. Second, timely issue guidance and implementation plans for epidemic prevention and control to ensure that prevention and control measures are accurate and effective. Third, macro control, overall leadership of the prevention and control of the COVID-19 epidemic. Four, clarify needs and formulate institutional-level epidemic prevention and control work plans. Five, establish mechanisms for releasing epidemic information to ensure a high degree of openness and transparency. Six, build a grassroots epidemic prevention and control network.

After the outbreak of the COVID-19 epidemic, Shenzhen established the Shenzhen COVID-19 Epidemic Prevention and Control Headquarters and established a power and responsibility system and coordination mechanism integrating the functions of epidemic emergency management command, decision-making, execution, scheduling, feedback, and public opinion guidance. In accordance with the responsibilities and requirements of each working group, the work plan clarifies the main lead responsible unit, department and member unit, and selects a liaison from the member unit to ensure the efficiency of work docking; The work responsibilities of each working group are clarified, and the division of responsibilities is clear, and the working mode of multiple working groups is coordinated and cooperative. All departments have actively introduced corresponding prevention and control measures and implementation plans, carried out epidemic prevention and control work scientifically and efficiently, and carried out different prevention and control guidelines for different places, such as ordinary families, public places, public transportation, schools, enterprises, nursing homes and other 9 key places. At the same time, media at all levels in Shenzhen concentrated on reporting the city's anti-epidemic situation, releasing epidemic prevention news and popular science knowledge. Efficient, open and transparent information release allows residents to establish a comprehensive and clear understanding of the trend of the epidemic (Jin et al., 2023). The specific work breakdown is shown in Figure 2.2.

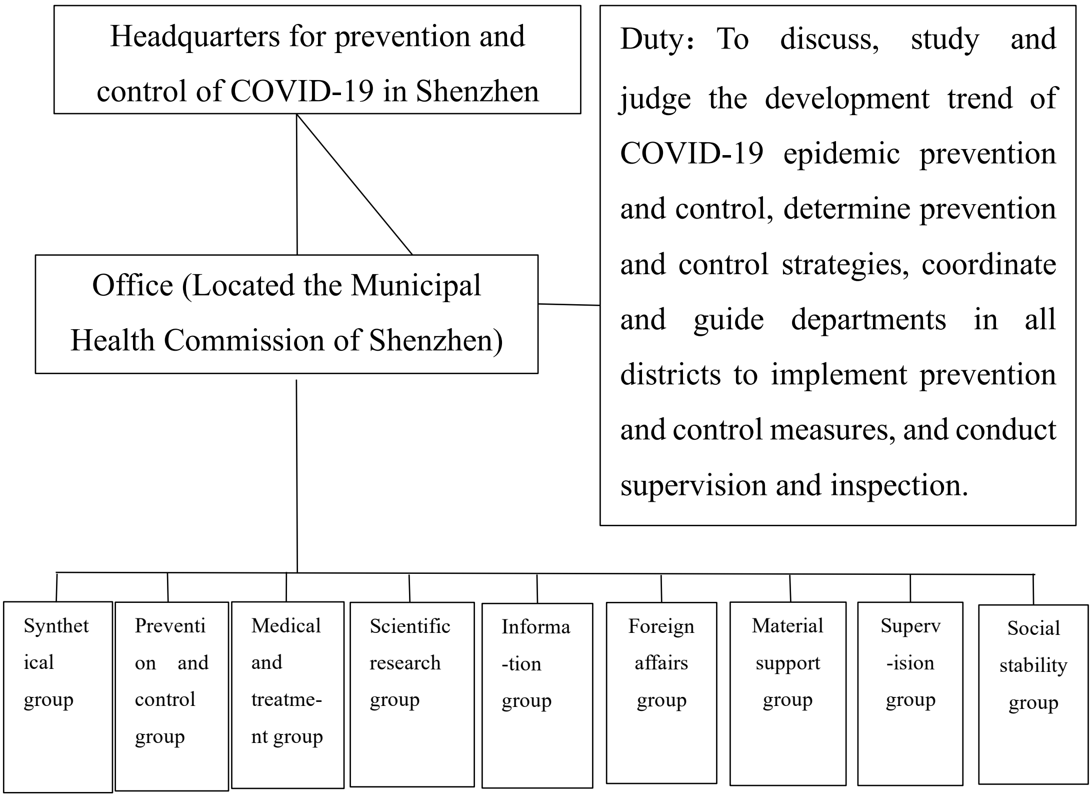

Figure 2.2 Shenzhen Municipal Government Working Group

Source: Jin et al. (2023)

2.5.2.3 Human resource allocation in primary medical and health institutions

During the normalization of the COVID-19 epidemic, China's grassroots CDC built a "2-7-1" structured emergency post module (see Table 2.1 for details) according to the characteristics of COVID-19 pneumonia epidemic prevention and control and the theory of human resource management, that is, 20% human resources are the core resources of epidemic prevention and control, including three sub-modules: centralized medical observation sites, community epidemic prevention and control, and prevention of nosocomial infections; 70% of human resources are public resources for epidemic prevention and control, including four sub-modules: nucleic acid sampling, out-of-hospital infection prevention and control supervision, COVID-19 vaccination services and health management; 10% human resources are logistics resources for epidemic prevention and control, including two sub-modules of administrative management and logistics support. After the establishment of the module, all staff and special training will be carried out for routine work and special work of prevention and control, that is, nucleic acid sampling, COVID-19 vaccine vaccination services, hospital infection prevention and control, and pre-inspection and triage will be used as routine work for prevention and control to train and assess all staff; Take epidemiological investigation, recollection of suspected positive subjects and health management of centralized medical observation points as special contents, and select specialists for training and assessment to ensure that key contents are mastered in a short period of time and that people and posts are matched. Once a public health emergency is encountered, it can immediately respond to the post and appoint personnel, and quickly form an emergency team with complete structure and functions (F. Lin, 2022).

Table 2.1 "2-7-1" structured emergency post module for primary medical and health institutions

Main module	Sub-module	Personnel setting		
		post	Work task	number of people
Core assets for epidemic prevention and control Source (20%)	Centralized medical observation site	Epidemic prevention officer	24-hour station, responsible for infection prevention and control work in centralized medical observation sites.	5
		Medical specialist	24-hour station, responsible for the health management of quarantined personnel.	5
	community-based epidemic prevention and control	Flow control specialist	Responsible for epidemiological investigation.	3
		Sampling specialist	Responsible for emergency nucleic acid sampling.	3
		Information commissioner	Responsible for tracking the progress of nucleic acid sampling, data statistics, submission, etc.	2
	Prevent nosocomial infection	Pretest triage specialist	Responsible for pre-inspection and triage related work.	2
		sensationalist	To be responsible for the prevention and control of nosocomial infection.	2
Public funds for epidemic prevention and control (70%)	Nucleic acid sampling	sampler	It is divided into six groups, the group leader is responsible for the organization and coordination of on-site sampling, and the team member is responsible for the implementation of sampling work.	84
	Supervision of hospital infection	Sense of supervision staff	Responsible for on-site coordination of nucleic acid sampling sites, supervision of	10

	prevention and control		hospital infection prevention and control and other related work.	
	COVID-19 vaccination services	Registrars/vaccinators	Responsible for the COVID-19 vaccination service of the sub-center: to carry out COVID-19 vaccination in villages according to the unified arrangement of the superior.	10
	Health management	Health specialist	Responsible for in-home nucleic acid sampling, health management, medical and medicine delivery services for residents in sealed or controlled areas	1
Logistics resources for epidemic prevention and control (10%)	Administrative management	Administrative commissioner	Responsible for receiving and sending documents, drafting documents, conveying instructions, collecting information, writing reporting materials, propaganda materials, and popularizing health knowledge inside and outside the hospital.	3
	logistical support	Logistics specialist	Responsible for canteen dining management, property management, medical waste and sewage management.	1
		marshal	Responsible for personnel transfer, material transportation, vehicle coordination, etc.	3
		Information commissioner	Responsible for information system deployment and other work.	1
		Materials specialist	Responsible for the procurement and allocation of sampling materials and protective equipment.	2

Source: F. Liu (2022)

According to the requirements of epidemic prevention and control tasks in different periods, primary medical and health institutions adopt the combination of emergency and emergency deployment mode (see Table 2.2 for details), which are divided into three periods according to the epidemic situation in the region, namely the normalization period, the epidemic sporadic period and the epidemic outbreak period. Flexibly coordinate human resources, reasonably arrange work tasks and formulate shift scheduling system. During the normalization of the epidemic, the center's epidemic prevention and control work is parallel to daily work, and if there is an emergency, the sampling team will arrive at work in time according to the rotation situation to complete the task. During the outbreak period, the whole institution took the prevention and control of the epidemic as the core, suspended the COVID-19 vaccination service, compressed the daily work to only retain the basic convenience clinic and the maternity examination clinic, and urgently allocated the human resources of the whole hospital in a short period of time, and invested in seven rounds of nucleic acid testing for all staff in the area, household sampling of close contacts and secondary close contacts or disabled objects, epidemiological investigation, recollection of suspected positive objects, health management of centralized medical observation sites, and prevention and control management of hospital infection at sampling points. 29 sampling points to prevent and control the supply of materials and other tasks, all work is carried out efficiently and orderly. During the period of epidemic distribution, the grassroots center focused on emergency prevention and control tasks, took into account the normalization of prevention and control work and daily work, and completed the tasks of door-to-door sampling, epidemiological investigation, support for convenient nucleic acid sampling service points in the jurisdiction and national nucleic acid sampling service points, and effectively responded to the call of the city's work headquarters for responding to the COVID-19 pneumonia epidemic (F. Liu, 2022).

Table 2.2 Combined emergency deployment model of primary medical and health institutions

Human resource classification	Epidemic situation	Work task	Personnel scheduling
Core resources for epidemic prevention and control (20%)	Normalized period Sporadic period	Health management of centralized medical observation points, community epidemic prevention and control tasks, and prevention of nosocomial infections.	The number of personnel in the centralized medical observation place is one shift per month, and the management of "14+7+7" is implemented. Community epidemic prevention and control personnel and nosocomial infection prevention personnel should work according to normal opening and closing hours.
	Outbreak period	Health management of centralized medical observation points, community epidemic prevention and control tasks, prevention of nosocomial infections and nucleic acid sampling of all personnel.	The number of personnel in the centralized medical observation place is one shift per month, and the management of "14+7+7" is implemented. Community epidemic prevention and control personnel and nosocomial infection prevention personnel shall participate in nucleic acid sampling, epidemiological investigation, nosocomial infection prevention and control, and pre-detection and triage according to work arrangements.
Public resources for epidemic prevention	Normalized period	Routine work such as COVID-19 vaccination services, basic medical	In case of sudden emergency, the sampling team is responsible for completing. The sampling team adopts a rotating management system. One

and control (70%)		services, basic public health services and family doctor contract services; Household sampling and epidemiological investigation and other emergency tasks.	sampling team is on duty every week, and two sampling personnel are on standby 24 hours per shift. Emergency tasks are immediately on duty. When there is no emergency task, work according to normal opening and closing hours.
	Sporadic period	Emergency household sampling, epidemiological investigation and other work, taking into account the normal work of the epidemic and daily work.	"One morning, one night" three shifts and three lines rotation system, the first line in the unit to perform tasks second and third line 24 hours standby, keep mobile phones unblocked, there are tasks in place within 30 minutes.
	Outbreak period	Complete seven rounds of nucleic acid sampling for all staff, prevention and control of hospital infection in sampling sites of the whole population, and household sampling of close contacts or sub-close contacts or disabled people; Daily work has been reduced to retaining only the basic outpatient clinic and the maternity clinic.	According to the number of residents in the sampling point, the number of sampling personnel should be reasonably arranged; Adopt shift system, each shift work duration of 2~3 hours, alternating work.
Logistics resources for epidemic prevention and control (10%)	Normalized period Sporadic period	Responsible for administration and support work.	Work your regular commute.
	Outbreak period	Responsible for the preparation of nucleic acid sampling materials, materials transportation and information system deployment.	According to the national nucleic acid sampling period, work in advance to safeguard materials, inventory materials after the end of sampling, and do registration and reporting.

Source: F. Liu (2022)

2.5.2.4 Public health emergency management

In the prevention and control of the COVID-19 epidemic, China has given full play to the superiority of the socialist system, all departments attach great importance to the arrangement of various work tasks, under the unified leadership of division of labor and cooperation, starting from personnel and material arrangements, information collection and reporting, changing work forms, postponing the start of school, human resource management and other parties, guiding the people of the whole country to live and work in an orderly manner on the basis of strengthening personal protection, and quickly transform a number of cabin hospitals and isolation places, timely isolation and treatment of patients, and prevent the further spread of the epidemic. In order to ensure national productivity, China has introduced a variety of policies to give workers full protection, including increasing work-related injury insurance, work subsidies, improving the working environment of employees, helping graduates find employment, subsidizing small and medium-sized enterprises producing medical supplies, strengthening the protection and subsidies of anti-epidemic staff , which greatly increased the enthusiasm of workers and confidence in defeating the virus, and also gave the front line of anti-epidemic. Strong life support from staff. However, at the same time, during the outbreak of the epidemic, China's protection for the lonely elderly, the disabled, left-behind children and other groups is still insufficient, resulting in infected elderly people jumping to commit suicide, family isolation of disabled children starving to death at home, relevant departments should do a good job in epidemic prevention and control, do a good job in the protection of all kinds of vulnerable groups, to avoid the occurrence of tragedies (Sun & Weng, 2021).

In addition to the leading work of government departments, mainstream media have also actively participated in the COVID-19 epidemic, obeying commands, shouldering heavy responsibilities, and investing in news reports with a high sense of responsibility and mission to help prevent and control the COVID-19 epidemic. The epidemic is the order, and prevention and control are the responsibility. They "rushed time" with the development of the epidemic and "competed" with online rumors, so that there was no loss of speech at critical moments and no shortage of major issues. At the moment of the epidemic, the strong leadership of the Party Central Committee and the authoritative release of mainstream media have injected a "shot in the arm" into the people of the whole country - a survey on the COVID-19 pneumonia epidemic shows that in late January 2020, the public's confidence in government governance, medical treatment, scientific research and other aspects showed a significant trend of increase. Unlike other public opinion events, public health emergencies have more uncontrollable factors and greater uncertainty. In order to fight the "protracted battle" against the epidemic, the commentary column of the People's Daily Overseas Edition "one review a day", and the People's Daily mobile phone newspaper added an epidemic section, so that the epidemic news was "reported once a day". During the epidemic, the mainstream media shouldered the dual responsibility of information dissemination and public opinion guidance, stabilizing people's support, inspiring people and strengthening confidence (X. Gao & Zhao, 2020).

2.5.3 Concept and evaluation of performance of emerging infectious diseases prevention and control

The world is experiencing a crisis of emerging infectious diseases on the global scale, with new emerging infectious diseases emerging and spreading around the world along with population migration. Emerging infectious diseases seriously endanger public health and safety, and even have a negative impact on politics and economy. In particular, the outbreak of COVID-19 in 2020 has brought great trouble to the world, and more and more attention is paid to the prevention and control of emerging infectious diseases throughout the world (L. Guo & Huang, 2020).

2.5.3.1 The concept of effectiveness in the prevention and control of emerging infectious diseases

At present, there is no uniform definition of performance of emerging infectious diseases prevention and control. In the Modern Chinese Dictionary of New Words, performance is defined as achievements and benefits; meanwhile, the Modern Business Management Dictionary mentions the direct consequence of efforts to complete the work—that is, the quantity and quality of the work completed through effort. The concept of work performance was introduced in the public sector at the end of the 20th century. From a macro perspective, performance in the public health sector (e.g., British National Health Service) is results-oriented and evaluated based on health improvement, fairness, health service efficiency, and medical and health effects. The WHO's health system performance framework includes health system modules (governance, financing, manpower, drugs, vaccines, and information systems), intermediate goals (coverage, quality, and safety), outcome goals (improvement of health, efficiency, and emergency response), and performance core quality (disability improvement, life expectancy, and response level). U.S. public health performance evaluations consider mission, organization, capability, process (technical service exchange), results (both short- and long-term), and macro environment. The performance assessment of basic health service projects of China Health and Family Planning Commission includes organizational management, project operation, fund management, and project performance (National Administration of Traditional Chinese Medicine, 2016).

China's public health emergency system has played an important role the prevention and control of public health emergencies both domestically and globally. Performance of emerging infectious diseases prevention and control can be analyzed from different perspectives. For example, the effects of disease control measures in infectious disease outbreaks can be examined from the standpoint of preparations for epidemic treatment, investigation processes, and control measures and their effects; or preparation for public health emergencies, response capabilities, surveillance epidemiology, and assessment of dangerous situations (per-announcement, education, and training). Additionally, epidemic control performance can be evaluated in terms of stages of preparation, occurrence, and recovery and its 13 sub-indices.

Throughout the prevention and control process, decision-makers also need to identify the cost and benefit outputs associated with various planning and policy choices and be able to rigorously and systematically compare the advantages and disadvantages of policies when evaluating a policy and the choice of incorporating it into a legislative or regulatory package, in order to achieve maximum benefits with minimum cost input. Economic assessments, pandemic-related policies and interventions are often used by researchers to weigh the costs and benefits of health policy. In addition to reporting the benefits and costs quantified as part of the analysis, economic performance assessments can summarize various results. In terms of policies, China has adopted many policies during the new crown epidemic, including improving the ventilation of indoor spaces; monitoring wastewater; increase vaccines, therapeutics; testing or supply of face shields; providing financial incentives for vaccination; Vaccination; investing in the development of new vaccines, therapeutics or tests; limiting the capacity of certain establishments; Ensure isolation of people who test positive; providing financial support to people who must quarantine or suffer economic damage; Restrictions on domestic or international travel . The quantity and quality of evidence on the costs and benefits of these interventions varied. Economic assessments of COVID-related policies often address the combined impact of interactions between policies, particularly for non-pharmacological and social policy interventions (Persad & Pandya, 2022).

2.5.3.2 Analytical methods for the prevention and control of infectious diseases

There are different analytical tools commonly used to assess the performance of emerging infectious disease prevention and control including cost-benefit analysis, cost-effectiveness analysis, and cost-utility analysis (Stone et al., 2005).

1. Cost-effectiveness analysis

Cost-effectiveness analysis (CEA) is a quantitative analysis method used to evaluate the effectiveness of a project or decision, usually measured using indicators such as net present value (NPV) and internal rate of return (IRR). A cost-benefit analysis (CBA), on the other hand, is a comparative method used to compare the costs and benefits of a project or decision in order to determine whether it is worth implementing. CBA is typically measured using metrics such as benefit-cost ratio (BCR) and NPV. CEA is often used for evaluation when the outcomes of health programming programme cannot be measured in credits. CEA can be considered a special case of CBA, but CEA can usually only be used to evaluate programs with the same objectives but different results and express the results in terms of "ratio" (cost/effect amount). This ratio indicates the cost required to achieve a given effect (W. Tian, 1995).

Bai et al. carried out a CEA to study the influence of methadone maintenance therapy, needle exchange and intervention for sex workers on the AIDS epidemic in G province. The results showed that in 2005, needle exchange was the most cost-effective in high and low prevalence areas, and the cost per averted case of new HIV infection was $892 and $1801, respectively. Methadone maintenance treatment programs cost US $2,687 and US $5,101 per averted new infection, respectively; While interventions aimed at the sex worker population averted one new infection at $3,029 and $6,429, respectively. This study shows that needle exchange is the most cost-effective in high and low prevalence areas where prevention of new infections is the ultimate effect of intervention, revealing the need for long-term investment in AIDS interventions (Bai et al., 2010). Gan used a retrospective method to collect and collate relevant information and HIV antibody test results from outpatient consultations between January 1, 2016, and December 31, 2020. CEA was used to analyze the average cost of tested cases, and the characteristics of population distribution and economic efficiency of the results of HIV voluntary counseling and testing in Shaanxi Provincial People's Hospital from 2016 to 2020 were obtained. In 5 years, the average cost of patients infected with HIV was 6168.29 yuan through VCT outpatient screening, and the average cost of patients infected with HIV through routine screening was 93,493.57 yuan, the latter was 15 times of the former. The study found that the positive rate of in-hospital VCT screening for HIV is higher than that of in-hospital routine screening, but the cost of VCT and in-hospital screening for HIV is higher and the positive rate is lower (Y. Gan, 2022).

Liu used economic analysis and evaluation methods to analyze the cost effectiveness of tuberculosis control projects in China and obtained the average cost of the 3-year total average level of the project. They believed that indirect cost had a great influence on the average cost, and to reduce the average cost, only efforts should be made from the direct cost (G. Liu et al., 2003). Xu evaluated the cost-effectiveness of current malaria prevention measures in the Yuanjiang River Basin. Three field intervention experiments and economic analysis were conducted to specifically analyze the antimalarial effects and cost-effectiveness of prophylactic drugs, single DDT residual spraying and their combined use. Thus, there is no significant difference in cost between piperaquine/sulfamdoxine once a month and chlorine plus primula 10d1 times a month. The effect of once-a-month piperaquine/sulfamdoxine was further confirmed in this area. Compared with the single measure, the comprehensive measure is the most cost effective but expensive (Xu et al., 2002).

2. Cost-benefit analysis (CBA)

Cost-benefit analysis (CBA) is a method to evaluate the value of a project by comparing the total cost and benefit of the project. As an economic decision-making method, cost-benefit analysis is applied to the planning decision-making of government departments, in order to seek how to obtain the maximum benefit with the minimum cost in investment decision-making. It is often used to evaluate the value of public utility projects that need to quantify the social benefit.

Cost-benefit analysis is generally divided into the following steps: identify the problem to be solved and the objectives to be achieved; identify various alternatives; analyze the cost of each option; analyze the benefits of each program; discount; evaluating costs and benefits; sensitivity analysis; discuss the results; and make decisions. The classical method of cost-benefit analysis is carried out, in other words, benefit and cost ratio (BCR) and net present value (NPV). BCR is the ratio between the total value of the present value of the program benefit and the total value of the present value of the cost, namely, the benefit obtained by the unit cost. Only the program whose benefit is greater than the cost (BCR>1), the program is considered to be beneficial. Net present value (NPV) refers to taking a certain time as the base point, according to the conversion rate, the net benefit of each year in the service life of the investment into the sum of the present value of the time point. Economic theory reveals that when NPV>0, it means the investment is effective (W. Tian, 1995). The specific process is shown in Figure 2.3.

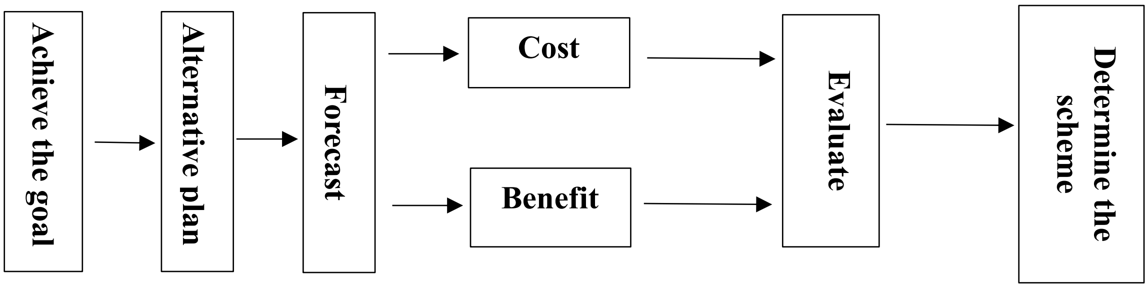

Figure 2.3 Cost-benefit analysis program

Source: W. Tian (1995)

Zhang calculated the cost and benefit of resources input for COVID-19 prevention and control in medical institutions by combining field survey data and literature research parameters and analyzed the cost benefit and sensitivity of economic benefits by using health economics methods. The benefit-to-cost ratio (BCR) in the case of the existing cost was greater than 1 when the proportion of COVID-19 infected persons in the whole population was greater than 0.025% and 0.183%, respectively. It is concluded that the investment in prevention and control of infectious diseases in medical institutions has produced good social benefits. Under the condition of existing cost inputs, the higher the infection rate of the population happen, the more obvious the economic benefits will be (M. Zhang et al., 2022). Based on the perspective of the whole society, Li collected data from relevant departments and literature to construct an improved SEIR model for all permanent residents of Guangzhou. Through constructing different scenarios, they analyzed the output values of real-world scenarios and the scenarios in which the epidemic prevention and control measures were delayed for 3 days and 7 days respectively and conducted cost-benefit analysis on four large-scale nucleic acid tests in Guangzhou. The results showed that under the real-world scenario, the total economic burden of this round of epidemic was about 34.402 billion yuan. Compared with the timely implementation of epidemic prevention and control measures, delaying the implementation of epidemic prevention and control measures for 3 days would result in 1391 cumulative confirmed cases, 43 deaths and a supplementary economic burden of 14.191 billion yuan. And a 7-day delay would bring 2,6237 cumulative confirmed cases, 882 deaths and an additional economic burden of 29.462 billion yuan. The net income of four rounds of large-scale nucleic acid testing was 22.182 billion yuan, with a benefit-cost ratio of 24.23. Finally, it is concluded that timely implementation of epidemic prevention and control measures in the face of the epidemic can greatly reduce the economic burden, and large-scale nucleic acid testing has a good economy (Li & Zhang, 2022).

In addition to emerging infectious diseases such as the novel coronavirus, other infectious diseases also have the methods of benefit-cost ratio and net benefit to carry out cost-benefit analysis. In order to acquire the direct economic losses caused by brucellosis in a class of brucellosis areas in China and the rationality of the investment in prevention and control, Gao constructed the index system of direct economic losses and the cost-benefit evaluation of prevention and control. The results showed that: In 2020, the average direct loss of a single brucellosis sheep was 4557 yuan (excluding dairy sheep), and the brucellosis loss of each province was 180 ~ 2.04 billion yuan, among which the loss of sheep farmers accounted for a relatively high proportion, 73.0%~81.0% of the total loss. The BCR of brucellosis prevention and control by provincial governments was 5:1~38:1. The results showed that brucellosis caused serious economic losses, and the prevention and control of brucellosis could achieve significant economic benefits. It is suggested that farmers and the government should further increase the investment in brucellosis prevention and control, and the government should increase the proportion of preventive investment, which provides technical support for the optimization of brucellosis prevention and control policy (S. Gao et al., 2022). Cai carried out a cost-benefit analysis on the project of preventing and controlling mother-to-child transmission of syphilis in Shenzhen, providing a reference for government decision-making. The cost-benefit theory of health economics was applied to study the implementation results of prenatal syphilis screening. To investigate the staff of syphilis control project institutions and clinical medical technicians in Shenzhen City and grasp the cost of the prevention and treatment process of the project. Results The benefit-cost ratio (BCR) of the whole project in 2003 was 4.88:1, of which the direct benefit-cost ratio was 2.29:1, the indirect benefit-cost ratio was 6.23:1 and the intangible benefit-cost ratio was 0.81:1. It is concluded that prenatal syphilis screening is a low-cost and high-yield public welfare undertaking, which has huge economic benefits and obvious social benefits (Cai et al., 2007). Cai evaluated the economic benefits and cost effects of the strategy regarding preventing mother-to-child transmission (PMTCT) on hepatitis B virus. According to the principle of Hepatitis B immunization decision analytic-Markov model, strategies on PMTCT and universal vaccination were compared. And the universal strategy and no vaccination were used as the reference to determine the model. After introducing parameters related to hepatitis B prevention in Shenzhen, the number of births in 2013 was taken as the cohort population. The benefit-cost ratio (BCR) and incremental cost-effectiveness ratio (ICER) were calculated, and the comparative evaluation of cost-benefit analysis and cost-effectiveness analysis was carried out. Results In 2013, the per capita net benefit of the strategy was 3,7097.51 yuan and the BCR was 14.37 yuan. The per capita net benefit of the general population was 37083.03 yuan, and the BCR was 12.07 yuan. The study revealed that PMTCT strategy gained more economic benefit and effects on health (Cai et al., 2016). Huang analyzed the influenza-like case surveillance data from 421 medical institutions above grade I and 144 medical institutions above grade II in Beijing, evaluated the applicability and effectiveness of influenza-like case surveillance in medical institutions above grade I and above grade II in Beijing, and concluded: The proportion of influenza-like cases attributed to influenza virus infection in primary and secondary medical institutions was basically the same. From the perspective of cost-benefit analysis, the use of 144 primary and secondary medical institutions to carry out influenza-like case surveillance in Beijing could meet the needs of disease surveillance. It has a better cost-benefit ratio (BCR) than expanding to 421 medical institutions above grade I

(Huang et al., 2014).

3.Cost-utility analysis (CUA)

Cost-utility analysis (CUA) is a special form of cost-effectiveness analysis. In evaluating the effectiveness of a health technology, quality of life should be considered in addition to changes in health status. From the social point of view (the benefits brought by the health technology to the society) and the individual's feelings (the satisfaction of the patient or family on the quality of life). Quality-adjusted life years (QALYs) and disability-adjusted life years (DALYs) are often used to measure effectiveness in cost-utility analysis. Cost-utility analysis compares the incremental cost and the incremental health benefit of an intervention project from a certain perspective. The incremental health benefit can be represented by the QALYs gained or DALYs avoided, and the analysis results are presented in terms of the cost per QALYs gained or DALYs avoided.

In addition, the cost-utility ratio (CUR) and the incremental cost-utility ratio (ICUR) are also commonly used analysis indicators. The cost-utility ratio (CUR) is a ratio with a cost denominator and utility numerator used to evaluate interventions in the medical and health fields. The cost refers to the cost of implementing the intervention, and effectiveness refers to the degree of health effect or improvement of quality of life brought about by the intervention. Incremental cost-utility ratio (ICUR) is a variation of the cost-utility ratio used to compare the cost-utility effectiveness of two interventions. ICUR means how many units of utility can be improved for each additional unit of cost spent. Cost-utility ratios and incremental cost-utility ratios can be used to evaluate interventions in the medical and health sector to help decision makers compare the cost-utility effects of different interventions and make more informed decisions.

The study of the cost-utility analysis of vaccination is more used. Ding compared the expected economic costs and health benefits of pneumatically vaccine with routine vaccination of healthy children in Switzerland. Eighty thousand children were followed from birth to age 5. The results showed that the net cost of the vaccination programme, from the point of view of the disease fund, was 190 million Swiss francs. For each quality-adjusted life year, the cost-utility ratio from the sickness fund perspective is 3,9300 Swiss francs (approximately US $2,8900). Additional vaccinations for all children younger than 24 months yield additional benefits and cost Swiss francs 3,3600 per quality life adjusted year (QALY) earned. If this additional vaccination was extended to all children under 60 months of age, there would be a very high cost per additional quality cost-adjusted life year. The study therefore concluded that routine vaccination of healthy Swiss children under 2 years of age would reduce mortality and would have a reasonable cost-utility ratio (T. Ding et al., 2011). Pan adopted the decision analysis to establish the Markov decision tree model, taking cost as the input index, and the number of apparent infections, hospitalizations, quality-adjusted life years lost (QALYs) and deaths of hepatitis A as the output index. Combined with the incremental cost utility analysis, based on the situation of different anti-HAV epidemic areas in China, the output in the next 73 years is expected. And compared with no inoculation program, select the best program. Results The input and output indexes of the common hepatitis A vaccine were lower than those of no vaccination in low HAV, medium-low and moderate epidemic areas, and the incremental cost-utility ratio (ICUR) was lower than 0, indicating that the vaccination program could save costs while increasing QALYs. In the medium-high prevalence area, the investment of hepatitis A vaccine of common species was less than that of no vaccination, the number of apparent infections, the number of hospitalizations, the loss of QALYs were also less than that of no vaccination, and the ICUR was less than 0, but the number of deaths of hepatitis A after common species was 20 more than that of no vaccination. In the highly prevalent areas, the total cost of health service and social total cost of common species were 456,0814 yuan and 584,0430 yuan more than that of non-vaccination, but the number of apparent infections, the number of hospitalization and the loss of QALYs were also smaller than that of non-vaccination, and the number of deaths of hepatitis A increased by 51 cases. The health service cost and social cost for each additional QALY were $1507 and $1929, respectively. Finally, it is concluded that the anti-HAV positive rate should be used to determine whether the vaccine is a common type of vaccine in different endemic areas of hepatitis A in China (X. Pan et al., 2012). Wu calculated the cost of hepatitis B vaccination using the cost calculation method. It is estimated that the number of HBsAg reduction and the number of patients with chronic hepatitis B, cirrhosis and liver cancer after vaccination are the direct indicators. The duration of disease and treatment cost of patients with hepatitis B, cirrhosis and hepatic-cellular carcinoma were investigated by questionnaire. Expert interview to understand the treatment and course of hepatitis B patients; Disability adjusted life years were used to calculate their disease burden as an indicator of effectiveness. The results showed that the estimated total burden of saving hepatitis B, liver cirrhosis and liver cancer was 5,9762.55 DALYs, and the cost of saving 1 DALY was 402.50 yuan. It is concluded that neonatal hepatitis B vaccination is a cost-effective strategy (G. Wu et al., 2004). Wang constructed a dynamic model of canine group transmission and a decision tree model of immunization strategies for canine bite populations, used incremental cost-utility ratio (ICUR) to compare the advantages and disadvantages of different immunization strategies, and used sensitivity analysis to evaluate the influence of relevant parameters on the results. The results showed that compared with the current immunization strategy, 70% vaccination coverage was the optimal strategy, the total cost was 1408,4354 yuan, the total utility value was 2207,8616.23 quality adjusted life years (QALYs), and the incremental cost-utility ratio was -624,8147yuan /QALY. The optimal immunization strategies under different groups of dogs' vaccination coverage and the probability of carrying virus were compared. It was concluded that increasing the vaccination coverage of dog groups and reducing unnecessary human vaccines would be beneficial to further prevention and control of rabies and save social costs (D. Wang et al., 2014).

Cost-benefit analysis, cost-effectiveness analysis and cost-utility analysis have been widely used in the formulation of health planning, the allocation of health resources, the prevention and control of infectious diseases, the evaluation of medical technology and the equipment application and other aspects, become the main methods of health economic research and evaluation, mainly used in the prevention and control of the following infectious diseases: AIDS: Cost-effectiveness analysis can be used to evaluate various AIDS prevention and control strategies, such as HIV antiviral treatment, prophylactic medication, publicity and education. Viral hepatitis: Cost-effectiveness analysis can be used to evaluate various viral hepatitis prevention and control strategies, such as vaccination, screening tests, drug treatment. Tuberculosis: Cost-effectiveness analysis can be used to evaluate various TB control strategies, such as TB screening, treatment and management, and TB vaccination. Influenza: Cost-effectiveness analysis can be used to evaluate various influenza control strategies, such as vaccination, mask wearing, quarantine measures. Pneumonia: Cost-effectiveness analysis can be used to evaluate various pneumonia prevention and control strategies, such as pneumonia vaccination, education, drug treatment.

In summary, cost-benefit analysis, cost-effectiveness analysis and cost-effectiveness analysis are widely used in the prevention and control of infectious diseases and can help decision makers to more comprehensively evaluate the costs, benefits, effectiveness and effects of different prevention and control strategies, so as to make optimal decisions.

2.5.4 Human resources of CDCs and performance of emerging infectious diseases control

Prevention and control of emerging infectious diseases is a race against time, the sooner the disease is controlled, the less damage. Rational allocation of human resources of CDCs and adequate reserve of human resources of CDCs will save valuable time for epidemic control and prevention of emerging infectious diseases. The prevention and control of emerging infectious diseases includes procedures such as surveillance, detection, epidemiological investigation performance and risk assessment, and involves professional public health knowledge. Therefore, a high-level professional talent team of CDC is essential. There are many problems in the allocation of human resources of CDCs in China, and it has become a consensus to strengthen the construction of human resources of CDCs system (Y. Jiang & Cao, 2017).

The rational allocation of human resources is conducive to the rational development and utilization of public health resources and achievement of good disease control in the face of emergencies. Conversely, the lack of human resources for disease control negatively impacts disease control performance. In grassroots emergency management, solving actual performance and system dilemmas and making full use of emergency human resources is an optimal strategy for epidemic control. An analysis of the SARS emergency response showed that disease control agencies had certain emergency response capabilities in terms of response speed and resource allocation but had not sufficiently invested in public health manpower and were mostly self-financing, which limited their ability to respond to the emergency. Since the SARS outbreak in 2003, China has established an effective public health management system and has made significant progress and improvements in preparedness, response, and recovery, although there is considerable heterogeneity across regions and levels of government and the application of new technologies remains insufficient (M. Sun, 2018).

In terms of input and output, the Chinese CDC has a sound organizational structure and standardized emergency information reporting system for public health emergencies. After the SARS outbreak in 2003, China increased investment in the public health system and achieved remarkable results, with the greatly improving overall completeness rate of public health services. But the structure of emergency response teams, item storage, special emergency response agencies, and expert database construction require improvement. China’s county-level CDCs have low operating efficiency according to a data envelopment analysis. An investigation of the emergency response capability of rural public health personnel found that those involved in disease control had a low level of knowledge concerning emergency response, although skills training had a positive effect and was well-received. Meanwhile, an investigation of the emergency performance of municipal health institutions in Shandong Province showed that the training exercises were ineffective, and the number of health emergency responders could not meet actual work needs (X. Gao & Li, 2015).

2.5.5 Emergency management capability and effectiveness of emerging infectious disease response

The emergency management of COVID-19 is closely related to epidemiological research (Y.

Ye et al., 2020). After the outbreak of COVID-19 in 2020, the popularity of emergency management research has been rising (H. Zhang & Z. Tao, 2021a). The spread of emerging infectious diseases is non-linear and dynamic, simulating the spread of COVID-19 through mathematical models, and the number of infected people in the epidemic rises exponentially before effective emergency measures are taken (Musa et al., 2020), while the actual number of infected people is indeed the case. The short-term cost of controlling emerging infectious diseases is smaller than the long-term cost of non-control (Wilder-Smith et al., 2020), the characteristics of emerging infectious diseases require timely response and action by governments and other public institutions. McClokey and Heymann (2020) believe that overreacting in emergency response is better than underreacting, because the consequences of insufficient response may be more severe. Based on the theory of emergency management, a theoretical framework constructed, and from the perspective of pre-prevention, in-process disposal, and post-event assessment of emergency management, they used literature research and multi-round expert consultation methods to construct an evaluation index system for the prevention and control of COVID-19.

Emergency response to public health emergencies is one of the basic functions of disease prevention and control agencies, and it is also the key work of disease prevention and control (J. Yu & Yu, 2007). The scope of the epidemic can be effectively controlled under the intervention of emergency response measures (Xiong, 2020). The outbreak of SARS in China in 2003 highlighted the lack of emergency response capacity for public health emergencies, so China planned to spend about three years to improving the emergency response mechanism, disease prevention and control system and health law enforcement supervision system. The emergency management capacity has been defined above. Emergency management capacity refers to the ability of the government and relevant public institutions to prevent, respond, deal with and recover from public health emergencies using scientific, technological, management and regulatory means to protect public health. Maximizing emergency management capabilities is inseparable from the support of human, financial, material, information, and technical resources (H. Zhang et al., 2020). An important task in controlling the spread of the outbreak is to reduce the number of infections while increasing cure rates. Reducing the number of infected people requires investing money and manpower to limit access through information and administrative means; improving the cure rate requires investing many medical staff and medical supplies (Z. Jiang et al., 2020). COVID-19 can be rapidly controlled in China, and the public health emergency management system plays a key role. In recent years, there have been many large-scale public health incidents in China, and the emergency management system of government departments has been continuously improved in practice. At the beginning of the outbreak in Wuhan, in the face of the menacing COVID-19, the Chinese government mobilized various resources to support Wuhan. Due to the shortage of human resources for epidemic prevention in Wuhan, medical staff from all over the country have come forward to carry out anti-epidemic actions for Wuhan, and many medical supplies such as masks and protective clothing have been transported to Wuhan. At the same time, governments at all levels have invested a lot of financial funds to support the procurement and allocation of various types of resources. In addition, Chinese government departments have worked together to form an effective joint prevention and control mechanism (H. Zhang & Tao, 2021b). Emergency management is based on information resources, and adopts response strategies based on real-time information (Z. Peng, 2020). During the COVID-19, according to the information provided by the direct reporting system for emerging infectious diseases, an effective joint prevention and control mechanism has been formed.

2.6 Situational factors related to emergency response capability

China has achieved major strategic results in the fight against COVID-19 compared to many other countries. China's epidemic prevention and control capabilities will continue to improve and will be equal to the actual situation of the COVID-19 epidemic. The death toll from COVID-19 in the U.S. has exceeded those of Americans fighting in the first World War and Vietnam War. The epidemic control performance of the U.S. has not matched the strength of their disease control system. The U.S. CDC ranks first in the world in terms of human resources and European disease control systems have comparable capabilities; yet the epidemic has not been adequately controlled in either the U.S. or Europe. The anti-epidemic motivation and level of public response are two situational factors that may be contributing to this apparent contradiction. The level of public response affects the execution of emergency management capabilities and the results of emergency response. The Nobel Prize-winning economist Paul Krugman has suggested that the failure of the U.S. to contain the epidemic stems from the population's mistrust of the government and its unwillingness to make compromises to protect the health of others. As an example, in response to the requirement of wearing a mask, many people expressed anger. On August 29, 2020, an anti-coronavirus march took place in the German capital of Berlin in which >38,000 people gathered at Brandenburg Gate without wearing masks or complying with the 1.5 m social distance rule issued by the German government. On the same day, there was a demonstration in London's Trafalgar Square against the government's lockdown measures; demonstrators held signs bearing slogans such as "Do not block," "Refuse to be vaccinated," and "Refuse to wear masks," and demanded that the government end restrictions on activities (R. Huang, 2020).

In contrast, when the COVID-19 outbreak occurred in Wuhan, the city was immediately closed as an emergency response. It has been estimated that the lockdown of Wuhan along with national emergency operations reduced the number of cases by >700,000 and played a critical role in containing the initial outbreak (Iswarya, 2022). The Chinese population actively responded to the call of duty to their country, with front-line workers persevering in their posts and some people engaging in voluntary service, and the vast majority staying at home to stop the spread of the virus. After successfully controlling the domestic COVID-19 epidemic and resuming work and production, the population continues to take epidemic prevention measures including wearing masks; maintaining social distance during travel and work; and submitting to daily body temperature checks, disinfection measures, and registration procedures (The State Council Information Office of the People's Republic of China, 2020).

Anti-epidemic motivation is an important situational factor affecting the mobilization and application of emergency management capabilities. Over the course of the COVID-19 epidemic in China, President Xi Jinping repeatedly emphasized that the safety and health of the people must be prioritized (X. Wang et al., 2021). Faced with the dilemma caused by the pandemic of sacrificing the economic foundation of the U.S. to save lives or relax epidemic prevention and control measures to protect the economy, President Donald Trump chose the latter option despite warnings from experts, with the result that the COVID-19 epidemic has not yet been controlled in the U.S. (The New York Times, 2020; HePing, 2020).

2.7 Theoretical study on the mediation role of Emergency Management Ability

In this study, how can China's disease prevention and control institutions maintain their competitive advantages, and effectively control the development of the epidemic, and how to express the intermediary role of emergency management capacity? These related studies of dynamic capacity are involved, and research on this issue is the basic task of research in the field of strategic management (Michael & Porter, 1991).

The Strategic Positioning School believes that the environment determines organizational capabilities and strategies, which in turn affects the achievement of organizational goals. But they put emphasis on the analysis of the macro environment and neglect the focus on the capabilities of the organization itself. As a result, the resource school, and the capability school, which focus on the internal elements of the organization, came into being. However, in the process of development, the static research perspective of the resource school and the "core rigidity" problem of the capability school have highlighted the shortcomings of the resource and capability school (Barney, 1991; Leonard-Barton, 1993), that is, these theories cannot explain that in a dynamic environment, why do some organizations perform better than others. Focusing on COVID-19 pandemic in 2020, governments have mobilized resources to combat the global pandemic caused by COVID-19. However, in the face of various complex factors, some countries have achieved satisfactory anti-epidemic results, and some countries have failed to achieve anti-epidemic goals even if they have abundant resources and first-class emerging infectious disease research capabilities. Obviously, the resources school and the ability school cannot explain.

Based on the resource-based view, Teece et al. (1997) and Teece (2007) proposed the concept of dynamic capabilities in the context of thinking about how companies can maintain and enhance their competitive advantage in the context of rapid technological development. Their study found that dynamic capabilities are "integrate, build, and reconfigure internal and external competitiveness in order to adapt to a rapidly changing environment". Augier and Teece (2009) and Teece (2007) argue that the key to the organization's sustained competitiveness lies in its ability to adjust its strategy and integrate the organization’s various resources in response to changes in the external environment quickly and continuously. Since then, dynamic capabilities have been considered by Borch and Madsen (2007), Teece (2014), and Winter (2003) to be the foundation of today's organizations to gain sustainable competitive advantage.

Teece et al. (1997) believes that dynamic capabilities include three configurations (3P) of process, position, and path, that is, dynamic capabilities are embedded in the process of the organization, and the process of the organization is shaped by the position and path of the organization. The author further proposed a framework for interpreting dynamic capabilities, decomposing dynamic capabilities into "sensing", "seizing" and "transforming" capabilities, believing that under the theoretical framework of dynamic capabilities, the opportunities for perception, shaping and acquisition are the support of organizational dynamic capabilities (Winter, 2003). In 2000, Eisenhardt and Martin (2000) further defined the connotation and extension of dynamic capabilities as a specific and identifiable set of processes, such as product development, strategic decision-making, alliances, which may differ in detail and paths in different organizations, but have commonalities, namely "best practices", including the ability to "integrate, reconstruct, acquire, release" an organization.

Chinese scholars have developed four aspects of dynamic capabilities based on empirical research by Chinese firms: environmental insight, change and renewal capabilities, technological flexibility, and organizational flexibility. Table 2.3 summarizes the elements of dynamic capabilities.

Table 2.3 Components of dynamic capability

References	Components
(Teece et al., 1997)	Coordinate; Integrate; study; Refactor; Transform
(Eisenhardt & Martin, 2000)	Integrate; Refactor; Acquire; Release
(Zahra, 2002)	Obtain; Digest; Transform; Utilize
(Pavlou, 2004)	coordination capacity; absorptive capacity; collective consciousness; market orientation
(C. Wang & Ahmed, 2007)	adapt; absorb; innovate
(Ambrosini & Bowman, 2010)	integration; refactoring
(Cetindamar et al., 2009)	way of resource allocation; way of innovation
(Teece, 2007)	Perceive the environment; seize the opportunity; adapt and reshape the environment in which the enterprise is located
(Barreto, 2010)	Solve problems systematically; perceive opportunities and threats; transform resources; adapt to the environment
(Jiao & Koo, 2013)	Environmental recognition; integration and reconstruction; organizational flexibility; technical flexibility

From the dynamic capability components of Table 2.3, scholars have different definitions of dynamic capability based on different research perspectives, but the common point is that dynamic capability is to integrate resources and reconstruct capabilities based on changes in the external environment to effectively respond to the increasingly dynamic situation.

In this essay, the definition of dynamic capabilities was a specific, identifiable set of processes in which an organization exhibits the ability to perceive and seize opportunities, the ability to reallocate the organization's resources, and the ability to achieve organizational goals (Eisenhardt & Martin, 2000). Specifically, in the relationship between human resources of CDCs and performance of emerging infectious diseases prevention and control studied in this thesis, dynamic capabilities are more reflected in emergency management capabilities, including the ability of different departments to coordinate, the ability to integrate resources, and the three aspects of collective consciousness.

From the analysis of the synergy ability of different departments, the establishment of organizational structure is a key element. Research by Widen and Gudergan (2015) confirms that in the face of a changing external environment, an organization's structure can have a significant positive effect on its performance if it adapts and designs its structure according to local conditions. From the further analysis of the theory of change, dynamic capabilities emphasize the consistency inside and outside the organization, that is, according to the specific conditions of the external environment, the organization needs to adjust internal processes and resources to adapt to external needs. To achieve internal and external consistency, one of the key elements is the adjustment of the organizational structure, to achieve the same steps and goals between different departments, and to form a synergy.

2.8 Summary

Emergent public health emerging infectious diseases require timely and comprehensive response. By comparing the differences of domestic and foreign emergency management and system, the current situation of our country's emergency management system and ability is as follows. The level of prevention and control of infectious diseases has been gradually improved, but attention should be paid to practical problems such as unbalanced social and economic development and the increase of floating population. There are still problems in the feasibility and operability of emergency plans. It is necessary to learn from the United States and other countries to clarify their responsibilities and further strengthen information sharing. Although China's emergency management construction started late than western developed countries, after the SARS incident, China has gradually improved its emergency management capacity. In the management system of our country's current emergency rescue leadership system is unified by the central arrangement, each department is responsible for the division of labor, can better avoid the defects of complicated procedures, insufficient coordination ability.

Research on emergency management capability attaches great importance to the evaluation of emergency management capability through the evaluation index system of emergency management capability. Human resources are an important factor in emergency management capability. The emergency response in China exposed the defects of human resources in the disease prevention and control system, and the study of human resources in disease control was not deep enough, which needs to be further discussed. Cost-effectiveness analysis, cost-benefit analysis and cost-utility analysis are commonly used in the research on evaluating the effectiveness of COVID-19 prevention and control. This study will use the above three analysis tools for evaluation. In the theoretical research on the mediating role of emergency management capacity and the actual public health emergencies, the motivation of fighting against the epidemic and the level of public response are two important contextual factors that need further research.

Chapter 3: Method

This study adopts one of qualitative research methods, namely case study method. Compared with quantitative research, the advantage of case study lies in its systematisms, which enables a more in-depth and comprehensive analysis of the research object. When choosing case studies, many scholars emphasize that case studies are particularly applicable to many important events in history, and their findings often reflect the context of historical times (Huang et al., 2014). Guangdong province, the subject of this study, is one of the frontier areas of epidemic prevention and control in mainland China. In 2003, Guangdong was the "main battlefield" of SARS, and at the end of 2019, Guangdong was the first to pay attention to the particularity of COVID-19 patients in Shenzhen and reported to the central Government. Guangdong CDC has experienced the control process of two major epidemics and accumulated rich successful experience, which is worth studying. Based on Grounded Theory, this chapter discusses the reasons why Guangdong CDC was selected as the object of the case study; the logical relationship between the two cases of SARS and COVID-19 being designed as the two study cases; qualitative data collection methods, data validity, validity guarantee is explained. And the method is prepared for the proposition verification in Chapters 4 and 5.

3.1 Theoretical basis of research design and case selection

3.1.1 Interpreting the choice of case study methods from Grounded Theory

A case study is the investigation and analysis of single or multiple cases designed to capture the complexity and typicality of the object of study.

In 2006, Academy of Management Journal conducted a survey and found that most of the "interesting research articles" were classified as qualitative research (Bartunek et al., 2006). Because new discoveries and theoretical innovations are the results of high-risk qualitative exploration of uncharted territory. A review of qualitative research literature revealed that many research methods use Grounded Theory. As advocated by the proponents of Grounded Theory (Glaser et al., 1968), the purpose of social research is to uncover existing and pervasive explanations of social behavior. From a pragmatic point of view, Glaser et al. (1968) believed that the scientific truth stems from the behavior of observation and the consensus formed during the observation process. "Grounded Theory" is defined as a practical approach to the study of interpretive processes (Glaser et al.,1968). The analysis for interpretive processes is defined that real meanings and concepts adopted by social actors in real situations, which means new theories can be developed by paying close attention to what is happening in the real domain, and by experiencing the interpretations derived from the course of that event. Therefore, the Grounded Theory fits well with the context and research objectives of this study.

The researcher in this work personally participated in the whole process of fighting against SARS in 2003 and COVID-19 in 2020 in Guangdong Province. As a participant, the researcher can observe carefully, and interpret policies independently and proactively. The proposed interpretations, based on the fit of data and concept of type, are more profound than bystander perspectives, and their reliability and validity are guaranteed. They even have the ability of data tracking, and the interpretation of questions that were developed on a rolling basis. As a participant in two major events of epidemic control in Guangdong, the researcher meets the criteria of the middle ground applicable to the Grounded Theory defined by Glaser and Strauss (1968). In this study, the researcher can make "continuous comparisons", with data collection and data analysis carried out at the same time, which overcomes the defect of complete separation of these two parts. At the same time, the researcher can also conduct “theoretical sampling”, which means the data to be collected next is determined by the theory to be constructed or tested rather than a priori assumptions, with ongoing data interpretation and emerging conceptual categories determining the direction of new data collection, which can overcome the flaws of theoretical sampling.

This research is carried out around an ongoing event in which the researcher is also a participant. The research objective is to construct and verify theories from subjective experience. Therefore, it is appropriate to choose Grounded Theory as the main research method. Under the premise of logical consistency, it is possible to understand how the reality of key assumptions is (Suddaby, 2006). Thus, Grounded Theory is better for understanding how people interpret reality.

However, many people have misunderstandings about Grounded Theory. One of the misunderstandings is that Grounded Theory requires researchers to enter a research field without knowing any existing research results (Suddaby, 2006). Therefore, we reviewed the relevant literature to find the answer. Glaser et al. (1968) put forward Grounded Theory for the construction of grand theory, but they were by no means to encourage this research method which ignores existing empirical knowledge. On the contrary, they encouraged Grounded Theory applications that apply substantive theory to a topic area. Therefore, this research will be related to the existing resource-based theory and emergency management theory.

3.1.2 Reasons for review object selection

The challenge often faced by case researchers is the lack of representational of the selected cases (Siggelkow, 2007). The object of this case study is center for diseases control and prevention in Guangdong Province, whose typical significance lies in its successful prevention and control of SARS and COVID-19 epidemics. The core of public health work lies in the prevention and control of epidemic diseases. When only small-scale and local epidemics occur, the public tends to ignore the role of public health work, but once a large-scale epidemic broke out, its role becomes prominent, as the proverb goes, “train an army for a thousand days to use it for an hour”. COVID-19, which began in the winter of 2019 and outbreak in the spring of 2020, is a good example. However, to truly exert the value of disease prevention and control, it is necessary to organize a team of public health personnel at a certain scale, with scientific research and technical capabilities, organizational management capabilities, and professional network relationships for rapid response. As emphasized by G. Zheng (2020), talents are the decisive factor in the victory of the anti-epidemic campaign. In the past two decades, public health personnel in Guangdong Province have significantly improved their ability to prevent and control epidemic diseases. And they successfully prevented and controlled COVID-19 in Guangdong under the command of the government's emergency management system in 2020.

COVID-19 is a highly contagious infectious disease without specific drug. It has no experience in epidemiological monitoring, testing, investigation, and risk management. It is a special case that Guangdong Province was able to successfully monitor and control the COVID-19 epidemic. The study on SARS and COVID-19 will Generate three important messages of value.

First, it can trigger a research question. According to the introduction in Chapter 1, even though China neither has the most abundant resources nor the best technology for disease control, the incidence and mortality rate of COVID-19 was much lower than developed countries. Using two typical cases of GDCDC as research objects to trace the cause would increase the credibility of the conclusion.

Secondly, it can refine existing theories and inspire new ideas. The reality is complex, and the value of theory lies in penetrating the surface of individual cases to discover the similarity between the two cases, and ultimately find out the relationship that cannot be accurately explained by the existing theories. Therefore, in Chapters 4 and 5, efforts will be made to explain the general significance of these two cases. To establish a conceptual framework that does not over-judge the decisive role of resources to the final performance, some possible key constructs should be explored in the path between resources and performance. This means that only a theory with general significance, which was extracted from the two cases experienced by GDCDC, is ultimately useful.

Thirdly, the cases themselves are valuable illustrations. There are common limitations of singular theoretical argument. That is, given that construct A leads to construct B, what is construct A in reality? How do you measure A? How do you know that the known empirical variables really catch A? The case study helps the reader inference and imagine one or more empirical scenarios by showing how each construct in the argument is applied to specific examples, thus helping to understand the result from A to B.

3.2 The logical relationship between the two sub-studies

Case studies can be classified into three types: descriptive, exploratory, and causal explanatory (R. Yin, 2010). Among them, explanatory case studies can be divided into theory-oriented and practice-oriented. Practice-oriented research aims to provide knowledge for specific practitioners of specific practices, while theory-oriented case studies aim to promote theoretical development. Based on the research questions and research objectives of this thesis, two representative cases experienced by GDCDC (SARS and COVID-19) were selected, aiming to improve the existing theories through induction and deduction. Clearly, a purely descriptive case study cannot accomplish the goals of this study, nor can the research question be addressed. Therefore, the case study of this dissertation is designed with two sub-studies.

Study 1 corresponds to the SARS case, which is an exploratory case study to establish a basic theoretical analysis framework. Before the establishment of the China CDC in 2002, the system of epidemic prevention stations of local governments at all levels took the basic responsibility for epidemic prevention and control. In 2003, when China's disease control system had not yet been established, the outbreak of the SARS crisis exposed the inability of China's disease control system to adapt to new situations and the lack of emergency response capabilities to public health emergencies. It not only seriously affected social stability, but also caused immeasurable direct or indirect economic losses. WHO estimated that the loss of the global economy was nearly 30 billion dollars, which caused the worst blow to the Chinese economy since the 1980s. There is no experience in how to establish a professional disease prevention and control system, cooperate with other local medical systems and social emergency management, or build a system to resist major, national, and even global epidemic outbreaks. However, the experience accumulated by GDCDC in against SARS has provided valuable experience for the improvement of China's CDC system. This sub-study uses Case Study Theory to extract key constructs from documents, news reports, and research literature, analyzes the logical relationship between these constructs, and summarizes the theoretical framework. The theoretical framework includes the most important constructs and the logical relationship between them, and several propositions are drawn. See Chapter 4 for details.

Sub-study 2 corresponds to the COVID-19 case, which is an explanatory case study. Sub-study 1 builds a basic theoretical analysis framework, while sub-study 2 is designed as a "theory-testing study", the case selection of the double-case study must be based on the existence of dependent concepts or independent concepts. For the choice of the second case, it is necessary to weight the independent value of related concepts before experimental validation, i.e., before "measurement" takes place. However, the basic theoretical model constructed in the first case study did not take contextual variables into account. Therefore, in the second case, sub-study 2, the analytical framework with Chinese characteristics was further refined, and China's efforts in the fight against COVID-19 were further improved. The Chinese system and the situational factors of Chinese people are placed in the mediating variables, and the propositions of Chapter 4 are added to form all the assumptions of sub-study 2 of Chapter 5, and then use text analysis technology to verify.

Therefore, the logic behind sub-study 1 and sub-study 2 of this thesis is complete, in other words, the inductive research is carried out first, the theoretical analysis framework is proposed, and then the deductive research is carried out to verify and explain all the propositions. Through the design of the two studies, there are sufficient practical examples to illustrate the practice-oriented value proposed by the basic theoretical framework, which is then verified in sub-study 2, and the theoretical analysis proposed in sub-study 1 is further verified with practical examples. The general meaning of the frame.

3.3 Data collection

According to the Grounded Theory and practice steps required by Glaser and Strauss (1967) and Strauss (1987), data collection and data analysis of the SARS epidemic response process were carried out simultaneously. In data collection and data analysis, analytical codes and generics are constructed from data rather than from preconceived logical deductive assumptions. A constant comparison method was used in the analysis, comparing not only the evaluation of the decision-making process and decision-making effectiveness at each stage by different respondents, but also the evaluation of the current in-service leaders of the GDCDC, to continuously promote the progress of the research framework. These steps help to enhance the analytical strength of the research, so that the qualitative research method goes beyond the descriptive case study to interpret the resulting research model and obtain a concrete understanding of the abstract and conceptual aspects of the research object.

During data collection, key steps are recorded through time series, illustrating their properties and relationships. Regarding the people who were interviewed, only those who had experienced SARS and were personally involved in decision-making were selected. According to the objectives of this study, we designed the interview outline as Table A1 (see Annex A).

3.4 Data coding analysis

Classical Grounded Theory emphasizes the analysis of actions and processes. Based on Grounded Theory on a dispassionate empiricist and strictly coding approach, Glaser et al. (1968) emphasized the emergent discoveries, and Graffigna (2009) imitated the somewhat ambiguous specialized language of quantitative methods. Therefore, the coding process is based on textual analysis, asking analytical questions that help to understand the SARS case studied, i.e., what resources Guangdong Province mobilized and what actions were taken to bring the outbreak under control.

3.4.1 Open coding

Open coding follows the procedure of "labeling - extracting concepts - defining categories". First, open coding is performed on the text line by line; second, concepts with core content are abstracted through this process; and situations are named and classified into main categories (Strauss, 1987).

3.4.2 Axial coding

Axial coding is to classify and aggregate categories level by level. The primary category is more specific, it will be more abstract after classification. Finally, the category forms a hierarchical structure with an increasing degree of abstraction from low to high (Hsieh, 2005).

3.4.3 Selective coding

Selective coding is a systematic analysis of established conceptual categories, from which a dominant "core category" that can string other categories into a whole is selected to form a systematic theoretical framework (X. Chen, 2000). This study takes "epidemic control effectiveness" as the core category and determines the selective coding path relationship of the main category of this study by analyzing the interview data of experts who experienced SARS and the categories summarized.

3.4.4 Theoretical Saturation Test

To ensure the scientific and rigor of the theoretical model, this thesis conducts a theoretical saturation test, which is a scale for measuring Grounded Theory sampling. The main method is that in the open coding and axial coding stages, two groups of coders who are familiar with coding rules and research content carry out independently, negotiate and discuss the coding with inconsistent results, and take the consistent coding as the final result to ensure coding credibility (C. Zhang & Dang, 2022).

Two groups of coders conducted open coding on 12 interview records respectively, and found that no new categories were generated, which proved that the conceptual model obtained in the selective coding stage was saturated and complete.

3.5 Text Analysis

Text analysis is a qualitative and quantitative content analysis method. The word frequency statistics of certain keywords in text data can be used as an indicator of the cognitive concentration or importance of organizations and decision makers (Y. Jiang & Pan, 2020). Our study uses NVivo11 software for word frequency statistics. The "word frequency" function of the software represents the frequency of specific words or sentences in the text, and can be visually expressed by the "word cloud" function. The size of the font in the "word cloud" represents the frequency of the word in the text, and the larger the font, the more frequent it appears, and vice versa.

3.6 Quality assurance of case studies

Case studies are qualitative studies. Compared with quantitative studies, case studies require rigorous research methods rather than replication, that is, follow scientific laws, the validity and reliability of scientific research strictly. Because the validity and reliability of scientific research are social constructions, and its rules are constructed based on consensus of the academic community. The validity and reliability of case studies are somewhat different from those of quantitative studies, but the systematic nature of cases can dig deeper into concepts. For example, in interviews, the definition of concepts can be replaced by the detailed example provided by the interviewee, which makes it easier for readers to understand.

3.6.1 Construct validity

Construct validity refers to the concept of analysis and how to ensure that the measurement is operable and accurate. In general, the safeguarding methods of construct validity include the use of multiple sources of evidence triangulation, the establishment of evidence chains, the review of information providers, and the challenge of devil defenders (Eisenhardt et al., 2002; Yin, 1989).

In this study, multiple sources of evidence included documents, media reports, interviews with key persons from GDCDC, and the personally experience of researcher, which meet the requirements of multiple sources of evidence. The data from multiple sources of evidence, can learn from each other’s strengths and complement each other, to achieve triangular verification. When the multi-source data collected in Chapters 4 and five have similar results, it can indicate that the measure in the case study has construct validity, which is like the convergent validity in quantitative research.

In addition, construct validity can also be guaranteed by establishing a chain of evidence, analyzing whether the data from multiple sources have a certain logic and coherence, so that readers can predict the subsequent development of the case. In Chapters 4 and 5, chains of evidence namely nomological network is drawn to show the logic clearly.

Finally, a review of important information providers. Since the researcher of this thesis is an employee in GDCDC, it is convenient to find key information providers and to distinguish the reliability of these information. Inappropriate interpretations can be avoided by individual researcher selection biases by information provided by others, rather than the researcher’s own subjective biases. To further ensure the reliability of the information, colleagues from the GDCDC were also invited to review the information and examine the blind spots and biases of the researchers.

3.6.2 Internal validity of the data

Internal validity refers to the determination that changes in the dependent variable are indeed caused by changes of the independent variables. As suggested by R. Yin (1989), case researchers can employ designs such as model fit, interpretation establishment, and time series to enhance and guarantee internal validity. Pattern fit can be used to suggest whether the data and the theory fit and match, examine whether the relationship of the various constructs is consistent with the data, and if so, it means the data provides supporting evidence.

In this study, the researcher conducted a thorough discussion with colleagues, completed the internal validity test, and found that the internal validity is high, in other words, the data can be consistent with the theoretical explanation.

3.6.3 External validity of the data

Analytical generalization, rather than statistical generalization, is the common approach when exploring the external validity of a case (Turner & Bryman, 1989). Analytical analogy means that the results obtained from a case study can be analogized to other cases. The repeated utilization could confirm the existence of results obtained in this case without doubt.

Guangdong is in the Guangdong-Hong Kong-Macao Greater Bay Area, which is one of the most economically developed regions in mainland China. The manufacturing and high-tech industries are highly intensive here. In the process of the reform and opening up, Guangdong’s experience is to try first. Therefore, in terms of external validity analysis, the cases of this study can also be replicated and promoted in other regions, in line with the logic of similar rules, and the external validity of the study can be judged by construct fit and theoretical fit (Eisenhardt et al., 2002). Guangdong is the first province in mainland of China to face the Delta variant of COVID-19 from May to July 2021, and the accumulated experience has been summed up. Once the epidemic outbreak in other provinces, the experience of Guangdong could be promoted. From a certain perspective, the results of this study can be analogized to larger areas in mainland China, and the more organizational phenomena that can be explained by imagination, the more powerful the results will be (Hyman, 1982).

3.6.4 Reliability of the data

Case studies have certain disadvantages in reliability, because it is impossible to confirm after the same number of interviews with the same interviewees or observations, whether different researchers can obtain the same perceptions and judgments and choose the same way to verify, which depends on very individual judgment. Therefore, all qualitative case researchers are aware of this deficiency, and strive to improve reliability through “triangulation verification”, which means reviewing and tracking all the decisions and judgments of the researcher in the process of carrying out the investigation and data analysis, at the same time coding interview results is also a feasible measure. In this study, the selected interviewees were staffs from the GDCDC especially those who have been deeply involved in the fight against SARS and COVID-19. All the questions for each interviewee strictly followed the interview outline, so the interview results of these respondents on the same question can be compared to analyze the degree of consistency.

Chapter 4: Study 1 The Case of SARS In 2003

4.1.1 A review of events in 2003

From 2002 to 2003, an epidemic broke out in China and spread to some countries and regions. WHO named the disease as "SARS" (Chang, 2003). On March 5, 2003, the epidemic has affected 24 provinces, autonomous regions and municipalities, Hong Kong, Macao and Taiwan of China, and spread to 30 countries or regions around the world, with more than 80% of the world's infected people in China (Xue & Zhang, 2003).

The first SARS case appeared in Foshan City on November 16, 2002 (Nan, 2003a). The first reported case was confirmed in Heyuan City on December 15. On January 2, 2003, several cases of infection among medical workers appeared in Zhongshan city, and the government of Guangdong province sent a team of experts to investigate. Due to the inadequate prevention and control measures taken by the government, the SARS virus spread rapidly, and the SARS epidemic in Guangdong further aggravated and spread to many provinces across the country and abroad. On March 6, Beijing has reported its first imported case of SARS, making it the city with the second most infected patients in China. On April 16, WHO announced that it had identified the causative agent of the SARS epidemic as a variant of the coronavirus (Chang, 2003). On April 17, the State Council decided to implement crisis management of the SARS epidemic, and established SARS Prevention and Control Headquarters of the State Council to command the national prevention and control work in a unified manner. In May, the number of new SARS cases in China declined rapidly. Guangdong and Beijing recorded zero new SARS cases on May 13 and 29 respectively (National People's Congress Construction, 2003). On June 15, mainland China achieved zero new confirmed cases and suspected cases. On July 13, the number of SARS patients and suspected cases in the world increased to zero, and the SARS process was basically over. On August 16, the Ministry of Health announced that there were zero SARS cases in China (NHCPRC, 2003).

China has accumulated certain experience in the process of fighting the SARS epidemic. For example, on April 23, 2003, the Xiaotangshan SARS field hospital started urgently. After seven days and seven nights of hard work, Xiaotangshan Hospital began to accept patients on May 1. The Huoshenshan Hospital and Leishenshan Hospital during the COVID-19 period were built based on Xiaotangshan Hospital. National and international cooperation and collaboration are essential to contain the outbreak (James et al., 2006). After the emergence of SARS, China did not report the outbreak of new infectious diseases to WHO in time, delaying the best time to control the spread of the epidemic to the world (Heymann, 2004). After the outbreak of COVID-19 in 2020, the NHCPRC reported the new outbreak to the WHO timely, which was highly praised by the WHO. At the legal level, the SARS epidemic prompted China to establish a network of CDCs at all levels across the country and promoted the improvement of legal protection. The State Council issued the implementation of the overall national public emergency contingency plans and the emergent public health event emergency ordinance, the ministry of health, made the measures for the administration of the prevention and control of infectious atypical pneumonia. In terms of information and public opinion, in 2003, the information disclosure of the epidemic was mainly based on traditional media, and there was a lag in information disclosure. In 2020, the government has adopted methods such as big data and the Internet to announce the epidemic information at the first time of COVID-19 epidemic, and timely inform the public of epidemic prevention knowledge.

4.1.2 The prevention and control stages and effects of SARS

4.1.2.1 The development of the SARS epidemic in China

As the earliest country to experience the SARS epidemic, China has been most severely affected during this pandemic. Since the first SARS patient was discovered on November 16, 2002 in Foshan, Guangdong, the SARS epidemic in Guangdong has gradually entered a high incidence period. From the beginning of 2003 to the end of May, some regions of the country experienced the SARS epidemic, which went through three stages until it was effectively controlled (CPGPRC, 2005).

In the first stage, from January to March 2003, the epidemic is mainly concentrated in Guangdong Province. At the end of March 2003, a total of 1190 clinically diagnosed cases were reported in mainland China, with 1153 cases in Guangdong, accounting for 97%.

In the second stage, in April 2003, the epidemic began to spread to other provinces and gradually concentrated in Beijing, Shanxi, Inner Mongolia, Hebei, and Tianjin. At the end of April 2003, a total of 3460 confirmed cases were reported nationwide. Among them, there were 3368 cases in 5 provinces, autonomous regions, municipalities directly under the central government, and Guangdong Province, accounting for 97.3%.

In the third stage, in May 2003, the national epidemic situation showed a steady but declining trend. In early May 2003, there were an average of 151 new cases per day nationwide;

In mid-May, there were an average of 45 new cases per day; In late May, there were an average of 14 new cases per day. Afterwards, the number of cases gradually decreased, and the epidemic began to be effectively controlled.

4.1.2.2 The policies and measures for prevention and control of SARS Epidemic in China

The SARS epidemic in China can be controlled in a short period of time, thanks to a series of effective prevention and control measures in China. During the epidemic period, the Chinese government mainly took the following measures to control the epidemic (CPGPRC, 2005).

1.The government has listed SARS as a statutory infectious disease and managed it in accordance with the Infectious Disease Prevention and Control Law. It has also issued relevant regulations such as the "Emergency Regulations for Public Health Emergencies" and the "Management Measures for the Prevention and Control of Infectious atypical Pneumonia", improved the epidemic information reporting system and prevention and control measures, and incorporated prevention and control work into the legal track.

2. Establish a command center for the prevention and control of SARS. Local governments have made prevention and control work their primary task, concentrated their efforts, unified command, and integrated medical and health resources to increase efforts in the prevention and control of SARS.

3. Strengthen the prevention and control of rural areas and implement group prevention and control. Strict monitoring measures will be implemented for returning farmers and students to control the transmission channels.

4. Strengthen traffic quarantine and establish a tracking and visiting mechanism. Civil aviation, railways, ships, and long-distance buses all establish systems for passenger monitoring, registration, and tracking, and immediately isolate patients if found.

5. Concentrate advantageous resources and actively treat patients. Establish fever clinics in hospitals with conditions, identify patients, and determine designated hospitals for centralized treatment of patients to prevent hospital infections.

6. Adhere to the integration of traditional Chinese and Western medicine to improve the level of treatment. Collaborate closely with the best Chinese and Western medicine experts to study effective treatment methods and improve the cure rate.

7. Government support and implementation of medical assistance. The central and local governments allocate funds to support the purchase of medical equipment, drugs, protective equipment, and the renovation of designated hospitals, strengthen the construction of disease prevention systems, information networks, and medical assistance systems. Provide free

medical treatment and assistance to farmers and urban residents in need.

8. Carry out technical exchanges and strengthen scientific and technological breakthroughs. China maintains close and good cooperation with the World Health Organization and relevant countries, exchanging information and improving work. Medical experts from various regions have conducted academic exchanges multiple times, sharing diagnosis and treatment experiences with each other, and jointly researching effective methods and measures for preventing and treating SARS. Excellent domestic experts and scholars actively explore the causes, research related diagnostic and treatment technologies, and have achieved certain results.

4.1.2.3 Relevant prevention and control measures in global and other countries

In response to the prevention and control of the SARS epidemic, experts from the World Health Organization have also proposed four major strategies for effectively responding to SARS (Lv et al., 2003).

1. Establish a sound monitoring and reporting system. The monitoring system must be able to detect every case and promptly inform the public and health departments. And the monitoring system should pay special attention to preventing medical personnel from contracting SARS.

2. Strengthen hospital management and infection control. Timely detection of infected cases, and once confirmed, immediate isolation should be arranged to avoid the spread of infection. Protect medical staff and wear specially designed clothing and masks when participating in epidemic prevention work.

3. Improve community information exchange. Improve community information exchange and infection tracking.

4. Strengthen government support and emphasize the important role of the media in preventing and treating SARS.

Other countries have also quickly taken relevant control measures against the SARS epidemic.

In the United States, patients require home quarantine and should not leave home during the quarantine period unless follow-up medical care is required. If patients need to go out, they should wear masks and limit the use of public transportation. Strengthen publicity and education on the epidemic among residents. Conduct temperature testing and related symptom screening for inbound personnel, and conduct ten-day quarantine and tracking for tourists from high-risk areas (CDC, 2005).

As the earliest serious country to detect SARS cases, Vietnam has established a National

SARS Prevention and Control Steering Committee to guide national prevention and control work. At the same time, in order to cut off the spread of SARS, officials have closed down Vietnamese hospitals and strengthened quarantine at border ports. In addition, efforts have been made to strengthen publicity and education on the prevention and control of SARS, limit the scale of tourism and large-scale activities, organize mobile medical forces, and respond to emergencies at any time (Zhong, 2003).

The Singaporean government requires all inbound passengers to undergo health declaration, strengthen border prevention and control, recruit medical staff, stationed at airports and ports, and conduct 24-hour inspections of passengers arriving from high-risk areas of SARS to promptly detect suspicious cases. Tracking contacts and implementing home quarantine, actively participating in epidemic related work by relevant government agencies, providing diagnostic support (SARS Investigation Team from DMERI & SGH, 2005).

Although the severity of the SARS epidemic varies among other ASEAN countries, they attach great importance to it and have taken multiple measures, striving to detect SARS cases as soon as possible, isolate them, concentrate treatment, and prevent the spread of the epidemic. At the same time, they have also strengthened entry and exit inspections at airports and border ports (Zhong, 2003).

4.1.3 Epidemic control theory

Epidemic refers to infectious diseases that can spread widely in the population in a relatively short period of time, such as SARS, COVID-19. History has proved that epidemics threaten human health and safety seriously, and human beings must overcome the huge threat from epidemics. To overcome this, we must strengthen the research on the epidemic, master its pathogenesis and transmission law, and then study the epidemic control strategy.

At present, there are four main methods of epidemiological research in academia: descriptive research, analytical research, experimental research, and theoretical research (Cho & Chu, 2011). Mathematical models play a significant role in theoretical research. The main mathematical models include epidemic chain models and deterministic models. When studying the spread of epidemics, it is appropriate to use to study the spread of viruses between individuals (Bailey, 1977). The key to optimizing epidemic control is understanding heterogeneity, which needs to be considered in both host demography and disease transmission studies, especially when analyzing disease transmission within cohorts on a small scale, such as Family Models (House & Keeling, 2009). In addition, heterogeneity is also an important indicator when measuring whether an epidemic breaks out on a large scale (Charlesworth, 1994).

In the 20th century, scholars began to conduct systematic studies on deterministic epidemic models. To study the transmission paths of different epidemics, scholars established many epidemic transmission models, among which the four most basic models are SI model, SIS model, SIR model and SIRS model.

The effect of epidemic control measures can be evaluated by studying epidemics through mathematical models, and the optimal control of epidemic prevention can be studied using optimal control theory (She, 1987). Based on this, scholars use optimal control theory to study different types of epidemics. They studied media-boots of manifest diseases and found that the best multi-control strategy of other measures will be taken first, and can effectively resist media-host epidemic (Kong et al., 2011). The optimal control theory is used in tuberculosis models, and the best control strategy is studied to minimize tuberculosis infectivity and number of infections (Denysiuk et al., 2014). Vaccination is an effective way to respond to COVID-19, but the vaccine experiment and production needs a long period of time, before the effective vaccine is not produced, it is a key factor in blocking viral communication, which can minimize the number of infections at the lowest cost (Grigorieva et al., 2020). Under the conditions of resource scarcity, the optimal coverage strategy is to assign resources to groups with high risk of infection; the resources should be prioritized to the low risk of infection in relatively sufficient conditions (H. Zhang et al., 2020). Promotion activities are one of the means of epidemic control, which can affect people's awareness, and then prompted people to change their behavior. Misra et al. (2015) determines the best implementation rate of publicity activities.

The government adopts epidemic control measures to effectively respond to the epidemic. The results of the SARS epidemic analysis show that, compared with areas taking loose measures, there are fewer days with the peak number of infected people in areas taking strict measures (Hua et al., 2020). It is important to note that not all interventions in response to epidemics are effective, and studies of optimal control strategies for seasonal variations in influenza-like epidemics have found that some interventions in response to epidemics may lead to negative effects (Sunmi & Gerardo, 2017). In addition, when choosing a control policy, it is also necessary to consider cost, and sometimes the secondary control policy effect is only slightly lower than the optimal control strategy, but it can greatly decrease the cost (Caetano & Yoneyama, 2001).

4.1.4 Dialogue between performance of control and theory in SARS case

Emergency management capability refers to the ability of the government and relevant public institutions to use scientific, technological, management and regulatory means to prevent, respond, deal with and recover public health emergencies (Z. Han, 2020), and human resources are one of the important factors affecting emergency management capabilities.

On February 2, 2003, Department of Health of Guangdong Province held an emergency meeting in the conference room of Bureau of Health of Guangzhou Municipality. Zhong Nanshan, a famous respiratory expert, was appointed as the leader of the guiding group of Guangdong medical rescue experts (Nan, 2003b). Zhong Nanshan believed that the pathogen was not chlamydia, and announced on April 12, 2003, that a variant of the coronavirus might be the real cause of SARS. In the early stage of the epidemic, Zhong Nanshan explored a set of "three early" and "three reasonable" effective diagnosis and treatment experiences through practical summaries (Mu, 2020). During the epidemic, Academician Zhong Nanshan has always adhered to the front line of the fight against the epidemic and has made great contributions to calming people's emotions and fighting the epidemic. It can be seen that reasonable allocation of human resources for disease control and sufficient human resources for disease control can help improve the government's emergency management capabilities, thereby effectively controlling the epidemic (X. Cheng & Lu, 2003; X. Wang & Chen, 2003). Another example: On April 21, 2003, National Development and Reform Commission (NDRC) established a coordination group for the prevention and treatment of SARS medical supplies, and the staff of the group contributed to the security of medical supplies in Beijing. The rational allocation of human resources is conducive to the rational development and utilization of public health resources, to ensure that emergency management capabilities can play a role.

Epidemic control is a race against time, and the sooner it is brought under control, the smaller the losses (F. Lu & Zhang, 2003; Qin et al., 2003; Yang, 2003). The characteristics of epidemics require governments and other public agencies to respond and act in a timely manner, otherwise it will delay the control of epidemic (Z. Li, 2003). At the end of 2002, an outbreak occurred in Guangdong Province. Theoretically, the government should give full play to its emergency management and dynamic capabilities, sense the danger of the epidemic in a timely manner, and concentrate forces and mobilize materials to fight the epidemic. Due to the lack of relevant experience and a correct understanding of the epidemic, the SARS virus spread rapidly, and the SARS epidemic in Guangdong further aggravated and spread to many provinces across the country and abroad. On March 6, after the first imported SARS case appeared in Beijing, due to insufficient emergency management capabilities, serious hospital cross-infection occurred in Beijing, and the number of cases increased rapidly (J. Yin, 2003a). With the worsening of the epidemic in Beijing, on April 20, Minister of Health Wenkang Zhang and Deputy Secretary of the Beijing Municipal Party Committee Xuenong Meng were dismissed for their ineffectiveness in preventing SARS. On April 22, Wang Qishan became the acting mayor of Beijing. After taking office, the decision-making team represented by Wang Qishan immediately took more effective anti-epidemic actions. For example, measures such as isolation and control measures were taken for key areas of the SARS epidemic, and measures such as the establishment of Xiaotangshan Hospital were prepared. On May 9, it’s announced that the infection rate of medical staff had a marked decline in Beijing. On May 19, the number of newly confirmed cases in Beijing dropped to single digits for the first time (J. Yin, 2003b).

In general, the outbreak of the SARS epidemic in China during 2003 highlighted the insufficiency of emergency response capabilities for public health emergencies. Although the lack of emergency management capabilities in the early stage led to the spread of the epidemic, the government quickly adjusted its understanding of SARS and its response measures, coupled with the low inactivity of the SARS virus itself, the SARS epidemic was brought under control quickly (Anderson et al., 2004). From the outbreak to the announcement by the Ministry of Health that the SARS cases in China were cleared, the SARS epidemic lasted only eight months. The case of SARS has given us very useful inspirations: in the face of public health emergencies, the government's emergency management capability is the key to determining the effectiveness of disease control. Emergency human resources play a vital role in anti-epidemic emergency management. Whether it is the decision-making team making the anti-epidemic decision, the expert group, and the vast number of medical staff, only through the exertion of subjective initiative can they maximize their emergency management capabilities, to achieve good anti-epidemic results and protect the lives, health, and safety of the people.

4.2 Choice of research tools

The sub-study 1 is based on the logic of inductive research and adopted the Case Study Theory of qualitative research method to analyze the path to achieve epidemic control results from historical documents and interview data, to construct a research model and obtain several propositions. Grounded Theory was also initially applied to the health care system, in the same field as this research. In the 1960s in the United States, two sociologists, Glaser and Strauss (1967) collaborated to study the process of death of patients in hospitals. No researchers have looked at the dying state and death process of seriously ill patients until now, and the doctors and nurses had rarely talked about it. Glaser and Strauss' research team looked at the death processes of patients in hospital settings, focusing on information about when and how professionals and patients themselves knew they were dying, and how to do with professionals and patients once this information is known. The sociological research team conducted data analysis using the logic of social science, obtained a theoretical analysis of the social organization and the time series of the patient's death process, examined analytical concepts, and exchanged observation notes. Finally, a systematic analysis method and strategy about the death process of patients was constructed. The two sociologists also published *The Discovery of Grounded Theory (1967)*, which advocated developing theories in data-based research rather than deducing testable propositions from existing theories.

The SARS outbreak occurred in 2003, not long after the establishment of China CDC and GDCDC. It’s the first time for China to face the unknown pneumonia since the founding of People's Republic of China. There was no experience and knowledge for CDC to deal with SARS, therefore they must "grow" in the battle of disease resistance action. The situation is consistent with the application background of Case Study Theory. Therefore, the Case Study Theory method is adopted in this study to sort out the time series of the whole process and dig out the situation, decision-making ideas, and action results of each important step.

4.3 Case analysis of SARS

4.3.1 Basic information

In April and May 2021, this study screened seven and five interviewers respectively, all of whom have long been engaged in infectious disease prevention and control, immunization planning, pathogenic microorganisms, and clinical diagnosis and treatment, and experienced SARS and COVID-19 in 2003.Their personal information is shown in Table 4.1.

Table 4.1 Basic information of interviewees

Basic information	Number of interviewees
Gender	
Male	11
Female	1
Age(years)	
30~	1
40~	2
50~	9
Job title	
Senior Title	8

Vice-senior Title	4
Research direction	
Infectious Disease Prevention and Control	6
Immunization Program	3
Pathogenic microorganisms	1
Epidemiology of Infectious Diseases	1
clinical medicine	1

4.3.2 Open coding

In the open coding process of this study, after eliminating the initial concepts with frequency less than three times, 182 original sentences, 44 concepts, and 12 initial categories were finally obtained. The 12 initial categories including: effectiveness of epidemic control, monitoring effectiveness, detection effectiveness, epidemiological investigation effectiveness, coordination, and command ability, guarantee ability, system improvement ability, quantity of human resources for disease control, structure of human resources for disease control, human resource capacity for disease control, unbalanced development of CDC human resources knowledge and CDC workforce among regions. As shown in Table 4.2:

Table 4.2 Results formed by open coding (SARS)

Categories	Concepts	Original representative sentences(concepts)
Effectiveness of epidemic control	A1-1 Low fatality rate	There are 5,327 confirmed SARS cases nationwide and 349 deaths. Compared with the global fatality rate of 11%, the 6.55% in my country is relatively low.
	A1-2 Low incidence rate	The incidence rate of SARS is low.
	A1-3 The case did not develop	There were no second-generation, third-generation cases in the SARS epidemic.
	A1-4 The impact of the epidemic is small	Our prevention and control was successful, and it did not cause social unrest, and people's lives were not greatly affected.
	A1-5 Act quickly	Screen quickly, Act quickly, rapid intervention, evaluate the effect quickly, and adjust the prevention and control strategies at any time.
Monitoring effectiveness	A2-1 Quickly control the epidemic	SARS broke out in February 2003 in China, and the epidemic was basically brought under control in May. We controlled the epidemic in a short period of time.
	A2-2 Scientific prevention and control	The main means were control the source of infection, cut off the route of transmission, and protect susceptible population.
	A2-3 Isolating cases	They did a very good job of isolating patients, who were quarantined in a timely manner, and the epidemic was quickly brought under control.
	A2-4 No spread	Cases were isolated without causing large-scale spread.
	A2-5 Increase investment to ensure the smooth progress of monitoring work	The state placed emphasis on treatment and less on disease control in China, and does not invest enough in disease control system. Since the outbreak of SARS, the investment in disease control system could be increased, the monitoring work could be continued, and a correct judgment could be made.

Test effectiveness	A3-1 Limited detection capability	The detection capacity of the CDC laboratory is very limited. Basically, it was to do antibody testing, and the basic isolation and cultivation of pathogens. For unknown and undiscovered viruses, it may not be able to handle it, and it is not so easy to determine the pathogen.
	A3-2 Misdiagnosed pathogen	For pathogen identification, wrong conclusions were made during early investigations.
	A3-3 PCR technology is backward	For the cultivation of unknown viruses, PCR technology is not developed enough.
	A3-4 The pathogen cannot be identified and the disease cannot be diagnosed	The laboratory technology was backward and the pathogen could not be detected in time, so that the infectious disease cannot be reported as notifiable diseases. There was no clear diagnostic method, and the epidemic information had not been publicly released in a timely manner.
	A3-5 Hong Kong and other countries identify SARS pathogen	Canada proved Hong Kong's identification of the SARS pathogen, and then dozens of countries in the WTO proved the results together. Hong Kong is much better than us in detection.
Epidemiological investigation results	A4-1 The epidemiological investigation result is correct	In the absence of a clear virus, the rapid reversal of the development trend of the epidemic showed that the result of the epidemiological investigation was correct.
	A4-2 The route of transmission is clear	The epidemiological investigation was very successful, and it was very clear to know the ins and outs of each case, where it went, who it was passed on, and the transmission route was very clear.
	A4-3 Control the epidemic	From the perspective of controlling the source of infection to cutting off the transmission route, we controlled the epidemic successfully.
	A4-4 Grid management	We used the grid management in the community, and carpet inspection.
Coordination and command ability	A5-1 Comprehensive coordination	Finding a case that needed to be isolated, coordinating the cooperation of various departments and did a good job in epidemic prevention and control comprehensively.
	A5-2 Coordination	After the case was found, it was necessary to coordinate with other departments to find the patients.
	A5-3 Multi-departmental collaboration	It was necessary to coordinate the cooperation of the medical department, the transportation department, and the public security department to control the personnel.
Guarantee ability	A6-1 Safeguard mechanism	The deployment of materials, including protective equipment, medicines, food reserves, personnel arrangements, and technical capacity reserves, all of them required coordinated and orderly management
System improvement ability	A7-1 Make policy	Our state had issued the regulations on Emergency Response to Public Health Emergencies, which can report infectious diseases according to legal procedures.
	A7-2 Set up a special management department	Guangdong Province established a separate emergency management department, and the CDC established an emergency department
Number of human resources for CDC	A8-1 Insufficient attention to	Public health personnel had not been paid attention to for a long time. In 2000, we changed from an epidemic prevention station to a CDC. At that time, the Institute for Communicable Disease Control and Prevention was to be withdrawn and the Center for

	disease control and prevention	Disease Control and Prevention was to be established. The human resources changed from more than 60 people to eight after the merger.
	A8-2 Underinvestment	Before SARS, the business of our disease control system was mainly revenue-generating. Many employees belonged to non-media prevention and control, who could do some product testing to ensure the survival of the unit, which exposed the problem of insufficient personnel for infectious disease prevention and control.
	A8-3 Seriously understaffed	When the epidemic was raging, the human resources of disease control system were very insufficient. Even if the personnel of all the disease control system were deployed to various work battlefields such as epidemiological investigation, emergency scene, statistical report, they were also stretched.
	A8-4 Insufficient professionals	There were only a few professionals in the Center for Disease Control and Prevention and the GDCDC.
CDC Human Resource Structure	A9-1 Age stratification	A master leaded an apprentice. The masters who teach us at work were all in their 50s and were about to retire. There were no 30 to 40-year-olds in the middle without new people in our 20s, and there were faults in the middle.
	A9-2 Poor education and quality	At that time, the people engaged in public health work had relatively low education and low quality.
CDC Human Resource Capability	A10-1 Insufficient detection capability	For public health emergencies with unknown pathogens, effective prevention and control measures cannot be taken if the pathogens were not detected. The ability of the talent team was critical.
	A10-2 Insufficient talent training	Pathogen detection was very professional, which should pay more attention to the construction of talent team in this profession, while the technical ability was still relatively weak.
	A10-3 Weak comprehensive ability	Facing this unknown pathogen, what the disease control personnel could do is very limited, and the overall comprehensive ability of the personnel team was relatively weak.
	A10-4 Insufficient capacity leads to the spread of the epidemic	The shortcoming of disease control system at that time was that we lacked our ability. In the early stage of epidemic control, the level of different regions was different, which led to the spread of the epidemic.
	A10-5 Insufficient investment in talent training	In terms of funding, at that time the state did not have special funds to better build our monitoring and detection capabilities, which also led to the backwardness of capabilities.
	A10-6 Limited prevention and control ideas	Constantly follow the international measures to adjust its own strategy, and even the prevention and control ideas must follow the international
Knowledge of human resources for CDC	A11-1 Lack awareness of the epidemic	When the epidemic started, it was not taken seriously. When the cases became popular, the epidemic situation was recognized and prevention and control measures were taken.
	A11-2 The field of vision is not wide enough	At that time, we only used traditional means to deal with it. We had never experienced this kind of epidemic and did not have such a broad vision.
	A11-3 Lack understanding of the pathogen	Our disease control system experts do not know the virus; Government departments, medical departments, and the people are all worried; The government's instructions are not clear, and there are basically no prevention and control guidelines adopted.

	A11-4 Front line staff have limited knowledge	Working in the front line, there is really not much knowledge that can be imparted, and the ability to drive is also very weak.
	A11-5 Lack of external communication	Due to too little foreign exchange, foreign advanced technology is not known.
Unbalanced development of CDC workforce among regions	A12-1 Economic strength affects the technological capability of CDC manpower	In Guangdong Province, the economically developed areas of the Pearl River Delta have stronger technical skills than the less developed areas.
	A12-2 Different administrative levels have different technical capabilities for CDC	The provincial level has the strongest technical capabilities, followed by the municipal level, and the county level is weaker.

4.3.3 Axial coding

The above 12 categories are grouped into three main categories by axial coding. The three main categories are: Epidemic Control Effectiveness, Emergency Management Capability, and Human Resources for CDC, which are shown in Table 4.3:

Table 4.3 The axial coding results (SARS)

Category	Category	Content
Effectiveness of epidemic control	Monitoring effectiveness	The longer the real-time monitoring of the epidemic situation to , the better the monitoring effect and the better the epidemic control effect.
	Test effectiveness	Using laboratory technology to detect pathogens, the better the detection effect, the better the epidemic control effect
	Epidemiological investigation results	Use epidemiological methods to conduct survey research, mainly to study the distribution of diseases and health and their determinants; The more effective the epidemiological investigation, the better the epidemic control
Emergency management capability	Coordination and command ability	Coordinate and direct multi-department collaboration during the epidemic to achieve better prevention and control effects, The stronger the coordination and command ability, the better the epidemic control effect.
	Guarantee ability	Including the support of materials, personnel and other aspects during the epidemic; the stronger the guarantee capacity, the better the epidemic control effect.
	system improvement	Improving the institutional system for public health

	ability	emergencies; The better the ability to improve the system, the better the effectiveness of epidemic control
Human Resources for CDC	Number of human resources for CDC	Including the number of CDC staff that can be deployed; the more reasonable the number of disease control human resources, the better the epidemic control effect
	Human Resource Structure for CDC	Including the educational background, age, professional title of the disease control team; The more reasonable the structure of disease control human resources, the better the epidemic control effect
	Human Resource Capability for CDC	Including the monitoring and detection technical capabilities of the disease control team, the ability of epidemiological investigation. The stronger the capacity of disease control human resources, the better the epidemic control effect
	Knowledge of human resources for CDC	The professional knowledge of the disease control team need update. The more advanced the knowledge of disease control human resources, the better the epidemic control effect.
	Unbalanced development of human resources for CDC among regions	With different economic strength and administrative levels, the quality of disease control personnel is also different. The uneven development of disease control human resources among regions has a negative impact on the effectiveness of epidemic control.

4.3.4 Selective coding

This study takes "epidemic control effectiveness" as the core category, and determines the selective coding path relationship of the main category of this study by analyzing the interview data of experts who experienced SARS and the categories summarized. Its "story line" is: emergency management capability and human resources for CDC have a positive impact on the effectiveness of epidemic control; human resources for CDC also have a positive impact on emergency management capability; emergency management capacity plays a mediating role between human resources for CDC and the effectiveness of epidemic control.

4.4 Study proposition induction

Taking the SARS epidemic as an example, based on the Case Study Theory defined by Eisenhardt et al. (2002), this chapter obtains many research materials through literature review and expert interviews. We conduct the word frequency analysis on the interview data, and conduct the open coding, axial coding, and selective coding operations, to refine and categorize the concepts. Finally, Summarizing the above analysis, four propositions of study 1 are proposed (as shown in Figure 4.1):

Proposition 1: Human resources of CDCs have a significant positive impact on epidemic control performance.

Proposition 2: Human resources of CDCs have a significant positive impact on emergency management capacity.

Proposition 3: Emergency management capacity has a significant positive impact on epidemic control performance.

Proposition 4: Emergency management capacity plays a mediating role between human resources of CDCs and epidemic control performance.

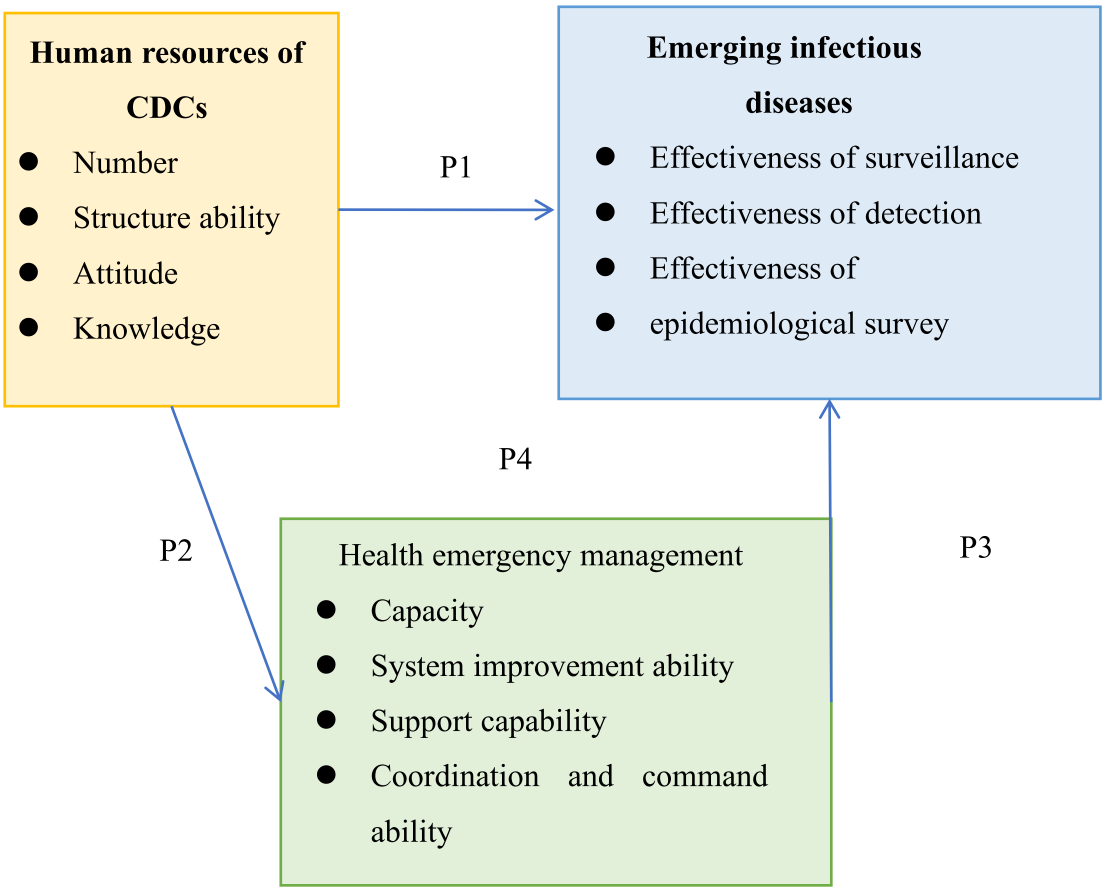

Figure 4.1 Proposition diagram of SARS case analysis

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Chapter 5: Study 2 The COVID-19 Outbreak And Response In China

5.1 The outbreak of COVID-19

On December 29, 2019, a case of pneumonia of unknown cause was detected in Hubei Province, China. Subsequently, provincial, and municipal health departments started work to conduct investigations and case searches. The clinical manifestations of infected patients are systemic symptoms such as fever and fatigue, accompanied by dry cough, and dyspepsia is more common in hospitalized patient (China News, 2020). On January 8, 2020, the expert evaluation team of the National Health and Medical Commission initially confirmed the pathogen of the epidemic as a "new type of corona virus". Human-to-human transmission of COVID-19 has led to a rapid rise in the number of cases (Wuhan Health Commission, 2020). On January 22, 2020, Hubei Province launched a second-level emergency response to public health events. During the Spring Festival travel period, in order to contain the fast spread of COVID-19 to the whole country, the city's urban bus, subway, ferry, and long-distance passenger transportation have been suspended since 10:00 on January 23. On January 24, Hubei Province launched a first-level response to major public health emergencies. At the same time, Wuhan urgently established the makeshift hospitals "Huoshenshan Hospital" and "Leishenshan Hospital" to specially treat patients with the COVID-19 outbreak. With the rapid progress and widespread spread of the epidemic, the World Health Organization declared the outbreak of the novel corona virus an international public health emergency on January 31, 2020. As of June 25 2022, SARS-CoV-2 has infected more than 540 million people worldwide and killed 6.35 million people (WHO, 2022). COVID-19 is a global pandemic with the widest impact that human beings have encountered in the past 100 years, and it is a serious crisis and a severe test for the whole world.

5.2 Actions and effects of global COVID-19 prevention and control

The outbreak of COVID-19 has attracted extensive attention from the international community. WHO declared the outbreak of COVID-19 a public health emergency of international concern

(PHEIC) on January 30, 2020. With the continuous spread of the epidemic in the world, different countries have adopted different strategies and measures. Looking at the current international prevention and control strategies and measures for COVID-19, although the specific measures of different countries are different, they can be simply classified into the following two categories according to the essential characteristics of the strategies and measures adopted (China Daily Online, 2020).

The first category refers to the strategies and measures adopted by countries represented by China, Singapore, South Korea, Thailand, which can be called "SARS-like prevention and control strategies and measures" or "blocking strategies", hereinafter referred to as "SARS-like strategies".

The second category is the strategies and measures adopted by the United States, Japan, Italy, France, Switzerland and other countries, which can be called "pandemic-like influenza prevention and control strategies and measures" or "mitigation strategies", hereinafter referred to as "pandemic-like influenza strategies".

5.2.1 Key prevention and control measures under the SARS-like and pandemic-like influenza strategies against COVID-19

5.2.1.1 Key prevention and control measures under the Class I SARS strategy

Under the SARS-like strategy, in order to achieve the purpose of interruption of transmission and reduction of health hazards, it is necessary to achieve the "five early", that is, "early detection, early reporting, early investigation, early isolation, and early treatment", and strictly manage the source of infection to achieve the purpose of gradually blocking transmission.

"Five early prevention" is one of the key measures to prevent and control the spread of COVID-19, which can effectively prevent COVID-19 patients, suspected patients and asymptomatic infected patients from infecting others, and avoid causing a wider epidemic.

Through the "Five early measures", the confirmed cases, suspected cases, positive cases and close contacts should be "collected and managed in spite", so as to effectively control the further spread of the virus until it is completely interrupted.

On the one hand, the purpose of "five early" is to timely detect and treat patients, on the other hand, to control the source of infection by early isolation of confirmed cases, suspected cases and asymptomatic infected cases, so as to reduce the risk of wider spread of the epidemic and protect the health of the wider population (Hunan Provincial Provincial Center for Disease Control and Prevention, 2020).

5.2.1.2 Key measures under the influenza-like strategy

Under the influenza-like strategy, in order to reduce health hazards, the treatment of severe cases is the most important measure. At the same time, in order to avoid excessive medical burden, it is also appropriate to increase social distance when necessary. However, early detection of all cases, isolation and treatment of mild cases, and screening and management of close contacts of cases were not emphasized.

"Severe case treatment" refers to giving priority to the hospitalization of severe cases or cases with underlying diseases, and reducing the mortality rate through active symptomatic and supportive treatment. At present, there is no specific drug for the treatment of COVID-19. Therefore, under the pandemic strategy, home observation is generally advocated for patients with mild symptoms, and hospitalization is not recommended if severe symptoms such as dyspepsia do not occur. Because early detection of COVID-19 cases is not emphasized, it is generally not recommended to test atypical cases, cases without contact history, and contacts without symptoms.

In case of a rapid increase in cases in a region, if the number of cases rises too fast, the number of severe cases exceeds the load that medical institutions can bear, or if there is a run on medical resources for severe cases, measures to increase social distancing should be taken accordingly, such as banning or reducing large-scale gatherings, suspending school and work, and even declaring a state of emergency or implementing a curfew.

The above measures are either to control the flow of infectious sources, or to increase social distancing, or to protect susceptible groups, so as to prevent or reduce the spread of the virus and reduce the occurrence of diseases. These measures may be more or less used for both types of population prevention and control strategies of COVID-19, but may vary according to the epidemic situation, prevention and control concepts, cultural customs. The SARS-like strategy may pay more attention to and adopt more radical closed management measures, such as the lockdown of Wuhan to prevent the further spread of COVID-19 infected people, and some closed management to prevent the spread of COVID-19 infected people in other areas. In order to prevent the spread of the epidemic through urban rail transit, rail transit enterprises have taken effective measures to implement strict body temperature detection and elimination work, implement traffic organization measures such as stopping and closing stations, adjusting operation hours or travel intervals, and effectively do a good job in operation management and service support under the prevention and control of the epidemic (He, 2022). In the pandemic-like strategy, more emphasis may be placed on relatively mild measures to increase social distancing, such as reducing social gatherings and school holidays. But all these measures are complementary to both types of strategies and can help or facilitate faster and better results for key measures.

5.2.2 Effectiveness of the two strategies against COVID-19

5.2.2.1 The Class-like SARS strategy had a good effect on epidemic control in China

Countries and regions that adopted SARS-like strategies, whether China and South Korea, which had serious epidemics in the early stage, or Singapore, Thailand, Vietnam, Hong Kong, China, which had imported epidemics in the early stage, have successfully controlled the COVID-19 epidemic by actively adopting SARS-like prevention and control strategies and measures, and even successfully interrupted the transmission of the virus locally. As the first country to detect the COVID-19 epidemic, China has successfully controlled the local transmission by actively adopting SARS-like prevention and control strategies and measures and is about to complete the complete interruption of local virus transmission. During the prevention and control of COVID-19, the South Korean government has always followed the principle of "rapid testing and transparent information disclosure". Finding, isolating, testing, and treating every case, and tracing every contact, are key reasons for bringing the outbreak under control in South Korea (J. Ye, 2020).

Countries adopting SARS-like strategies have broken the transmission chain of cases due to the implementation of the key measures of focusing on the discovery and management of infection sources, which has effectively curbed the new epidemics and controlled the number of severe cases. Except for the high fatality rate in Wuhan, China, due to the run-on medical resources in the early stage in most other countries or regions, the crude case fatality rate remained relatively low.

In addition, countries with SARS-like strategies have generally exported fewer outbreaks to other countries. Although in the early stage of the Wuhan outbreak, imported COVID-19 cases from China were found in about 20 countries around the world, with the implementation of various positive and even radical prevention and control measures, there have been few reports of COVID-19 cases from China being exported to other countries since February 2020.

5.2.2.2 Pandemic influenza-like strategy countries continue to increase or even rapidly

Due to the lack of comprehensive and effective management of infection sources, community transmission continued to occur in countries with pandemic influenza-like strategy. However, the rate of increase of the epidemic varied among countries due to the differences in the capacity of case treatment, the compliance of people to home treatment, the intensity and willingness of measures to increase social distancing, and the different start time of the epidemic. The epidemic continues to rise in Italy, the epidemic has increased rapidly in most European countries and the United States, and the epidemic has recently continued to rise slowly in Japan.

Italy is the "starting point" of the COVID-19 epidemic in Europe. The domestic epidemic in Italy has the characteristics of rapid development, many ups and downs, wide spread and difficult to trace back. With the spread of the disease and the increase of the number of cases, the number of severe cases in Italy has increased, which has exceeded the ability of local medical institutions. Medical staff are facing the dilemma of having to carry out selective treatment for patients, and the mortality rate continues to be high, becoming the country with the highest crude mortality rate in the world. It remains to be seen whether other countries will experience similar runs on medical resources for severe cases. Italy's medical and health system was overwhelmed by the epidemic, which had a huge impact on social stability, and the prevention and control situation was not optimistic (C. Zhang, 2020).

In the case of extensive community transmission of the virus in the heavy epidemic area, Italy did not implement strict real blockade in the heavy epidemic area, and the epidemic continued to spread and spread to other parts of Italy, and Italy continued to spread and spread to other countries in Europe and the world. Italy has been the biggest exporter of cases to other countries for some time, making it in some ways an important source of the pandemic. At the same time, with the number of COVID-19 cases rising rapidly in most European countries, the United States and other countries, these countries have also become an important source of imported cases to other countries, which has become a booster for this global pandemic.

However, through the comparison of the key measures of the two types of global strategies, it is clear that the key to control and stop the spread of SARS, whether in high-incidence areas where there has been extensive community transmission or low-incidence areas where there has not been extensive community transmission, is to implement the "five early steps" and "all should be collected, although should be managed". And the earlier the implementation, the easier the implementation, the lower the cost. The later it is implemented, the harder it will be and the more costly it will be. The development of the epidemic is mainly affected by the above key measures, rather than the closed measures that are difficult to replicate in countries with pandemic strategies such as Europe and the United States. These closed measures are necessary under specific circumstances, and they only play an auxiliary role in the control of the epidemic. Therefore, all countries in the world can adopt SARS-like strategies. While strengthening the treatment of severe cases, by paying close attention to the implementation of key control measures, realizing the "five early" and "all should be collected, although should be managed", the increase of incidence can be effectively controlled, and finally the spread of the novel coronavirus can be stopped, which will benefit the people of all countries and the people of the world.

5.3 Actions and outcomes of COVID-19 prevention and control in China

In the face of the outbreak, China has given top priority to the safety and health of its people, coordinated epidemic prevention and control with medical treatment, adopted the most comprehensive, strict and thorough prevention and control measures, adopted unprecedented large-scale isolation measures, and mobilized national resources on an unprecedented scale to carry out large-scale medical treatment, so that no one was lost. We did not abandon any patients, and realized "all should be collected, all should be treated, all should be tested, and all should be isolated", which contained the large-scale spread of the epidemic and changed the dangerous course of the spread of the virus. The time that can be bought by fully implementing these measures, even if it is just a few days or weeks, will ultimately be of immeasurable value in reducing COVID-19 infections and deaths (Y. Song, 2020).

5.3.1 Establish a unified and efficient command system

Under the strong leadership of the CPC Central Committee with Comrade Xi Jin Ping as the core, a command system featuring unified command, coordination and dispatch by the central committee, coordination and cooperation among all localities and departments, centralized, unified, coordinated and efficient operation has been established, providing a strong guarantee for winning the people's war, the general war and the war against the epidemic.

Chinese government has strengthened the construction of emergency command mechanisms for major epidemics. We have established a centralized, unified and efficient leadership and command system, improved and optimized a joint prevention and control mechanism that combines peacetime and wartime efforts, and a working mechanism that links up and down to respond to the epidemic, so as to better combine the governance advantages of local Party committees and governments with the technical advantages of national professional departments. To achieve clear instructions, systematic and orderly, smooth lines and forceful implementation, and accurately solve the front-line problems of the epidemic. The government has strengthened inter-departmental and regional coordination mechanisms for joint prevention and control, strengthened training and exercises for management personnel, professionals and the public in response to major epidemics, improve the working mechanism of combining prevention and control, joint prevention and control, and mass prevention and treatment, and improve the ability to respond to major epidemics.

All localities and all aspects are responsible for keeping the soil. All provinces, cities, and counties have established an emergency command mechanism headed by major Party and government officials, and a top-down emergency decision-making and command system featuring unified command, front-line guidance, and overall coordination. Under the unified leadership of the CPC Central Committee, all local governments and all authorities have resolutely implemented the central government's decisions and arrangements, followed orders and stopped any prohibition, and implemented all prevention and control measures in a strict and efficient manner. As a result, a nationwide epidemic prevention and control situation has been formed in which all measures have been mobilized, deployed, and strengthened in a horizontal manner and in a vertical manner (Leading Group of the National Health Commission of the CPC, 2022).

5.3.2 Build a strict prevention and control system with the participation of the people

In view of the large number of people and mobility during the Spring Festival, China has rapidly carried out social mobilization and the participation of the whole people, followed the principle of legal, scientific and precise prevention and control, and implemented unprecedented large-scale public health response measures nationwide. Through extraordinary social isolation and flexible and humanized social control measures, China has built a joint prevention and control system, and a mass prevention and control system. The people's war against the epidemic has been launched, and the chain of virus transmission has been effectively interrupted through non-pharmaceutical means (NHCPRC, 2022).

Strong measures have been taken to firmly control the source of infection. Focusing on the confirmed patients, suspected patients, febrile patients, and close contacts of confirmed patients, the prevention and treatment policies of "early detection, early reporting, early isolation, early treatment" and "all should be collected, all should be treated, all should be tested, and all should be separated" were implemented to minimize the infection rate. During the closure of the exit channel from Wuhan, Wuhan carried out two rounds of dragnet investigation of 4.21 million residents in the city to achieve "zero stock clearance" according to the standard of "leaving no family and no one missing" to ensure that no new potential sources of infection occurred. Continue to improve the ability of nucleic acid detection, enhance the supply capacity of kits, expand testing institutions, shorten the testing cycle, ensure the quality of testing, and achieve "all testing should be detected" and "immediate detection". In Hubei Province, the testing cycle was shortened from 2 days to 4-6 hours, and the daily test volume increased from 300 at the beginning of the epidemic to more than 50,000 in mid-April, which shortened the diagnosis time of patients and reduced the risk of transmission. The "four types of personnel" were investigated nationwide, and the community grid was used as the basic unit to carry out carpet investigation by combining on-site investigation with self-examination and self-reporting. Temperature screening in all places has been implemented, and case monitoring and infectious disease reporting in fever clinics of medical institutions have been strengthened. The network direct reporting system is implemented within two hours, and the test results are reported back within 12 hours. On-site epidemiological investigation is completed within 24 hours, and confirmed cases and asymptomatic infections are found and reported in a timely manner. Epidemiological investigation has been strengthened to accurately track and cut off the transmission route of the virus. As of May 31, more than 740,000 close contacts had been traced and managed nationwide (Li & Shan, 2020).

The government in China have implemented hierarchical, classified, dynamic and precise prevention and control measures. The national prevention and control strategy is implemented by regions and levels of precision implementation. Based on the comprehensive study and assessment of the population and incidence of the epidemic, the county level is divided into low, medium and high-risk levels of the epidemic, and differentiated prevention and control is implemented by regions and levels. The low-risk areas should strictly prevent the importation and fully restore the order of production and life. In the middle risk zone, we should prevent the importation outside and prevent the spread inside, and fully restore the order of production and life as soon as possible. In high-risk areas, we must prevent proliferation, prevent export, strictly control and focus on epidemic prevention and control.

5.3.3 Make every effort to treat patients and save lives

We should concentrate resources to strengthen the treatment of severe cases. The outbreak of COVID-19 caused a run-on medical resource in Wuhan. In view of the prominent contradiction between the surge in the number of patients and the shortage of bed resources at the beginning of the epidemic, resources and efforts were concentrated in the construction and expansion of designated hospitals for severe diseases and beds in Wuhan, and all severe and critical patients were concentrated in the general hospitals with the strongest comprehensive strength and the conditions for treating respiratory infectious diseases. Two special infectious disease hospitals, Huoshen Mountain and Leishenshan Mountain, each with over 1,000 beds, were built, a number of designated hospitals were renovated and expanded, and a number of general hospitals were renovated, rapidly increasing the number of beds for critical patients from about 1,000 to over 9,100, solving the problem of treating severe patients on a large scale (Y. Song, 2020).

Free treatment for patients. Timely appropriation of epidemic prevention and control funds to ensure that patients do not suffer from medical treatment due to cost problems, and that local governments do not suffer from medical treatment and epidemic prevention and control due to funding problems. By May 31, 2020, a total of 162.4 billion yuan had been allocated for epidemic prevention and control. Medical insurance policies should be timely adjusted, medical insurance policies for confirmed and suspected patients should be clarified, and "treatment first, settlement later" should be implemented for confirmed and suspected patients. For the medical expenses incurred by COVID-19 patients (including confirmed and suspected patients), the basic medical insurance, critical illness insurance, and medical assistance will be paid according to regulations, and the part paid by the individual will be subsidized by the government. The medical insurance payment in other places shall be paid in advance by the local medical insurance department. By May 31, 2020, a total of 58,000 confirmed inpatients had been settled nationwide, with a total medical cost of 1.35 billion yuan, and the average medical cost of confirmed patients was about 23 thousand yuan. Among them, the average treatment cost of severe patients is more than 150,000 yuan, and the treatment cost of some critically ill patients is hundreds of thousands or even millions of yuan, all covered by the government.

5.3.4 Release epidemic information in a timely, open and transparent manner according to law

As an important part of the open government movement, information disclosure and data disclosure are the proper meaning of the construction of transparent government, democratic government and service-oriented government. Public health crises are often accompanied by social disorder and public panic. As a sudden public crisis, a major epidemic outbreak is not only an important test of the government's ability to govern, but also an urge for the public to practice their civic duties. It is realistic and urgent to open the data of major epidemics, and the protection of the public's right to know and to health is also the core and key to the prevention and control of major epidemics. How to promote the opening up of major epidemic data in the case of imperfect government data opening system requires in-depth analysis of major epidemic data, classification and regulation, and key protection according to the basic classification of major epidemic data. The regulation of epidemic data list, classification regulation of data use rights, and key protection of personal private data are only an attempt to make major epidemic data open by law. The core value of major epidemic data is how to fix the opening of major epidemic data in an institutionalized form and provide data reference and decision-making for responding to major public health crises (Y. Zhang, 2020).

A hierarchical press release system will be established. To establish a multi-level, multi-channel and multi-platform information release mechanism, continuously release authoritative information, and timely respond to the epidemic situation, epidemic prevention and control, medical treatment, scientific research and other hot issues of concern at home and abroad. By May 31, 2020, the Joint Prevention and Control Mechanism of The State Council and The State Council Information Office had held 161 press conferences, inviting more than 490 people from more than 50 departments to attend and answering more than 1,400 questions from Chinese and foreign media. Hubei Province held 103 press conferences, and other provinces held 1,050.

5.3.5 Give full play to the supporting role of science and technology

Throughout the previous major epidemic such as SARS, H7N9 and COVID-19, scientific and technological progress has played a key role in the effective control of the epidemic. At the beginning of 2020, the COVID-19 epidemic spread rapidly. In response to the rapid spread of COVID-19, China's science and technology, vital and other departments formed interdisciplinary and cross-field research and development groups and determined five main directions of clinical treatment and drug and vaccine research and development, detection technology and products. The complete genome sequence of SARS-CoV-2 and the viral strain, the introduction of a variety of testing products, the screening of old drugs for new applications, the integration of traditional Chinese and western medicine, and the promotion of vaccine research and development have all provided strong scientific and technological support for winning the hard battle of epidemic prevention and control (J. Pan, 2021).

5.4 Guangdong’s actions to prevent and control COVID-19 epidemic

5.4.1 The process of fighting the epidemic in China and in Guangdong

The COVID-19 epidemic is a major public health emergency with the fastest spread, the widest infection, and the most difficult event to prevent and control in China since 1949. Since the outbreak of the COVID-19, China's response to the epidemic can be roughly divided into four stages:

(1) the first stage is the emergency containment stage for outbreak. China adheres to its

dynamic zero-COVID policy and strategies to tackle both imported and domestic infection. The time has achieved decisive results in the defense of Wuhan, winning precious time and providing experience for the world.

(2) The second stage is the exploratory stage of normalized epidemic prevention and control. Under the guidance of this general strategy, we will expand prevention with nucleic acid testing as the center, and generally to control sporadic cases and local clustered outbreaks in two to three incubation periods.

(3) The third stage is the " dynamic zero-COVID" stage of the whole chain of prevention and control, with special emphasis on speed and precision, mainly to take corresponding control measures for the characteristics of delta variant strains with stronger transmission power and faster transmission speed. During the period, China tries to control the epidemic within a maximum incubation period.

(4) The fourth stage is the "scientific and accurate, dynamic clearing" stage of all-round comprehensive prevention and control since March 2022. In addition to emphasizing rapidity and precision, it also emphasizes comprehensiveness, that is, comprehensive prevention and control measures are adopted, including the prevention and control of the source of infection. Management, the rapid blocking of transmission routes, and the protection of susceptible groups must be effectively combined and superimposed, and the most stringent, thorough, and resolute measures should be taken to prevent the social spread of the epidemic.

The outbreak and control stages in Guangdong Province are basically the same as those in the country. On January 19, 2020, the first case was observed in Guangdong Province, the case was the first reported case outside the Hubei Province. The next day, Guangdong Province detected 13 new confirmed cases. On January 21, 2020, the Provincial Government held a briefing on COVID-19 epidemic and its response to prevention and control. Zhong Nanshan said "It is now known that there is human-to-human transmission, and the first thing to do is to isolate the patient", "until now, there is no targeted and effective treatment for COVID-19." (Cai & Wei, 2020). On January 23, 2020, Guangdong launched a first-level response to public health emergencies. Guangdong Province was the first province in the country to initiate a first-level emergency response to the public health emergency and issued 16 first-level response measures for epidemic prevention and control. On January 26, 2020, Guangdong punished for not wearing a mask in public places. On January 30, 2020, with the rapid increase of confirmed cases, Guangdong Province launched three major investigations; formulated a "three-intensive" plan for patient treatment. From February 4, 2020, the closed management of residential areas will be implemented, including restricting the entry and exit of non-owners and their vehicles, and closing public gathering places. On February 6, 2020, Guangdong issued the No.2 mask order. On February 7, 2020, all communities in Guangzhou implemented closed management, and all patients in the Fever Clinic in Guangdong Province were required to undergo nucleic acid testing. With the steady control of the epidemic, Guangdong Province decided on February 24, 2020, to adjust the first-level response to the second-level response. In the early days of the fight against the epidemic, Guangdong Province developed a set of anti-epidemic tactics. In addition to the anti-epidemic tactic, Guangdong Province has also comprehensively implemented a community-based "grid" epidemic prevention and control management.

5.4.2 Fighting against the outbreak is mainly based on "tackling imported infections" in Guangdong Province

On May 9, 2020, Guangdong Province adjusted the second-level response to COVID-19 epidemic to a third-level response, and the epidemic entered the stage of normalized prevention and control. With no new confirmed cases in cities for several days in a row, Guangdong's epidemic prevention focuses on preventing overseas imports. Guangdong Province is the province with the largest number of people entering the country during the epidemic, and the pressure to prevent overseas imports is enormous. In 2020, Guangdong has found several new coronavirus mutants in imported confirmed cases of COVID-19 from abroad, such as B.1.1.7 mutants, South African mutants, Nigerian mutants, and Delta mutants. According to statistics, in 2020, Guangdong province has reported a total of 1,656 imported cases from abroad, and sporadic local cases associated with imported cases. To prevent overseas imports, the province implements a full-process health monitoring for Chinese passengers who enter Guangdong from abroad (including transit through Hong Kong and Macau airports) through Guangdong ports, enter Guangdong from other mainland city ports, and have a history of living abroad within 14 days before arriving in Guangdong. And management services focus on achieving "three full coverages": port screening, special car transfers, and community health management. Take measures such as flight interruptions, limit the number of inbound personnel, and implement closed-loop management of inbound passengers to effectively control the local transmission and spread of the epidemic.

5.4.3 Fighting against Delta Variant Epidemic in Guangdong Province

On May 21, 2021, an overseas import-related local epidemic occurred in Guangzhou, which was confirmed to be a Delta variant outbreak. Prior to this, Guangdong had experienced six local epidemics, all of which had the characteristics of short transmission chains. The virus in this outbreak is a Delta variant with stronger transmission and faster transmission, and it lasted for 29 days in Guangdong, with a total of 167 cases involving four cities of Guangzhou, Foshan, Zhanjiang, and Maoming. In the face of Delta variants, Guangdong Province attaches great importance to potential risks and tries to minimize the negative impact. Guangzhou immediately started the nucleic acid screening operation. As the epidemic worsened, Guangzhou conducted accounting tests from the district to the whole city; implemented hierarchical management and implemented closed management of individual communities; built large outdoor temporary vaccination sites. As the epidemic situation in Guangzhou gradually stabilized, and cases of cross-city transmission appeared, on May 30, Guangzhou issued the control measures for leaving Guangzhou. In this action to control the epidemic, Guangdong Province has continuously improved its efficiency and raced against time. On June 26, 2021, Lei Haichao, head of the Guangdong Working Group of the Comprehensive Group of the Joint Prevention and Control Mechanism of the State Council and deputy director of the National Health Commission, said that Guangdong completed nucleic acid screening of over 200 million people within a month. More than 18 million people were tested, setting two national records (L. Liu & Yue, 2021). In addition, as of April 2, 2021, the cumulative number of COVID-19 vaccinations in Guangdong Province exceeded 10 million doses for the first time, and it took 108 days to exceed 10 million doses. On June 20, 2021, the cumulative number of COVID-19 vaccinations in Guangdong Province exceeded 100 million doses, and only 79 days have passed since the breakthrough of 10 million doses (X. Li, 2021b). Guangdong's cumulative inoculation volume, cumulative number of inoculations, and the number of people who have completed the whole process of inoculation ranked first in the country, laying a solid foundation for building a population immune barrier and preventing and controlling COVID-19 epidemic (X. Li, 2021a). Due to strict prevention and control measures, the local epidemic has not spread outside the province, and Guangdong Province has left valuable experience in fighting the Delta virus.

5.4.4 Fight against the Omicron variant strain in Guangdong Province

Since 2022, local outbreaks of Omicron mutants have occurred in many cities in Guangdong Province. Compared to the previous variant, the Omicron variant has a shorter incubation period, is more contagious, spreads faster, and is stealthier. At this stage, the number of imported cases of the epidemic in Guangdong Province increased by 3.35 times compared with that in 2021; the local epidemic spread to 20 cities, with two reported cases exceeding 1,000 and seven cases exceeding 100; one epidemic lasted the longest 43 days, six cases over 14 days. After the outbreak, the provincial, municipal and district new crown pneumonia prevention and control headquarters immediately launched emergency response, adhered to the dynamic zero-COVID policy and strategies to tackle both imported and domestic infections, deployed strict epidemic investigation and disposal, and strictly prevented Epidemic spread. The leading experts rushed to the scene as soon as possible, and the station worked with the main leaders of the party committees and governments at the two levels in the city to set up a front-line headquarters to quickly study and deploy the epidemic disposal and prevention and control work, seize the 24-hour golden disposal time, and adhere to the integration of point, line and surface. Quickly complete all measures to deal with the epidemic, such as the tractability of the epidemic, the control and investigation of key populations, the closure and control of key places, and the nucleic acid testing of community personnel, to realize the "dynamic zero-COVID" of the society in the shortest time. Among them, Shenzhen City has implemented 11 measures to strengthen epidemic prevention and control since March 12, promoted the formation of a community management Shenzhen model of "enclosure + bayonet + electronic sentinel + white list + checking 4 types of people", and upgraded the control area Management; on March 13, the transition from "first-level connection to second-level operation" to "full connection" was realized; the "triangle" area of Futian was resolutely sealed and controlled; During the period of Japan, three rounds of nucleic acid testing for all employees will be implemented throughout the city, social control will be strengthened, unnecessary movement and activities will be reduced, urban bus and subway operations will be suspended, and community communities, urban villages, and industrial parks will be closed. Management; Do a good job in emergency response in key places. As of April 14, the city has maintained zero new social cases and staged results have been achieved in epidemic prevention and control.

During the epidemic, Guangdong Province took many efficient anti-epidemic actions. For example, since the outbreak of the COVID-19 in Wuhan, Guangdong Province has attached great importance to it and responded quickly. The provincial government immediately established an epidemic handling leading group, a prevention and control expert group, and an epidemic prevention and control guarantee group. The Provincial Health Commission also established an epidemic prevention and control leading group and an expert group. On January 24, 2020, in the face of the increasingly severe epidemic, the emergency approval process of Guangdong Province accelerated the listing of epidemic prevention medical devices. "It took only three days from enterprise declaration to approval." Science and technology anti-epidemic is also one of the highlights of Guangdong's anti-epidemic action (Sina Aspect, 2020). For example, self-driving cars are used to deliver important supplies; drones are used to deliver small items. In addition, Guangdong has continuously innovated on the basis of prevention and control experience and has formed innovative scientific management measures. For example, Guangdong has established a "yellow code" system for the first time in the country, requiring "yellow code" personnel to complete nucleic acid testing within 24 hours, combined with measures such as "two inspections in three days" and "three inspections in seven days", to a certain extent, more accurate prevention and control can be achieved (China Times, 2021).

5.5 Human resources and economic investment for disease control in Guangdong Province

Since the COVID-19 epidemic in January 2020, Guangdong Province responded quickly, established headquarters of epidemic prevention and control, established an organizational framework with municipal leaders as the first person in charge of epidemic prevention and control, and established a top-down unified and coordinated prevention and control network. What's more, special classes for epidemic prevention and control at land and airports, special classes for rural and fishermen epidemic prevention and control, special classes for isolation management, special classes for sentinel monitoring, special classes for flow tracking and tracing, and special classes for coronavirus detection work, were established. The province-wide epidemiological team and nucleic acid testing team were also boiled. Epidemiological investigation is the key to the epidemic control. The information collected by epidemiological investigation is invaluable and plays an essential role in curbing the epidemic effectively.

In the early stage of the epidemic, the basic organization of community grid epidemic prevention was formed, that was, a "three-person team" composed of community workers, public health personnel and grass-roots police. The "three-person team" had a clear division of labor. Health workers who possess healthcare expertise were responsible for the health observation, nucleic acid testing and registering; community workers were familiar with local conditions and were responsible for comforting and explaining to residents; grassroots police were responsible for the supervision of home isolation personnel, maintaining order, transportation of epidemiological investigation, and utilizing large data for key personnel screening and nucleic acid testing, and timely handling of epidemic-related disputes. As of 2021, there were 12,000 public health physicians in the province, as well as relevant personnel from 142 institutions of disease prevention and control, fully devoted themselves to the epidemiological investigation work. In the process of epidemic prevention and control, Guangdong Province set up 21 provincial-level epidemiological investigation commandos, which were divided into 21 prefectures and cities. For instance, there were more than 3,400 "three-person teams" in Guangzhou with more than 11,000 members, working day and night on the front line of the community anti-epidemic; Dongguan City has set up a three-level epidemiological investigation team with 1.5 epidemiological investigation team members per 10,000 population to ensure that in the event of an epidemic, unified command, unified coordination, unified dispatch, timely response, and effective response.

In response to the COVID-19 epidemic, in 2020, all levels of finance in Guangdong Province gave priority to ensuring epidemic prevention and control funds, with a total investment of 30.278 billion yuan in epidemic prevention and control. Among them, 615 million yuan was invested to realize "full free" nucleic acid screening for people who should be tested, "full guarantee" for fever clinic screening costs, and "zero burden" for patient treatment costs; 1.977 billion yuan was invested to care for the front-line work of epidemic prevention and control personnel; 11.948 billion yuan was invested to fully ensure the supply of prevention and control materials during the epidemic, and accelerated the construction of emergency material security system. In the construction of public health and major epidemic prevention and treatment systems, 5.656 billion yuan had been invested, focusing on supporting the construction of standardized fever clinics and clinics in public medical institutions above the second level in the province, improving nucleic acid detection capabilities, and accelerating the construction of Guangzhou Respiratory Center led by Academician Zhong Nanshan; Invested 10.082 billion yuan, focusing on supporting scientific research on epidemic prevention, foreign defense imports, and local emergency response. In the first half of 2021, Guangdong Province invested 24.357 billion yuan in epidemic prevention and control funds (including medical insurance funds) to fully guarantee vaccination and patient treatment, care for front-line medical and epidemic prevention personnel, strengthen public health and major epidemic prevention and treatment system construction, build a strong defense line against external imports.

5.6 Effect of prevention and control of COVID-19

As a province with a large population and economy, in order to ensure the safety of people's lives and health, Guangdong Province adheres to the general strategy of "external anti-input, internal anti-rebound" and the general policy of "dynamic zero clearance", has realized the timely detection, rapid disposal, precise control and effective treatment of epidemic situations, has quickly restored the social economy to normal, and has better taken into account the epidemic prevention and control and social and economic development at the same time. The current prevention and control strategy has good health and economic benefits. The following four aspects are specifically reflected:

5.6.1 Cost effectiveness

Since the normalization of epidemic prevention and control in Guangdong Province on may 9,2020, as of June 2022, 136 cluster epidemics have occurred in total. However, the total number of infected people, the number of people involved in cities and regions, especially the number of serious cases and deaths (2 deaths) are very small, and the cost-effectiveness ratio of prevention and control is very high. As of May 31, 2022, 15168 confirmed cases of COVID-19 (9702 imported from abroad) and eight deaths have been reported in the whole province.

5.6.2 Cost efficiency

The response level of public health events can reflect the degree of epidemic control. On January 22, 2020, Guangdong launched the first level response to public health emergencies. On that day, seven cities in Guangdong Province had confirmed cases, and a total of 26 confirmed cases were found. Only one month later, the epidemic was controlled. Guangdong Province determined to adjust the primary response of major public health emergencies to the secondary response. At that time, 1345 confirmed cases of COVID-19 were reported, 772 cases were discharged from hospital and six cases died. On May 9, 2020, the second level response to major public health emergencies was adjusted to the third level response, and the epidemic entered the normal prevention and control stage. Up to now, the concentrated epidemics in Guangdong Province, including the delta epidemic in Guangzhou and the Omicron epidemic in Shenzhen, have basically been quickly extinguished within the two longest incubation periods with high efficiency.

5.6.3 Cost utility

On February 7, 2020, the people's Government of Guangdong Province issued the notice on several policies and measures to support enterprises to return to work in response to the epidemic of pneumonia infected by the novel coronavirus, fully supporting and promoting the return to work and production of various enterprises affected by the epidemic. Adhere to the "Dynamic zero COVID-19" policy, ensure the normal production and life of the vast majority of regions and people, minimize the inconvenience and health problems of the people, and demonstrate a high-cost utility.

5.6.4 Cost benefit

During the outbreak, economic activities were greatly affected. Guangdong Province made every effort to control the epidemic and created conditions for the resumption of work and production. According to the data released by Guangdong Provincial Bureau of statistics, the completion of the main goals and tasks of Guangdong's economic and social development in 2020 was better than expected. The annual GDP exceeded 11 trillion yuan, ranking the first province in China, with a GDP increase of 2.3% in 2020. The first quarter of 2020 is the beginning of the outbreak of the epidemic and the most serious period of the epidemic. The secondary and tertiary industries have been seriously influenced due to shut down, home isolation and other measures. In the first quarter of 2021, Guangdong's GDP was 2711 billion yuan, a year-on-year increase of 18.6%, of which the added value of the secondary industry was 990 billion yuan, a year-on-year increase of 25.1%. The added value of the tertiary industry was 1626 billion yuan, with a year-on-year increase of 18.6% (The paper, 2021). In 2021, despite the severe pressure of epidemic prevention and control, Guangdong's total GDP reached 12.4 trillion yuan, with a year-on-year increase of 8.0% and an average increase of 5.1% in the two years. Through comparison with other countries, it is found that China's GDP has maintained stable growth from the outbreak of the epidemic in 2020 until 2021. The United Kingdom (-11.0%), Japan (-4.3%), the United States (-2.8%), Canada (-4.9%) and the globe (-3.3%) even have negative GDP growth in 2020. Overall, the cost benefit is high. Obviously, the remarkable effect of epidemic control has created good conditions for the recovery of economic activities.

5.7 Eight propositions based on Covid-19 cases

The content of this section is based on sub-study 1, the related research on SARS cases, and the related content of the COVID-19 cases mentioned above. Two contextual factors are added, which are the anti-epidemic motivation of the government and the corresponding level of the public, and a total of four propositions are added, plus the four propositions of the SARS case, there are eight propositions overall. According to the Grounded Theory, the eight propositions are verified in this chapter.

5.7.1 Scenario factor 1: the government's motivation for epidemic prevention

In 2020, the COVID-19 spread to many countries in the world, and all countries have taken certain anti-epidemic measures. However, the motivation for fighting the epidemic varies from country to country. Some countries pursue freedom to maintain economic growth, while the Chinese government puts life first (Xinhua News Agency, 2021).

In 2020, the COVID-19 broke out. China implemented urban blockade measures to control the epidemic. This measure has contributed to considerable controversy in Europe and the United States. The governments of Europe and the United States believe that urban blockade limits individuals' freedom However, the control effect of the COVID-19 in China shows the effectiveness of the urban blockade measures, which not only blocks the path of virus transmission, but also wins valuable time for other countries in the world to deal with the COVID-19 (Gramsch et al., 2022), reflecting the conscientiousness of China and the responsibility as a major country. While some countries are still debating whether people have the freedom to wear masks and vaccinations, it has become the consensus of the Chinese people that wearing masks and vaccinations can help prevent infection. To implement the concept of life first, the government has spared no effort to carry out the battle against epidemic diseases and invested an army of resources. Only by February 24, 2020, the financial departments at all levels have issued a total of 100.87 billion yuan (Chinese Finance and Economics News, 2020). As a public health emergency, the government has also invested lots of manpower to fight the epidemic. At the initial stage of the epidemic, Hubei Province was the province with the most concentrated epidemic. The party and the government concentrated many medical teams on the front line of anti-epidemic and helped Hubei with the strength of the whole country. As of February 13, 2020, more than 20000 medical personnel had formed more than 180 medical teams to help Hubei and Wuhan, including more than 7000 critical care professionals (Taiyuan Daily, 2020; Xu, 2020). At the same time, in order to reduce the burden on the people and encourage them to actively receive treatment, the government also included the expenses of patients with COVID-19 into the medical insurance (Long, 2021).

The epidemic is a big test for the government. The Chinese government has taken the people as the center, implemented the concept of life first, spared no effort to fight the epidemic and protected people's life, health, and safety. It is precisely because the Chinese government puts life first and the people are willing to cooperate with the government that China has initially curbed the spread of the epidemic in just over a month and controlled the daily new cases in China within a single digit in about two months (Taiyuan Daily, 2020; Xu, 2020).

The motivation of the Chinese government to fight the COVID-19 epidemic is very clear, and it is also the key to the success of prevention and control. In the face of the dangerous situation that the virus is more virulent and the vaccine has not yet been developed, the Chinese government aims to protect the health of the people and reduce the number of morbidity and deaths as soon as possible. Although it cannot fully consider people's personal freedom as other countries such as the United States, it still decided to adopt the strictest and fastest anti-epidemic policies and guidelines. At a critical time when people’s lives and health were endangered, the CPC and the Chinese government acted with a keen sense of responsibility and swiftly identified the problem. The central authorities took multiple factors into consideration, made timely and resolute decisions, employed extraordinary measures to deal with an extraordinary emergency, and made every effort to safeguard people’s lives and health. This made great strategic achievements in the prevention and control of the local epidemic.

5.7.2 Situation factor 2: People's response level

The response level of the public is an essential variable affecting the effect of the government's measures during the epidemic period. The government's anti-epidemic action cannot be separated from the support of the public. A higher public response level will greatly reduce the resistance to the implementation of the government's anti-epidemic measures and help the government's anti-epidemic measures achieve ideal result (Hua et al.,2020). The response level of the public is influenced by the social psychology of the public to a certain extent.

After the outbreak of SARS in 2003, some scholars found that the social psychological characteristics of the people were a key situation factor (Liu et al., 2003). By studying the psychological characteristics of the people in the early stage of the COVID-19, it is found that the people have cognitive biases and insufficient cognition of the COVID-19, which has given rise to panic (Mohamed et al., 2021). There are still some ordinary people who have little knowledge of the COVID-19, which may lead to the lack of anti-epidemic enthusiasm of these people and increase the risk of infection (Li et al., 2020). The response level of the people affects the implementation of the government's anti-epidemic measures. In turn, the government's anti-epidemic action also affects the response level of the people. The public opinion propaganda of the government and the media has had a great impact on the people's behavior. Most of the people have improved their personal and family awareness of protection and taken positive epidemic prevention measures (Mohamed et al., 2021).

During the COVID-19, the response level of the public was high. First, in terms of policy compliance, the Chinese people have given support to the implementation of the government's anti-epidemic policy. For example, after confirming that wearing masks to fight the epidemic effectively blocked the spread of novel coronavirus, relevant departments immediately called on the people to wear masks. Wearing masks can prevent the infection of the virus and soon became a consensus among the people. It is precisely because people actively respond to the government's anti-epidemic policy that the epidemic can be controlled in a short time (X. Wang et al., 2020). In addition, the people were united in this epidemic and formed a great cohesion. One of the crucial ways to supplement the supply of medical materials is social donation. In the early stage of anti-epidemic, the hospital was in short of medical materials. People donated in various forms, which alleviated the pressure on the hospital's medical materials to a certain extent (Perkins et al., 2020). In addition to providing material assistance, some people also actively take great risks to voluntarily participate in volunteer services (Nazerali-Maitland et al., 2021), which reflects the people's dedication and patriotism.

After the outbreak of the COVID-19 epidemic, the response level of the public, whether in the speed of spontaneous anti-epidemic or the degree of cooperation with the government, is very high, so the efficiency of prevention and control is greatly improved. After the outbreak, the entire country acted promptly. Relying on its overall national strength, China mobilized the people, enhanced the procured supplies, and brought them to those in need rapidly. It mustered the support of the whole country to assist Hubei, and particularly Wuhan, to combat the disease. It pooled all its strength in the shortest period of time, and halted the spread of the epidemic. All citizens share a responsibility for the fate of their country. The 1.4 billion Chinese people, irrespective of their gender, age, and occupation, have plunged themselves into the battle against the epidemic. The speed and scale of China's anti-epidemic operation are unprecedented in the world, demonstrating the efficiency and the strength of China’s system.

5.7.3 The mediating effect moderated by situation factors

This chapter adds four proposition derivations, plus the previous four propositions, and a total of eight propositions need to be verified in this chapter. The logical framework of the moderator variable is derived, as shown in Figure 5.1.

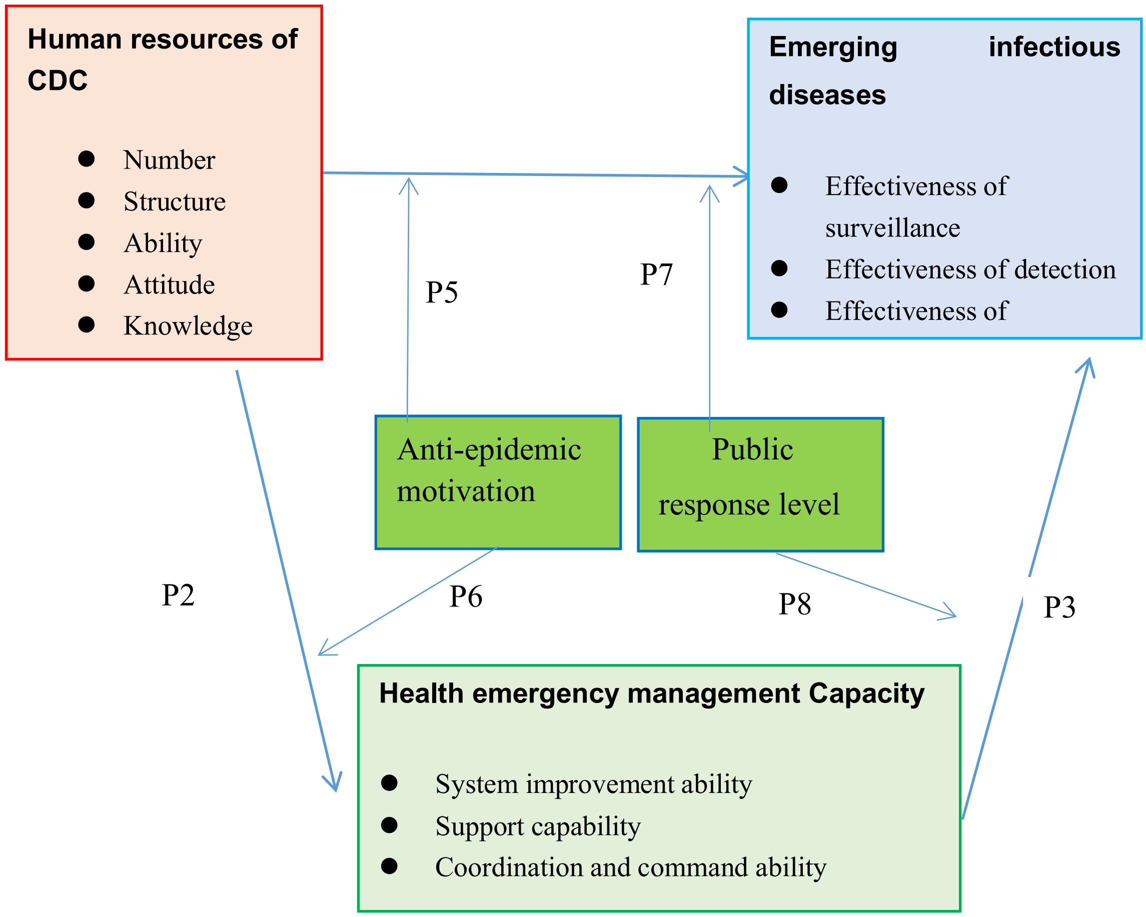

Figure 5.1 Model of the relationship among emergency management capability, human resources for disease control, and epidemic control performance

5.8 COVID-19 case coding results

This study invited 12 experts who have long been engaged in infectious disease prevention and control, immunization planning, pathogenic microorganisms, and clinical diagnosis and treatment, and experienced SARS and COVID-19 in 2003 to interview them and organize their results.

5.8.1 Open coding

By sorting out the original interview data and analyzing it word by word, the original materials are conceptualized. In the conceptualization part, the original sentences are used as much as possible for local conceptualization, to avoid deviation from the meaning of the original sentences.

In the open coding process of this study, after eliminating the initial concepts with frequency less than three times, 464 original sentences, 43 concepts, and 14 initial categories were finally obtained. The 14 initial categories including: effectiveness of epidemic control, monitoring effectiveness, detection effectiveness, epidemiological investigation effectiveness, coordination and command ability, guarantee ability, system improvement ability, quantity of human resources for disease control, structure of human resources for disease control, human resource capacity for disease control, knowledge of human resources for disease control, unbalanced development of CDC human resources knowledge and CDC workforce among regions, motivation to fight the epidemic, and the level of public response, as shown in Table 5.1.

Table 5.1 Results formed by open coding (COVID-19)

Categories	Concepts	Original representative sentences (concepts)
Effectiveness of epidemic control	A1-1 Low fatality rate	For such a large-scale Covid-19, the mortality rate in my country is about 2.5%, which is relatively low.
	A1-2 Low incidence rate	We have fewer confirmed cases than other countries.
	A1-3 Act quickly	Identify viruses quickly, control of the epidemic quickly, and development of vaccines quickly.
	A1-4 High cure rate	Once a case is found, active treatment is carried out, so that the severe rate is low, and the cure rate is high.
	A1-5 Control the impact of the epidemic	The resumption of work and production is fast, and the economic recovery is rapid, so that the economy and life have not been greatly affected.
Monitoring effectiveness	A2-1 Quickly control the epidemic	The COVID-19 broke out in the Spring Festival of 2020 and was basically controlled in May, and there was no widespread epidemic.
	A2-2 Scientific prevention and control	Control the source of infection, cut off the route of transmission, and protect susceptible populations.
	A2-3 Isolating cases	Expand the screening circle, lock cases, centralized isolation of cases, and adopt closed-loop management.
	A2-4 cases can be traced	The source of most cases can be found, and it only took about a week to trace the source of the COVID-19.
Test effectiveness	A3-1 Detection technology has improved	Isolate the strain in five days and know the virus type. Early detection prompt reporting swift isolation and early treatment so that we can rapidly control of the epidemic.
	A3-2 Detection capabilities have enhanced	Network management at the grassroots level, forming a three-person team, solidifying the investigation, and implementing it.
Epidemiological investigation results	A4-1 Focus on investigation	Focus on investigating the high-risk places where the cases have been and discovering the epidemic situation.
	A4-2 Grid management	Grid management is adopted at the grass-roots level, a three-person team is formed to solidify the investigation and implement the prevention and control measures.
Coordination and command ability	A5-1 Set up a special team	Set up various special classes and groups for prevention and control work, coordinate the deployment of people and property, and do a good job in daily information reporting.
	A5-2 Front line command	Quickly organize the flow adjustment and testing team, and lead the command to rush to the front line
	A5-3 Concentrate strength	Joint prevention and control, all departments perform their own duties, do a good job of feedback, and focus on major events throughout the country

	A5-4 Multi-departmental collaboration	Coordinate the forces of various departments, take prompt action, and implement prevention and control measures
Guarantee ability	A6-1 Safeguard mechanism	From materials, monitoring, testing, on-site investigation, isolation, treatment to vaccine development, interlocking, supervision and implementation, feedback and correction
System improvement ability	A7-1 Precise prevention and control guidelines	The introduction of refined prevention and control guidelines, strong operability, and rapid unified prevention and control measures
	A7-2 Improve the prevention and control system	Improve the prevention and control work system, issue various guidance books, emergency tool kits, management kits and work manuals, to guide the prevention and control work,
Number of human resources for CDC	A8-1 Human resource usage	For such a large-scale infectious disease of COVID-19, the manpower for disease control is insufficient, but if the manpower is greatly increased, during the non-epidemic period, the manpower will appear to be surplus.
	A8-2 Human resources does not apply to needs	With the development of society, the amount of services that can be provided by the current manpower for disease control is not in line with the growing health needs of the people
	A8-3 Insufficient investment	In the top-level design, the emphasis is still on prevention and medical care. After SARS, CDC in many places did not increase the establishment.
	A8-4 Insufficient professionals	Long-term neglect of public health, CDC personnel have a low sense of professional identity. Due to insufficient incentives, it is difficult to attract high-level talents, and the brain drain is serious.
	A8-5 Human resource allocation	With the improvement of technology, business coverage has expanded, but human resources have not been evaluated
CDC Human Resource Structure	A9-1 The team is aging	The CDC team is aging, and the talent gap is serious.
	A9-2 lack of professionalism	There are not many of the existing personnel who belong to the professional class.
	A9-2 lower education	The district-level disease control system only recruits 1-2 people every 10 years, while most of whom have a associate degree.
CDC Human Resource Capability	A10-1 Detection capabilities have been enhanced	It took more than five months for SARS to detect the pathogen, and our country was not the first one to detect it. For the COVID-19, it took us only 10 days to detect the pathogen, and the whole genome sequence was uploaded to the official website of the WHO for publicity, including the later development of detection reagents and vaccine research and development, which our country has made great contributions.
	A10-2 Flow adjustment ability is improved	In addition to virus isolation, epidemiological investigations, on-site disposal, and analysis were completed very quickly and in an orderly manner.
	A10-3 play a staff role	To make suggestions for the government, issue various prevention and control guidelines, implement scientific prevention and control, and implement precise policies.
	A10-4 Insufficient talent training	Routine training cannot deal with large-scale public health emergencies. It is necessary to strengthen personnel training and training to cultivate a team that can fight at any time.
Knowledge of human resources for CDC	A11-1 Detection speed is fast	From obtaining specimens and then sequencing, to virus isolation, we are very fast
	A11-2 Knowledge can	When the sample from the Shenzhen case was sent to the CDC, it was sequenced that night, and the patient was diagnosed. Finally, we isolated the virus.

	help quickly diagnose disease	
Unbalanced development of CDC workforce among regions	A12-1 The grassroots team is unstable A12-2 Poor technical level at the grassroots level A12-3 Economic strength affects the technological capability of CDC manpower	The grass-roots technical team is weakened, the personnel team is unstable, and the brain drain is serious, so the technical ability is relatively weakened. As for the technical level, the grass-roots level is generally poor, while the provincial and municipal levels are relatively strong. The technical level of CDC is related to the local economic and CDC in the Pearl River Delta is relatively strong. Compare with Guangzhou, Shenzhen has stronger grassroots technical capabilities.
Motivation to fight the epidemic	A13-1 State institutions A13-2 Focus on the people	The Chinese government is people-centered, and the starting point of the country's fight against the epidemic is to protect the lives, health and safety of the people, fully demonstrating the superiority of our system. In the process of fighting the epidemic, the CPC and the Government have fully mobilized resources, initiated emergency management, paid attention to the demands of the masses, and ensured good living conditions.
The level of public response,	A14-1 Popular trust A14-2 Public cooperation A14-3 Popular support A14-4 The public understands	Due to the image of the CPC and the Government governing for the people, the people trust the Party and the government. When it was confirmed that the COVID-19 would be transmitted from person to person, the CPC and the Government made a decisive decision to close Wuhan, and the people could cooperate with the local government's prevention and control measures and not get out. The prevention and control measures formulated by the government, such as wearing masks, do not participate in gatherings and getting vaccinated, the people are willing to obey and cooperate. Because the public recognized the seriousness of the epidemic and saw the determination of the Party and the government to prevent and control the epidemic, they can understand that the prevention and control measures are for everyone's health, so they consciously cooperate with the prevention and control measures.

5.8.2 Axial coding

The above 14 categories are grouped into five main categories by axial coding. The five main categories are: Epidemic Control Effectiveness, Emergency Management Capability, and Human Resources for CDC, motivation to fight the epidemic, and the level of public response, which are shown in Table 5.2.

Table 5.2 The axial coding results (COVID-19)

Main category	Category	Content
Effectiveness of epidemic control	Monitoring effectiveness	The longer the real-time monitoring of the epidemic situation to, the better the monitoring effect and the better the epidemic control effect.

Emergency management capability	Test effectiveness	Using laboratory technology to detect pathogens, the better the detection effect, the better the epidemic control effect
	Epidemiological investigation results	Use epidemiological methods to conduct survey research, mainly to study the distribution of diseases and health and their determinants; The more effective the epidemiological investigation, the better the epidemic control
	Coordination and command ability	Coordinate and direct multi-department collaboration during the epidemic to achieve better prevention and control effects, The stronger the coordination and command ability, the better the epidemic control effect.
	Guarantee ability	Including the support of materials, personnel and other aspects during the epidemic; the stronger the guaranteed capacity, the better the epidemic control effect.
	system improvement ability	Improving the institutional system for public health emergencies; The better the ability to improve the system, the better the effectiveness of epidemic control
Human Resources for CDC	Number of human resources for CDC	Including the number of CDC staff that can be deployed; the more reasonable the number of disease control human resources, the better the epidemic control effect
	Human Resource Structure for CDC	Including the educational background, age, professional title of the CDC; The more reasonable the structure of disease control human resources, the better the epidemic control effect
	Human Resource Capability for CDC	Including the monitoring and detection technical capabilities of the disease control team, the ability of epidemiological investigation. The stronger the capacity of disease control human resources, the better the epidemic control effect
	Knowledge of human resources for CDC	The professional knowledge of the disease control team need update. The more advanced the knowledge of disease control human resources, the better the epidemic control effect.
	Unbalanced development of human resources for CDC among regions	With different economic strength and administrative levels, the quality of disease control personnel is also different. The uneven development of disease control human resources among regions has a negative impact on the effectiveness of epidemic control.
Motivation to fight the epidemic	/	The fundamental purpose of fighting the COVID-19 is to protect the lives, health and safety of the people, and the motivation to fight the COVID-19 affects the effectiveness of epidemic control.
The level of public response,	/	The degree of public support and cooperation for prevention and control measures. The higher the public response level, the better the epidemic control effect.

5.8.3 Selective coding

This study takes "epidemic control effectiveness" as the core category and determines the selective coding path relationship of the main category of this study by analyzing the interview data of experts who experienced COVID-19 and the categories summarized, as shown in Figure 5.2. Its "story line" is: emergency management capability and human resources for CDC have a positive impact on the effectiveness of epidemic control; human resources for CDC also have a positive impact on emergency management capability; emergency management capacity plays a mediating role between human resources for CDC and the effectiveness of epidemic control; anti-epidemic motivation regulates the impact of disease control human resources on emergency management capabilities; anti-epidemic motivation plays a mediating role between human resources for CDC and the effectiveness of epidemic control; the influence of the public response level to adjust the emergency management ability on the effectiveness of epidemic control; the mediating role of public response level regulating emergency management ability in disease control human resources and epidemic control performance.

5.9 Comparative analysis of the coding results of COVID-19 and SARS cases

5.9.1 "Concepts" comparison between COVID-19 and the SARS cases

After comparison, the "concept" of COVID-19 involves 43 sentences, while the SARS involves 44 sentences. The "concept" of COVID-19 is more precise and focused, and the agreement rate between the two is 37.2%, which are shown in Table 5.3.

Table 5.3 "Concept" comparison between COVID-19 and the SARS cases

“Concepts” of COVID-19	“Concepts” of SARS	“Concepts” of COVID-19	“Concepts” of SARS
A1-1 Low fatality rate **A1-2 Low incidence rate** **A1-3 Act quickly** A1-4 High cure rate A1-5 Control the impact of the epidemic	**A1-1 Low fatality rate** **A1-2 Low incidence rate** A1-3 The case did not develop A1-4 The impact of the epidemic is small **A1-5 Act quickly**	A8-1 Human resource usage A8-2 Human resources does not apply to needs **A8-3 Insufficient investment** **A8-4 Insufficient professionals** A8-5 Human resource allocation	A8-1 Insufficient attention to disease control and prevention **A8-2 Underinvestment** A8-3 Seriously understaffed **A8-4 Insufficient professionals**
A2-1 Quickly control the epidemic **A2-2 Scientific**	**A2-1 Quickly control the epidemic** **A2-2 Scientific prevention and**	A9-1 The team is aging **A9-2 lack of professionalism** **A9-2 lower education**	A9-1 Age stratification **A9-2 Poor education and quality**

prevention and control **A2-3 Isolating cases** A2-4 cases can be traced	**control** **A2-3 Isolating cases** A2-4 No spread A2-5 Increase investment to ensure the smooth progress of monitoring work		
A3-1 Detection technology has improved A3-2 Detection capabilities have enhanced	A3-1 Limited detection capability A3-2 Misdiagnosed pathogen A3-3 PCR technology is backward A3-4 The pathogen cannot be identified and the disease cannot be diagnosed A3-5 Hong Kong and other countries identify SARS pathogen	**A10-1 Detection capabilities have been enhanced** A10-2 Flow adjustment ability is improved A10-3 play a staff role **A10-4 Insufficient talent training**	**A10-1 Insufficient detection capability** **A10-2 Insufficient talent training** A10-3 Weak comprehensive ability A10-4 Insufficient capacity leads to the spread of the epidemic A10-5 Insufficient investment in talent training A10-6 Limited prevention and control ideas
A4-1 Focus on investigation A4-2 Grid management	A4-1 The epidemiological investigation result is correct A4-2 The route of transmission is clear A4-3 Control the epidemic A4-4 Grid management	A11-1 Detection speed is fast A11-2 Knowledge can help quickly diagnose disease	A11-1 Lack of awareness of the epidemic A11-2 The field of vision is not wide enough A11-3 Lack of understanding of the pathogen A11-4 Frontline staff have limited knowledge A11-5 Lack of external communication
A5-1 Set up a special team A5-2 Frontline command A5-3 Concentrate strength **A5-4 Multi-departmental collaboration**	A5-1 Comprehensive coordination A5-2 Coordination **A5-3 Multi-departmental collaboration**	A12-1 The grassroots team is unstable A12-2 Poor technical level at the grassroots level **A12-3 Economic strength affects the technological capability of CDC manpower**	A12-1 Economic strength affects the technological capability of CDC manpower **A12-2 Different administrative levels have different technical capabilities for CDC**
A6-1 Safeguard mechanism	**A6-1 Safeguard mechanism**	A13-1 State institutions A13-2 Focus on the people	
A7-1 Precise prevention and control guidelines **A7-2 Improve the prevention**	**A7-1 Make policy** A7-2 Set up a special management department	A14-1 Popular trust A14-2 Public cooperation A14-3 Popular support A14-4 The public understands	

and control system

5.9.2 Comparison of the "category" of COVID-19 and SARS cases

After comparison, the "category" of COVID-19 involves 14 sentences, while the SARS involves 12 sentences, and the agreement rate between the two is 85.71%, which are shown in Table 5.4.

Table 5.4 "Category" comparison between COVID-19 and the SARS cases

"category" of COVID-19	"category" of SARS
Effectiveness of epidemic control	Effectiveness of epidemic control
Monitoring effectiveness	Monitoring effectiveness
Test effectiveness	Test effectiveness
Epidemiological investigation results	Epidemiological investigation results
Coordination and command ability	Coordination and command ability
Guarantee ability	Guarantee ability
system improvement ability	system improvement ability
Number of human resources for CDC	Number of human resources for CDC
Human Resource Structure for CDC	Human Resource Structure for CDC
Human Resource Capability for CDC	Human Resource Capability for CDC
Knowledge of human resources for CDC	Knowledge of human resources for CDC
Unbalanced development of human resources for CDC among regions	Unbalanced development of human resources for CDC among regions
Motivation to fight the epidemic	
The level of public response,	

5.9.3 Comparison of the "main category" of COVID-19 and SARS cases

After comparison, the "main category" of COVID-19 involves five sentences, while the SARS involves three sentences, and the agreement rate between the two is 60%, which are shown in Table 5.5.

Table 5.5 "main category" comparison between COVID-19 and the SARS cases

"Main category" of COVID-19	"Main category" of SARS
Effectiveness of epidemic control	Effectiveness of epidemic control
Emergency management capability	Emergency management capability
Human Resources for CDC	Human Resources for CDC
Motivation to fight the epidemic	
The level of public response,	

5.9.4 Comparison of "selective coding" results between COVID-19 and SARS cases

In this study, two cases were coded, and a comparison of the "selective coding" results of the two sub-studies found that the difference between the two is mainly reflected in the propositions of situational factors in sub-study 2. The two contextual factor assumptions in sub-study 2 both have moderating effects on the three main categories in sub-study 1. The eight propositions proposed in this study have been verified.

5.10 Theoretical saturation test

To ensure the credibility of the research, two groups of coders who are familiar with the coding rules and research content carry out the coding work independently. Two groups of coders conducted open coding on 12 interview records respectively, and found there were no new categories, which proved that the conceptual model obtained in the selective coding stage was saturated and complete.

5.11 Text Analysis Results

Conduct word frequency analysis on the interview content of the subjects of sub-study 2, and get the analysis results, which was shown in Figure 5.2. Figure 5.2 is the word cloud derived from the "word frequency statistics" of the text using NVivo11 software. Words such as country, emergency, government, people, management, and team are in the center of the word cloud and the font are large, which indicated that the focus of this research lies in the above-mentioned latitudes.

Figure 5.2 Conduct word frequency analysis on the interview content of COVID-19 and the SARS cases

5.12 Study proposition induction

Taking the COVID-19 epidemic as an example, based on the Grounded Theory, this chapter obtains many research materials through literature review and expert interviews. We conduct the word frequency analysis on the interview data, and conduct the open coding, axial coding, and selective coding operations, so as to refine and categorize the concepts. Finally, summarizing eight propositions between concepts and categories (as shown in Figure 5.3).

Proposition 1: Human resources of CDCs have a significant positive impact on epidemic control performance.

Proposition 2: Human resources of CDCs have a significant positive impact on emergency management capacity.

Proposition 3: Emergency management capacity has a significant positive impact on epidemic control performance.

Proposition 4: Emergency management capacity plays a mediating role between human resources of CDCs and epidemic control performance.

Proposition 5: Anti-epidemic motivation regulates the positive impact of human resources of CDCs on the effectiveness of epidemic control.

Proposition 6: Anti-epidemic motivation is a mediating role of emergency management ability between human resources of CDCs and epidemic control performance.

Proposition 7: The level of public response regulates the positive impact of human resources of CDCs on the effectiveness of epidemic control.

Proposition 8: The level of public response is a mediating role of emergency management ability between human resources of CDCs and epidemic control performance.

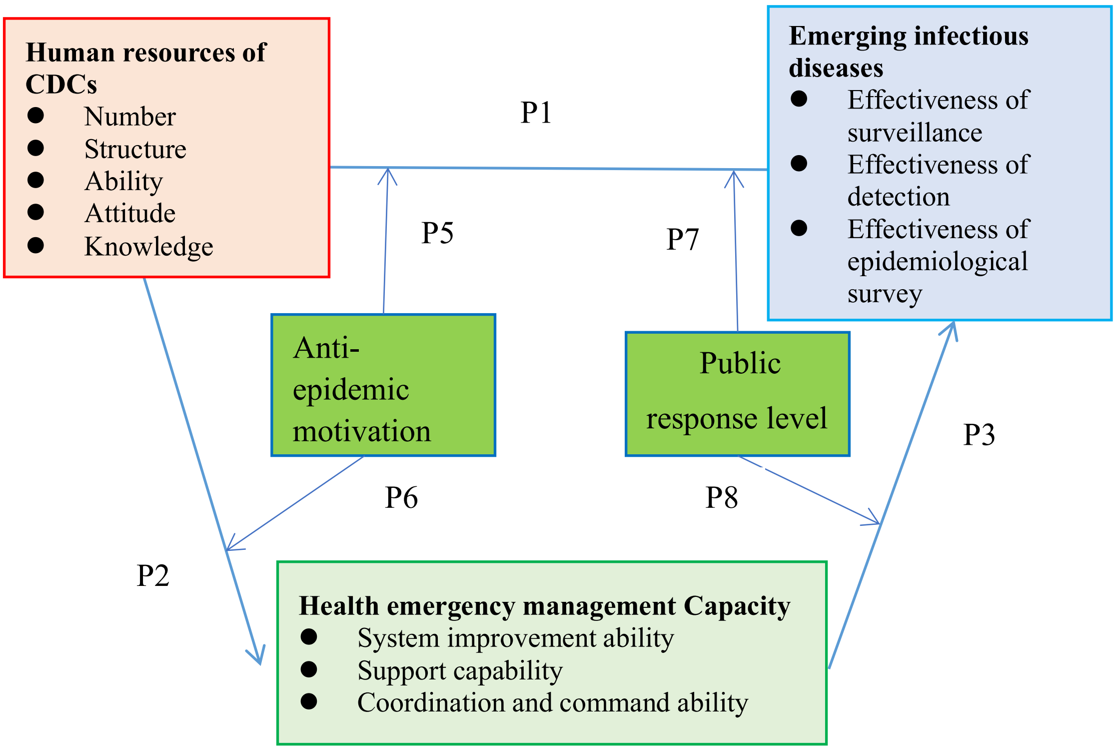

Figure 5.3 Model of the relationship among emergency management capability, human resources of CDCs, and health emergency management capacity

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Chapter 6: Discussion

6.1 Introduction

The outbreaks of infectious diseases, easily leading to large-scale outbreaks and being public health emergencies, will cause some serious impacts on society, economics, and politics, so some effective emergency measures must be taken to deal with it. Obviously, China, with a vast territory and a dense population, has experienced lots of large-scale epidemics of infectious diseases in history (Morens & Fauci, 2020; Yang, 2019). Since 2000, China has experienced two major outbreaks of infectious diseases, including the SARS epidemic in 2003 and the COVID-19, which has been progressing globally since the beginning of 2020. During the process of fighting against the epidemic, China has formed its own distinctive epidemic prevention strategies and made some remarkable achievements (J. Tang & Abbasi 2021). Certainly, the disease prevention and control system of China has played a vital role in the process of epidemic prevention and control.

This study based on the Case Study Theory. First, the study taking the fight against the epidemic in Guangdong Province as the case, inductive research methods were used to obtain the key concepts from the fighting against SARS, the summary of human resources for disease control, the effectiveness of infectious disease control as well as the capabilities of emergency management. Then, with the deductive research method, taking the COVID-19 prevention and control as the example, two Chinese situational factors including the motivation of fighting against epidemic and the level of public response were added to the previous framework as the regulated variables, to respectively verify the analytical framework proposed in the SARS and explore the regulated role of the two situational factors. Our results suggest that emergency management capability plays a positive intermediary role between human resources for disease control and the effectiveness of infectious disease control. Together, both the motivation of fighting against epidemic and the support of public positively play a mediating role of emergency management capability between human resources for disease control and the effectiveness of epidemic control. It is important to note that the results will lay a foundation for China to fight against the next outbreak of infectious diseases and will provide reference for other countries to deal with similar public health events.

6.2 Human resources-management capacity-control effectiveness relationship

This essay yielded significant results which included exploring the associations among human resources, emergency management and the effect of prevention and the mediating effect of emergency management capabilities on CDC human resources and emerging infectious disease prevention. Human resources considered as antecedent variables and the key factors of management occupy a crucial role in improving emergency management capability. Human resources also exercise a positive impact on the effectiveness of epidemic control. As the main force in controlling the epidemic in Futian district, Futian district Center for Disease Prevention and Control successfully completed the task of fighting against SARS, which benefited from the rational deployment of human resources (S. Zhang et al., 2004). As for emergency management capacity, it has a favorable effect of controlling the epidemic. Timely analysis of the deficiencies of emergency management in Xi'an city Center for Disease Prevention and Control can help provide reference for the faster realization of epidemic prevention and control (Y. Ma, 2020). Additionally, it plays a mediating role between human resources for CDC and the effectiveness of epidemic control at the same time.

Taking these associations and effects above into account, achieving sensitive emergency response to control emerging infectious diseases need drawing on the experience and putting theory into practice. It is advisable to rationally allocate human resources and maximize emergency management capabilities to achieve better disease control in emergencies. In addition, the essay also revealed the driving force behind these factors. The motivation for epidemic prevention and people's response level contribute to the mediating effect of emergency management capabilities on CDC human resources and emerging infectious disease prevention at the same time.

6.3 The role of anti-epidemic motivation

Our study found that the motivation of fighting against epidemic played an important role in the prevention and control of epidemic situation in the disease control system. Making every effort to ensure people's lives safety and health, China always adheres to the principle of "People first, life first" and "Putting people's lives safety and health first". Therefore, China has made great efforts to mobilize national resources and strength rapidly and effectively to ensure the safety and health of individuals at all costs during the epidemic period. Insisting on national coordination and unity, forming a pattern of epidemic prevention and control established by the government and actively participating by many parties (L. Sun & Sun, 2020), establishing an effective epidemic prevention and control mechanism, China will never relax to pay attention to the work of various diseases prevention and control, constantly improve the mechanism of major epidemic prevention and control and effectively improve the ability of health emergency management to establish the foundation for overcoming the epidemic (J. Gao & Zhang, 2021).

When the novel coronavirus struck, China decided that it would protect the lives and health of its people even at the cost of a short-term economic downturn and even a temporary shutdown. The government took unprecedented “lock down” measures in the city of Wuhan and Hubei Province. The study also found that because of this strict prevention and control measures, China avoided 740,000 infections in the early days of the epidemic (Tian et al., 2020). At the same time, to stem the spread of the virus, the movement of people across the country was tightly restricted, the Chinese New Year holiday was extended, gatherings were stopped, and the spring semester and business operations were postponed. After paying a heavy price, China has made significant strategic achievements in the fight against the epidemic. China had protected its people’s lives, safety and health, and made a significant contribution to safeguarding regional and global public health and bought valuable time for global epidemic prevention and control (China Daily, 2020). In general, the motivation for China's fight against the epidemic is the internal motivation for the government to lead the fight against the epidemic and win the fight against the epidemic.

6.4 The role of public response level

Public response also played an important role in epidemic prevention and control. As an important group, citizens participated in the prevention and control of COVID-19 most, directly received assistance or supervision from other subjects, combined passive bearing and active defense, and the individual heterogeneity among citizens is strongest. Citizens' attitudes and behaviors will greatly affect the overall development of COVID-19 epidemic (Zhou, 2021). In China's fight against the outbreak, the people are the most extensive basis for fighting the epidemic. During the COVID-19 outbreak, the general public voluntarily complied with the relevant requirements and actively participated in the epidemic prevention and control practices, which is an important guarantee for the effectiveness of the epidemic prevention and control work (China Daily, 2020). The outbreak of COVID-19 in China coincided with the 2020 Spring

Festival holiday. People canceled visits to relatives and friends and various gatherings during the Spring Festival, washed their hands frequently, wore masks and maintained social distance. People at risk should cooperate with health examinations and be quarantined. After China's epidemic prevention and control became normalized, the Chinese government put forward the general policy of "dynamic zero" epidemic prevention and control, and strictly implemented the full coverage of "Normalized nucleic acid testing + Venue code", which cannot be achieved without the full support and cooperation of the public. It was the collective will of 1.4 billion Chinese people that China was able to tackle a new and unknown virus through traditional public health interventions, which changed the epidemic curve of COVID-19, averted, and prevented more cases. In short, the participation of social forces, especially the public, in the emergency management of major public health emergencies can improve the effectiveness of emergency management of major public health emergencies (G. Tang & He, 2022).

6.5 Strengths and weaknesses of this study

Advantages of this study: Based on China's response to two important public health events of SARS and COVID-19, Case Study Theory is adopted to systematically summarize China's coping experience through comparison and verification, with good representation and strong causal argument.

There are some deficiencies in the research: 1. Few experts participated in the interviews, with only 10 experts. However, these twelve experts are all representative experts in the field of public health. 2. China's specific situational factor "anti-epidemic motivation" has an important positive effect on epidemic prevention and control effectiveness, and it also has an incentive effect on human resources of disease control, but these are not explored in detail in this thesis. 3. The COVID-19 epidemic is complex and changeable, and the current global pandemic is continuing. China is facing the challenge of how to adjust the epidemic prevention and control strategies under the new situation. Some prevention and control experience is not comprehensive enough and needs to be further research.

6.6 Conclusion

Based on the Grounded Theory case study method and the cases of China's successful response to the SARS epidemic and the COVID-19 epidemic, we find that the emergency management ability of public health emergencies plays a mediating effect on the human resources for disease control and the effectiveness of infectious disease control. The anti-epidemic motivation and public support of two Chinese specific situational factors are the important promoting factors to improve the effectiveness of disease control and prevention. This research systematically summarizes China's experience in dealing with public health emergencies such as emerging infectious diseases and provides a scientific theoretical basis for response of next potential epidemic. It would also provide a realistic reference for other countries or regions also affected by public health emergencies.

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Annex A

Table a.1 The interview outline of SRAS and COVID-19

Case 1: SRAS (about 10 people)	**Case 2: COVID-19 (about 10 people)**
1.1 Is the prevention and control SARS successful in China?	2.1 Is the prevention and control of COVID-19successful in China?
1.2 Success indicators? standard?	2.2 What are the success indicators? What are the factors?
1.3 The reason for the failure? Influencing factors?	2.3 Does emergency management work?
1.4 Is the establishment of the emergency department (department) related to it?	2.4 How to evaluate the disease control workforce?
1.5 Evaluation of SARS workforce?	2.5 Comparison of national anti-epidemic motives with the West? Is the public response important?

During the data collection process, two research assistants were invited to assist in the collection of documentation, and a total of three researchers discussed the quality of the data. Including but not limited to the following: "Have I collect enough background data about the people, process, and environment involved in the event to recall, understand, and describe a comprehensive picture of the SARS event?", "Could I receive information about the detailed description of the interviewee's views?", "Does the data reveal what lies beneath the surface?", "Does the data sufficiently reveal how events have changed over time?", "Have I obtained multiple opinions?", "Do the data I collect enable me to form a research categories?", "Which types of comparisons can I make between the data? How do these comparisons generate and support my ideas?".