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Improving the Core Capacity for EIDs Prevention and Control in Tertiary General Hospitals

MING Yanfen

Doctor of Management

Supervisor:
PhD Renato Pereira, Assistant Professor,
ISCTE University Institute of Lisbon

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Abstract

This study developed a core capability evaluation index system for emerging infectious disease (EIDs) control at tertiary comprehensive hospitals, based on semi-structured interviews and the Delphi expert consultation method. The system includes five primary indices (hospital infection risk prediction capability, hospital infection prevention and control capability, prevention and control knowledge and skills training capability, organizational coordination capability, and prevention and control professional development capability), 14 secondary indices, and 62 tertiary indices. Utilizing these five core capabilities as independent variables and the overall hospital EIDs control level as the dependent variable, multiple linear regression analysis was employed to explore the impact and mechanisms of these capabilities on hospital EID control levels.

The results indicate that all five core capabilities significantly positively impact the overall EID control level in hospitals, although their impact varies. Among them, the capability for prevention and control professional development contributed most significantly to enhancing overall control levels. This suggests that the construction of hospitals in terms of scientific research innovation, professional learning, and interdisciplinary cooperation plays a crucial role in enhancing long-term control capabilities. The impacts of knowledge and skills training capability and organizational coordination capability were relatively weaker, indicating further room for optimization in training system development, inter-departmental cooperation, and resource integration to better enhance the overall control level.

Keywords: Tertiary comprehensive hospitals; EIDs; core control capabilities; dynamic capabilities theory; overall control level

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Resumo

Nste trabalho desenvolveu-se um índice de avaliação da capacidade de controlo de doenças infeciosas emergentes (DIEs) em hospitais terciários com base em entrevistas semiestruturadas e no método Delphi. O modelo inclui cinco índices primários (capacidade de previsão de risco de infeção hospitalar, capacidade de prevenção e controlo de infeção hospitalar, capacidade de formação de conhecimentos e capacidades de prevenção e controlo, capacidade de coordenação organizacional e capacidade de desenvolvimento profissional de prevenção e controlo), 14 índices secundários e 62 índices terciários. Utilizando essas cinco capacidades centrais como variáveis independentes e o nível geral de controlo de DIEs hospitalares como variável dependente, estimou-se um modelo de regressão linear múltipla para explorar o impacto e os mecanismos dessas capacidades nos níveis de controlo de DIEs hospitalares.

Os resultados indicam que todas as cinco capacidades centrais impactam positivamente de forma significativa o nível geral de controle de DIEs em hospitais, embora o seu impacto varie. Entre elas, a capacidade de desenvolvimento profissional de prevenção e controlo contribuiu mais significativamente para melhorar os níveis gerais de controlo. Isso sugere que criar hospitais centrados na inovação e na investigação científica, formação profissional e cooperação interdisciplinar desempenha um papel crucial na melhoria das capacidades de controlo de longo prazo. Os impactos da capacidade de formação e capacitação, e da capacidade de coordenação organizacional foram relativamente mais fracos, indicando mais espaço para otimização no desenvolvimento do sistema de treinamento, cooperação interdepartamental e integração de recursos para melhorar o nível geral de controlo.

Palavras-chave: Hospitais terciários de atendimento geral; doenças infeciosas emergentes (DIEs); capacidades essenciais de controlo; teoria das capacidades dinâmicas; nível geral de controlo.

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摘要

本研究基于半结构访谈和德尔菲专家咨询法，构建了三级综合医院新发传染病防控核心能力评价指标体系，该体系涵盖 5 个一级指标（医院感染风险预测能力、医院感染防控能力、防控知识技能培训能力、组织协调能力、防控专业发展能力）、14 个二级指标及 62 个三级指标。在此基础上，本研究以这五个核心能力维度作为自变量，以医院新发传染病整体防控水平作为因变量，采用多元线性回归分析探讨各核心能力维度对医院新发传染病防控水平的响程度及其作用机制。

研究结果显示，五种核心能力均对医院新发传染病整体防控水平产生了显著的正向影响，但影响程度有所不同。其中，防控专业发展能力对医院整体防控水平的提升贡献最大，这表明，医院在科研创新、专业学习、跨学科合作等方面的建设，对增强医院长期防控能力具有关键作用。知识与技能培训能力与组织协调能力的影响相对较弱，表明医院在培训体系建设、跨科室协作及资源整合方面仍存在进一步优化的空间，以更好地发挥影响，为医院整体防控水平的提升做出更显著的贡献。

关键词：三级综合医院；新发传染病；防控核心能力；动态能力理论；整体防控水平

JEL: I18, I12

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Abbreviations

EID	emerging infectious disease
DCV	Dynamic Capabilities View
RBV	Resource-Based View

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Chapter 1: Introduction

1.1 Research background

1.1.1 Real-world background

At the end of 2019, the world was suddenly thrust into a public health crisis with the outbreak of COVID-19. This pandemic has had a profound impact on human society and has delivered an unprecedented shock to public health systems worldwide. The rapid spread of this EID not only tested the response capabilities of medical institutions but also highlighted weaknesses in global public health governance. According to relevant statistics, over the past 50 years, 52 new infectious diseases have emerged globally, including Ebola and COVID-19, with 29 of these occurring in China. On average, a new disease appears every one to two years. The occurrence and rapid spread of these emerging infectious diseases (EIDs) pose a severe challenge to the comprehensive capabilities of national healthcare systems in disease prevention and control (Fauci, 2001). Infectious diseases are often highly contagious and endemic, posing significant public health threats in contemporary society. In recent years, the emergence of new infectious diseases and the re-emergence of some previously controlled diseases have severely endangered human life and health. As a crucial frontline in the prevention and treatment of infectious diseases, comprehensive hospitals play a core role in disease prevention, monitoring, reporting, treatment, and control. However, with the increasing aging population and changes in the disease spectrum, the number of susceptible individuals in hospitals has significantly risen, leading to an increase in the incidence of hospital infections. The development of prevention, control, and rescue systems, along with core capability building in hospitals, plays a critical role in the overall control of infectious diseases (Davies, 2008; McArthur, 2019).

Hospital-acquired infections triggered by EIDs not only pose a serious threat to the recovery and life safety of patients within the hospital but also affect the health and safety of medical staff, hospital administrative personnel, visitors, and the broader community (Lobdell et al., 2012). According to a 1999 report by the World Health Organization (WHO), approximately 150 people die from various infectious diseases globally every hour, with the majority of these deaths occurring in developing countries (J. G. Xu, 2007). In fact, as early

as 1996, the WHO Director-General warned in the "World Health Report 1996" that the world was facing a crisis of infectious diseases, and no country could remain unaffected. All countries were urged to remain vigilant and prepare adequately. To emphasize the importance of this issue, the theme of World Health Day in 1997 was EIDs: Global Alert, Global Action" (Khan, 1997).

Over the past two decades, the severe hazards of hospital infections due to EIDs have become an unavoidable issue for the WHO and national health authorities. Notable instances include the transmission of SARS in hospitals in Guangdong, Beijing, and Hong Kong in 2003; the diagnosis of the first cases of Ebola in hospital staff in a Texas hospital in the USA and another in Madrid, Spain, in 2014; the outbreak of MERS in a hospital in Seoul, South Korea, in 2015; and the infection of thousands of healthcare workers with COVID-19 in Wuhan, China, during the early stages of the pandemic in 2020. These severe incidents remind us that hospitals are primary transmission sites for EIDs, and hospital infections are a major transmission route. Whether imported or locally originated, EIDs often lead to infections among medical personnel during the diagnosis and treatment of patients before confirmation or during their hospital stay due to various shortcomings in hospital infection prevention and control infrastructure or protocols. Factors such as close contact between medical staff and patients, the continuous flow of people, closed ventilation systems, and incomplete isolation measures are primary reasons for the spread of pathogens within hospitals (Morse, 1995).

However, on May 29, 2015, a case of MERS imported into Huizhou, Guangdong Province, from South Korea was initially diagnosed with unexplained fever at Huizhou Central Hospital and was promptly isolated. After being confirmed as MERS by the Guangdong Provincial Center for Disease Control, the patient was isolated in Huizhou Central Hospital for 15 days without any subsequent hospital-acquired infections, and no abnormalities were found among 38 close contacts (Xia, 2015). The rapid spread, large scale, and broad impact of COVID-19, primarily transmitted through droplets and close contact, highlight the potential for aerosol transmission in relatively closed environments as a significant pathway, necessitating serious prevention measures (Pradhan et al., 2020). During the assistance to Wuhan, Hubei, none of the 42,600 medical staff, including 16,000 specialists from intensive care, infectious diseases, and respiratory departments, were infected. This contrasts with the initial phase of the epidemic when over 3,000 medical personnel were infected, underscoring the critical importance of hospital infection prevention and control (C. W. Zhu, 2020). The facts of EIDs occurring, spreading, and becoming epidemic worldwide

since the new century remind us that hospital infections are a major route of transmission for EIDs, and WHO has explicitly stated that "infections and transmission are concentrated in hospitals." Additionally, China's success in combating EIDs also sufficiently demonstrates that hospital infections can be prevented and controlled.

1.1.2 Theoretical background

In the battle against EIDs, hospitals are not only central to medical treatment but also play a crucial role in disease prevention and control. Optimizing the allocation of medical resources and enhancing hospital infection prevention capabilities to reduce the risk of nosocomial infections are key issues in the development of public health systems. To thoroughly understand the construction of core capabilities and resource optimization in hospitals for the control of EIDs, this study incorporates Resource-Based Theory (RBT) and Dynamic Capabilities Theory (DCT), thereby constructing a systematic theoretical framework.

Resource-Based Theory (RBT) posits that an organization's competitive advantage stems from its internal resources which are rare, valuable, inimitable, and organized (VRIO) (Barney, 1991). In the context of hospital infection control systems, the key determinants of control capabilities include hardware resources (such as advanced laboratory equipment and negative pressure wards), human resources (such as specialized infection control teams), and knowledge and technical resources (such as guidelines for managing EIDs and vaccine development capabilities). The acquisition, integration, and optimal allocation of these resources directly impact a hospital's response speed, early warning capability, and treatment efficiency in controlling EIDs.

However, reliance solely on the accumulation of static resources does not guarantee a hospital's competitive advantage in the face of challenges posed by EIDs. Thus, Dynamic Capabilities Theory is introduced to explain how hospitals can continuously optimize their infection control systems through mechanisms such as sensing, learning, integrating, and reconfiguring (Augier & Teece, 2007; Teece, 2007). In the event of an outbreak of an EID, hospitals must have the capacity to rapidly adjust medical resources, optimize isolation processes, enhance training for medical personnel, and establish an effective infection control early warning system to deal with the high uncertainty of public health crises. For instance, during the COVID-19 pandemic, some tertiary hospitals in China quickly integrated information technology resources to build telemedicine platforms, strengthened infection monitoring inside and outside the hospital, and optimized treatment protocols through

multidisciplinary collaboration, demonstrating dynamic capabilities.

Combining RBT and DCT, this study posits that the core capabilities of tertiary comprehensive hospitals in controlling EIDs depend not only on the hospital's resource endowments (such as infrastructure, professional teams, and technical reserves) but also on their ability to dynamically adjust and optimize resources. Therefore, by constructing a resource-capability-control level framework, this study will explore how hospitals can optimize resource allocation in the complex and changing environment of infectious diseases, enhance infection control capabilities, and develop a sustained competitive advantage.

1.2 Research problem and questions

The frequent occurrence of EIDs leading to hospital infections presents significant challenges to infection prevention and control within hospitals. While some success stories have achieved a "zero infection" target, many hospitals still experience severe in-hospital outbreaks, highlighting the inconsistency in infection control outcomes (Woolhouse et al., 2014). The continuous occurrence of EIDs, whether from external sources or local transmission, complicates hospitals' ability to timely detect, diagnose, and respond, making it difficult to implement precise and scientific infection prevention strategies. Moreover, ensuring the robustness of hospital infection control requires the enhancement of core capabilities, proactive risk management strategies, and the construction of a resilient healthcare system. However, a research gap still exists, as it is not yet clear how hospitals can systematically and effectively reduce infection risks while maintaining operational efficiency and patient safety.

Consequently, this study raises the following two research questions (RQs):

RQ1: What are the core capabilities for infection prevention and control of EIDs in tertiary comprehensive hospitals?

RQ2: How do the core capabilities for infection prevention and control of EIDs affect the level of EID control in tertiary comprehensive hospitals?

1.3 Research objectives

In response to the challenges faced by tertiary comprehensive hospitals in infection prevention and control (IPC), this study aims to achieve the following objectives:

1. Identifying Core Capabilities: this objective aims to systematically define the key capabilities required by hospitals to manage hospital-acquired infections (HAIs) and EIDs

effectively, ensuring efficient infection control management.

2. Exploring Impact Mechanisms: this study aims to investigate the specific impact mechanisms of core capabilities on the control level of EIDs. It will analyze how various core capabilities (such as hospital infection risk prediction, infection prevention and control, prevention and control knowledge and skills training, organizational coordination, and prevention and control professional development) affect the hospital's overall infection control system. Through quantitative analysis and empirical research, this study seeks to identify key influencing factors and assess their contribution to the control level of EIDs, thereby constructing a systematic path for optimizing control capabilities.

Ultimately, the goal of this research is to provide scientific evidence for hospital managers and policy makers to optimize prevention and control strategies, enhance hospitals' overall level of response to EIDs, and strengthen the resilience and adaptability of the healthcare system in the face of new infectious diseases.

1.4 Research methods

This thesis employs a mixed-methods empirical approach, integrating qualitative and quantitative research methods. Initially, qualitative methods are used to develop an evaluation index for the core capabilities of infection prevention and control for EIDs in tertiary comprehensive hospitals. Subsequently, quantitative methods are applied to explore the specific impact mechanisms of these core capabilities on the level of EID control in these hospitals. The specific research methods are as follows:

1.4.1 Semi-structured interviews

After summarizing and organizing the relevant research literature on core capabilities, hospital core capabilities, EIDs, and infection prevention and control capabilities, this study identified the components of hospital core capabilities for the control of EIDs from existing literature. Based on this foundation, semi-structured interviews were conducted with four experts in the field of disease control to discuss and summarize the evaluation indicators and connotations of core capabilities for the prevention and control of EIDs in tertiary comprehensive hospitals. This process helped to refine and form an initial pool of indicators.

1.4.2 Delphi expert consultation

To scientifically construct an evaluation index system for the core capabilities of EID control in tertiary comprehensive hospitals, the Delphi method was utilized for expert consultation. In the first round of expert consultation, several experts with experience in hospital infection control, public health management, and EID control were invited to score the preliminarily filtered core capability indicators and provide suggestions for modifications. Experts assessed the applicability, feasibility, and importance of each indicator within the infection control system of tertiary comprehensive hospitals based on their professional knowledge. In the second round of expert consultation, the indicator system was adjusted and optimized based on feedback from the first round, and the importance and rationality of the indicators were further confirmed. This study ultimately constructed a scientific evaluation system for the core capabilities of EID control in tertiary comprehensive hospitals, providing theoretical support and practical evidence for enhancing hospital infection control capabilities.

1.4.3 Questionnaire survey

After constructing the core capability evaluation system and determining the weights of the indicators, this study designed a questionnaire to quantitatively analyze the factors influencing the core capabilities of EID control in tertiary comprehensive hospitals and their impact mechanisms on the overall hospital control level. The questionnaire used the five dimensions of core capabilities as independent variables and the hospital's level of control of EIDs as the dependent variable for multiple linear regression analysis, examining the impact of each core capability dimension on the hospital's control level.

1.5 Research significance

This study holds significant practical relevance and theoretical contributions. On one hand, it aids in enhancing the capabilities of tertiary comprehensive hospitals to control EIDs, improves the efficiency of medical resource utilization, and provides a scientific basis for the formulation of public health policies by governments. On the other hand, it extends the application of Resource-Based Theory (RBT) and Dynamic Capabilities Theory (DCT) in the healthcare sector and establishes a theoretical framework for core capabilities in hospital infection prevention and control, offering valuable academic references for future research.

1.5.1 Theoretical significance

(1) Expansion of Resource-Based Theory (RBT) in Healthcare

Traditionally, Resource-Based Theory has been primarily applied in the context of corporate strategic management, with less emphasis on healthcare. This study enriches the application of RBT in the field of medical management by exploring how tertiary comprehensive hospitals can leverage their resources (such as medical equipment, medical staff, and infection control systems) to enhance competitiveness. It provides a new perspective for future research related to healthcare management.

(2) Deepening the Role of Dynamic Capabilities Theory (DCT) in Hospital Management

Dynamic Capabilities Theory emphasizes an organization's ability to adapt and change in complex environments. Through empirical analysis, this study explores how tertiary hospitals enhance their capabilities to prevent and control EIDs through mechanisms such as sensing, learning, integrating, and reconfiguring. It provides empirical support for the application of DCT in medical institutions and extends its applicability in the public health domain.

(3) Construction of a Theoretical Framework for Core Capabilities in Hospital Infection Prevention and Control

Current research on hospital infection prevention and control often focuses on specific measures (such as disinfection management and isolation protocols) but lacks a systematic, theoretical framework for capability building. Based on the "resource-capability-control level" perspective, this study constructs an analytical framework for core capabilities in hospital infection control, providing theoretical support for further academic investigation into hospital management and infectious disease control.

(4) Advancement of Medical Quality Management and Health Services Research

This study not only focuses on the internal infection prevention and control system within hospitals but also addresses the optimization of medical resources, construction of quality management systems, and implementation of multidisciplinary collaboration (MDT). It provides new theoretical foundations and practical insights for research in medical quality management and health services management, fostering the development of the medical management discipline.

Overall, the research aims to impact both the practical aspects of healthcare delivery and the theoretical underpinnings of hospital management, thereby contributing to better outcomes in public health and hospital administration.

1.5.2 Practical significance

The frequent emergence of infectious diseases raises considerable challenges for hospital infection control systems, making the development of robust capabilities within hospitals crucial to minimizing the risk of in-hospital transmission. This study provides practical implications in several key areas:

(1) Enhancing Hospital Infection Prevention and Control Capabilities to Ensure Medical Safety:

By establishing an evaluation system for the core capabilities of infection prevention and control for EIDs in tertiary comprehensive hospitals, this research helps hospitals identify weaknesses in their infection control practices. Optimizing resource allocation and enhancing the infection prevention capabilities of healthcare personnel can effectively reduce the occurrence of hospital infections, thereby ensuring the safety of both patients and medical staff.

(2) Optimizing Medical Resource Allocation to Enhance Public Health Response Capabilities

During outbreaks of EIDs, critical medical resources such as isolation wards, negative pressure rooms, medical protective gear, and specialized personnel often face shortages. This study offers scientific strategies for optimizing these resources based on an understanding of hospitals' resource bases and dynamic capabilities. This ensures that medical institutions can respond swiftly during epidemics, improve the efficiency of medical services, reduce resource wastage, and strengthen the capability to handle public health emergencies.

(3) Driving Innovation in Hospital Management Models to Increase System Resilience

Integrating Resource-Based Theory (RBT) and Dynamic Capabilities Theory (DCT), this study examines core capability building for the control of EIDs in hospitals, providing scientific decision-making support for hospital administrators. The findings guide the establishment of efficient infection control systems, including standardized control procedures, enhanced training for medical staff, and optimized information monitoring systems. These measures enhance hospitals' responsiveness and strengthen the resilience of the healthcare system.

(4) Providing a Scientific Basis for Government and Public Health Policy Formulation

The government plays a vital role in the allocation of medical resources, the formulation of public health policies, and the optimization of hospital management. The outcomes of this research provide scientific decision support for government agencies, helping them to better

establish standards for hospital infection control, optimize the regional distribution of medical resources, and enhance the overall level of infectious disease control in the country. This supports the initiative for a "Healthy China" and offers practical evidence for building robust public health infrastructure.

Overall, this research has significant implications for enhancing the effectiveness and efficiency of healthcare systems in responding to the challenges posed by EIDs, thereby contributing to safer and more resilient public health outcomes.

1.6 Research innovation

This study achieves innovation in research methodology, theoretical application, and evaluation system construction, enriching the theoretical framework for hospital infection prevention and control and providing actionable guidance for practical management. These innovations will help enhance the infection prevention capabilities of tertiary comprehensive hospitals and drive the continuous optimization of the public health system.

(1) Combination of Qualitative and Quantitative Research Methods to Enhance Scientific Rigor and Empirical Value

This study employs a mix of semi-structured interviews, the Delphi method, questionnaire surveys, and multiple regression analysis, blending qualitative and quantitative research approaches. Through expert interviews, the study delves deeply into the composition of core capabilities for hospital infection prevention and control. It then uses the Delphi method to construct an evaluation index system, and large-scale questionnaire surveys and statistical analyses to validate theoretical hypotheses, thereby increasing the scientific rigor and empirical value of the research. This mixed-method approach not only ensures the reliability of the research findings but also enhances their applicability in actual hospital management.

(2) Expansion of Dynamic Capabilities View (DCV) and Resource-Based View (RBV) in the Disease Control Domain

Traditionally, the Resource-Based View (RBV) has been primarily used in corporate management studies. This research extends it to the domain of hospital control of EIDs, analyzing how hospitals can utilize existing resources to enhance their core competitiveness in controlling new infectious threats. Furthermore, the study introduces the Dynamic Capabilities View (DCV), exploring how hospitals can respond to sudden public health events through mechanisms such as sensing, learning, integrating, and reconfiguring resources, thereby promoting the optimal allocation of medical resources and enhancing hospitals'

responsiveness. This theoretical innovation not only fills a gap in organizational capability research in the field of disease control but also provides a new theoretical framework for future management of public health events.

(3) Construction of an Evaluation System for Core Capabilities in Infection Prevention and Control of EIDs in Tertiary Comprehensive Hospitals

Existing research often focuses on specific infection control measures such as isolation, disinfection, and personal protection, lacking a systematic assessment of overall hospital control levels. This study is the first to propose an evaluation system for the core capabilities of EID control in tertiary comprehensive hospitals, establishing a scientific capability assessment framework and proposing quantifiable evaluation indicators. This system not only provides hospital managers with a tool to assess their own control capabilities but also offers a theoretical basis for governments and public health agencies to formulate targeted policies.

1.7 Technical route

The technical roadmap for this thesis is shown in Figure 1.1. This figure illustrates the sequence and interdependencies of the methods and processes employed in this research, providing a visual guide to the methodological approach and theoretical contributions of the study. This roadmap likely details the steps from literature review and theory formulation through data collection, analysis, and findings, thus providing a comprehensive view of the research progression.

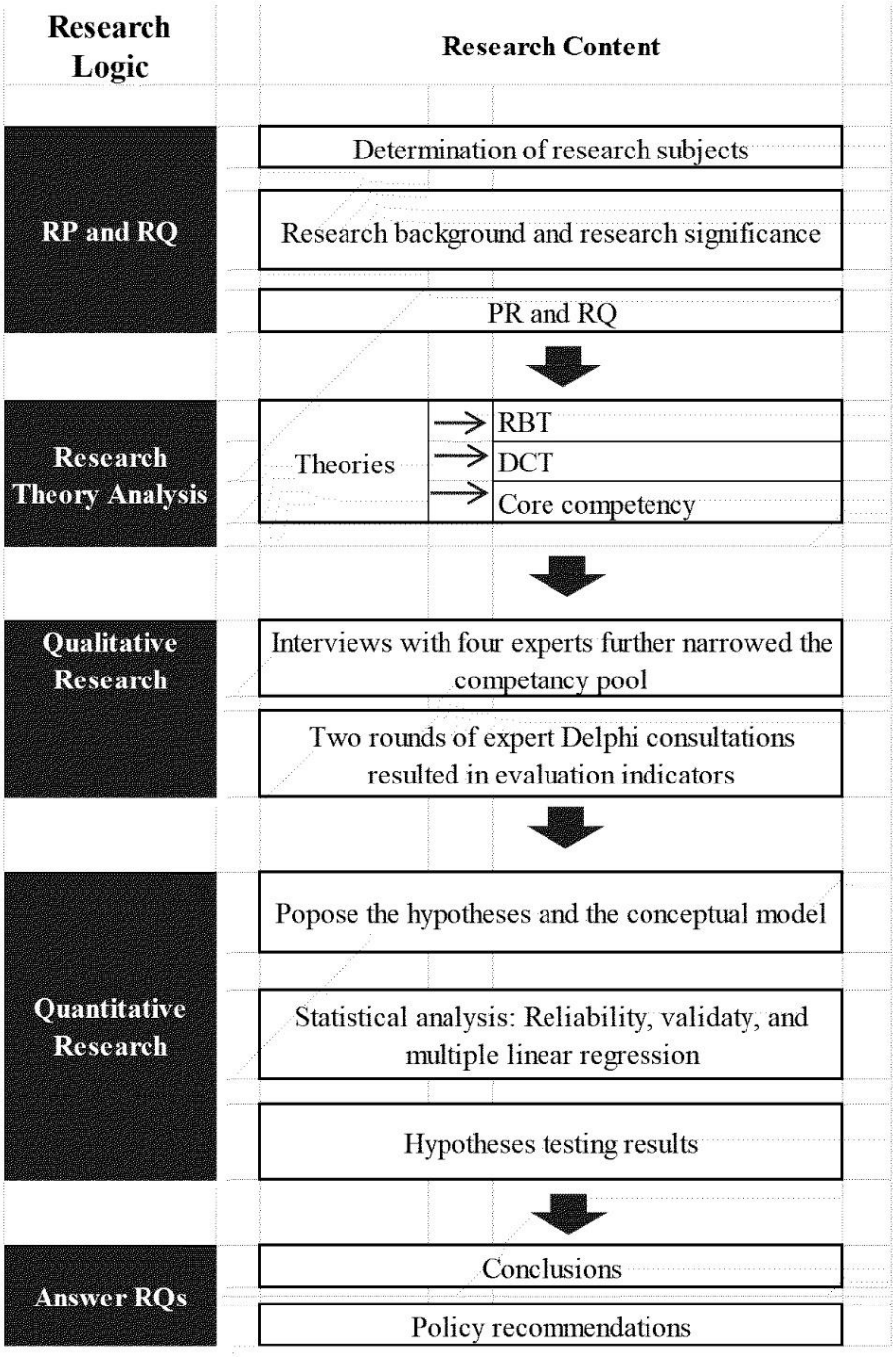

Figure 1.1 Technical roadmap

1.8 Thesis structure

The thesis is structured into six chapters, each designed to systematically explore different aspects of the research theme:

Chapter 1: Introduction

This chapter sets the stage by outlining the research background, highlighting the key issues that need addressing, and discussing the basic approach of the study. It elaborates on

the significance of the research, detailing the research objectives and content. Additionally, a technical roadmap is presented, visually demonstrating the research implementation path and key milestones. Finally, the innovations of the study are systematically discussed.

Chapter 2: Literature Review

This chapter systematically organizes and explains the core concepts and theoretical foundations involved in the study. Through a review and synthesis of both domestic and international literature, it analyzes the current state of research on tertiary comprehensive hospitals, EIDs, core capabilities, and infection prevention and control capabilities. It also briefly discusses the interconnections between these topics.

Chapter 3: Research Methods

This chapter describes the specific research methods employed in the study, including semi-structured in-depth interviews, the Delphi method, and survey research. By using both qualitative and quantitative methods, it first identifies the indicator pool for the infection prevention and control capabilities of hospitals against EIDs. It then constructs a scientific evaluation system for these capabilities in tertiary comprehensive hospitals. Based on this, empirical research is conducted through surveys to understand how different capability dimensions impact the control level of EIDs in these hospitals.

Chapter 4: Construction of the Indicator System

This chapter details the construction of the evaluation indicator system for core capabilities in EID control in tertiary comprehensive hospitals through expert interviews and the Delphi method. The system includes five primary indicators (hospital infection risk prediction, infection prevention and control, training in prevention and control knowledge and skills, organizational coordination, professional development in prevention and control), 14 secondary indicators, and 62 tertiary indicators.

Chapter 5: Empirical Study on the Evaluation of Core Capabilities in EID Control in Tertiary Comprehensive Hospitals

Based on the evaluation indicator system and its weights established in earlier chapters, this chapter involves conducting surveys to analyze the core levels of EID control capabilities in tertiary comprehensive hospitals. It discusses the data collection via questionnaire distribution and analysis using the statistical software SPSS 24.0 to evaluate the current state of these capabilities, identifying strengths and weaknesses to foster the development of core capabilities in these hospitals.

Chapter 6: Discussion and Conclusion

Building on the empirical findings from the previous two chapters, this chapter discusses

the results of the study, drawing conclusions and answering the research questions. It identifies key factors affecting the core capabilities of tertiary comprehensive hospitals in controlling EIDs and offers recommendations for enhancing these capabilities. The chapter also discusses the contributions, limitations, and future research prospects of the study.

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Chapter 2: Literature Review

After entering WTO, China accelerated its industrial structure adjustment and opening-up and its economy has participated more widely and deeply in international division of labor. The medical industry also integrated into the economic globalization and entered a new era where competition and business opportunities coexist.

In the past, tertiary general hospitals in China dominated the market due to the support of national policies, strong technical capacity, and their inherent brand image in people's minds. However, with the reform and opening up, economic globalization, and diversification of market entities, the medical industry is gradually moving towards marketization. The competition in the medical market is becoming increasingly fierce, with many private hospitals and Sino-foreign joint venture hospitals who have complete equipment and advanced technology entering the market and expanding their scale. This has put huge pressure on tertiary general hospitals.

In the face of the rapidly changing medical market, managers of tertiary general hospitals need to recognize their core competency, and identify, build, develop and enhance their core capacity to determine their competitive positioning in the market. Besides, they also need to analyze the internal and external environment to find out opportunities and threats, and analyze their internal and external resources to identify strengths and weaknesses. In this way, they can obtain sustainable core competency and competitive advantages.

2.1 Definition of relevant concepts

2.1.1 Public hospitals

Public hospitals refer to state-owned and collectively owned hospitals (including government-run hospitals). They are non-profit treatment hospitals and the state bears unlimited repayment responsibilities for them. They reflect the will of state-owned capital, provide basic healthcare services for the public, and maintain social health equity. They are an institutional arrangement or a public policy to improve national health (Thomas & Suresh, 2022).

2.1.2 Tertiary general hospital

Tertiary hospitals: (with more than 501 hospital beds) are hospitals above regional level that provide high-level specialized medical and health services to patients in several regions, and carry out the mandate of higher education and scientific research. The level of hospitals established by enterprises, institutions, collectives, and individuals can be delineated according to this. Tertiary general hospitals: refer to comprehensive multi-disciplinary hospitals (Min et al., 2021).

Hospitals in China are divided into 3 levels: community hospitals are the first level, county (district) hospitals are the second level, and municipal hospitals are the third level, while tertiary general hospitals refer to medical institutions that provide medical and health services across regions, and have functions such as medical treatment, education, scientific research, and public health services. Its primary mission is to provide specialized (including specialties) medical services, handle emergencies and serious conditions, treat difficult and complex diseases, accept referrals from secondary hospitals, provide technical guidance and personnel training to subordinate hospitals, guide the training of advanced medical specialists, offer courses for the training of various advanced medical specialists, undertake scientific research projects at provincial level or above, and participate in and guide the primary and secondary prevention work.

The latest version of The Basic Standards for Medical Institutions (Trial) issued by the former National Health and Family Planning Commission of the PRC in 2017 put forward seven major minimum standards for tertiary general hospitals, including hospital beds, department settings, personnel, housing, equipment, systems and rules, and registered capital. The tertiary general hospitals referred to in this study are the tertiary general public hospitals that comply with this standard and are issued with Practice License of Medical Institution by the health administration department.

2.1.3 Nosocomial infection management departments in tertiary general hospitals

According to the Law of the People's Republic of China on the Prevention and Control of Infectious Diseases and the Notice of the Ministry of Health on the Construction of Infectious Diseases Departments in Secondary and Tertiary General Hospitals, general medical institutions at all levels should set up infectious diseases departments, including respiratory fever clinics, intestinal clinics, hepatitis clinics, AIDS clinics and among others. Medical institutions at all levels shall, in accordance with the requirements of the Nosocomial

Infection Management Standards (Trial), establish nosocomial infection management committees who are responsible for nosocomial infection management and control. Tertiary medical institutions must set up functional departments for nosocomial infection management, equipped with 3-5 full-time personnel (physicians or public professional physicians and nurses).

2.1.4 History and function positioning of tertiary general hospitals

Hospitals in China have gone through three stages in their development: ancient hospitals, modern hospitals, and contemporary hospitals. Early hospitals were mostly temporary shelters or places with rudimentary equipment used to isolate patients. Doctors treated patients based on personal experience. In the era of modern hospitals, with the progress and development of medical technology, hospitals have begun to truly diagnose and treat diseases. The functions and roles of hospitals have also undergone revolutionary changes, and hospitals have become treatment institutions. At the same time, with the rapid development of medical science and medical diagnosis and treatment technology, specialized departments appeared with hospitals. For example, there are up to 30 secondary departments in some large tertiary general hospitals. The emergence of specialized departments is good for treatment. It provides professional diagnosis and treatment methods for difficult and complicated clinical conditions. But it also increases the difficulty of coordination and management among hospital specialties.

With the reform and opening up, and the rapid economic development in China, hospitals have also developed rapidly. But many problems arose. Therefore, China has carried out medical reform and graded hospitals to better allocate medical and health resources and better solve the problems of difficult and expensive medical treatment. The basis for hospital grading is the comprehensive level of hospital functions, tasks, facility conditions, technological construction, medical service quality, and scientific management. The essence of hospital grading is to implement standardized management and target management in accordance with the principles of modern hospital management and the scientific laws and characteristics of medical and health service work. Hospitals in China are divided into primary, secondary, and tertiary hospitals. Both primary and secondary hospitals are respectively divided into A, B, and C levels, while tertiary hospitals are divided into special, A, B, and C levels.

2.1.5 Nosocomial infection

Nosocomial infection refers to infections acquired by patients during outpatient or inpatient treatment in a hospital, including infections that occur during hospitalization and those that are acquired during hospitalization but occur only after discharge, as well as infections acquired by hospital staff (like medical staff, administrative and logistics personnel) in the hospital. Nosocomial infection should also refer to infections acquired by inpatients, hospital staff, outpatient and emergency patients, caregivers, visitors, and patients' families, as well as visitors to the hospital for work. All infectious diseases acquired by these people in the hospital are called nosocomial infection (W. Li, 2015; C. Y. Ma et al., 2005).

2.1.6 EIDs

Emerging Infectious Diseases (EIDs) refer to infectious diseases caused by newly identified pathogens that have not been previously discovered but have recently emerged in a population. These diseases may result from genetic mutations, zoonotic spillover events, antimicrobial resistance, or environmental changes that facilitate the transmission of novel pathogens to humans. EIDs can pose significant public health threats due to their unpredictable nature, rapid spread, and potential for severe outbreaks, often requiring urgent global response efforts. Notable examples of EIDs include COVID-19 (caused by SARS-CoV-2), Ebola virus disease, and Zika virus infection. Given their substantial impact on healthcare systems, understanding and improving preparedness, prevention, and response strategies for EIDs remains a critical priority in global health security (McArthur, 2019).

2.1.7 Core capacity for the prevention and control in tertiary general hospitals

The core capacity for the control of nosocomial infection mainly include capacity for prevention and control of nosocomial infection, capacity for risk prediction of nosocomial infection, capacity for training of prevention and control knowledge and skills, organization and coordination capacity and capacity for prevention and control professional development (McFee, 2009).

2.2 Discussion on capacity and resources

2.2.1 Capacity

Capacity was originally a psychological term: (1) capacity is a psychological characteristic that an individual frequently and steadily exhibits in order to successfully complete activities. And this psychological characteristic is always associated with the activities that people need to complete. (2) Capacity reflects an individual's likelihood of completing various tasks in a certain job, which is a current assessment of what an individual can do. A person's overall ability can be divided into psychological ability and physical ability.

In real life, capacity extends beyond an individual characteristic. The use of concepts such as team capacity and enterprise capacity has become very common (Collins & Parker, 2010; Haas, 2006). There are also individual capacity, organizational capacity, and systemic capacity. In management, capacity refers to the collection of excellent, patterned, and repetitive behaviors that make an organization perform better than other organizations (Jaradat et al., 2017; Potter & Brough, 2004; Ting, 2011). From an economic perspective, capacity can also be understood as the force possessed by an individual or organization to transform one resource into another, or to transform resources into social wealth (Corrado & Mattey, 1997).

2.2.2 Resources

Resources refer to all tangible and intangible objective entities that can be utilized by people to create social wealth. Resources are linked to wealth, so in some dictionaries, resources are defined as the source of social wealth (Sen, 1997). In a narrow sense, resources refer to the combination of various elements controlled by an organization in its production process, including intangible assets such as organizational culture and reputation. In a broad sense, an organization's resources include not only the production factors it possesses, but also active components such as skills and abilities (Sen, 1997). Resources are input factors in the production process, and the same resources may result in vastly different outcomes due to different ways of use and operation by different producers (Mahoney, 1995).

2.2.3 Differences and connections between capacity and resources

(1) In enterprise organizations, resources and capacity are both distinct and interconnected. They are the source of core competency of enterprises.

a). The concepts of capacity and resources are different. Resources are a static concept,

mainly referring to the various elements owned or controlled by enterprises themselves; capacity is a relatively dynamic integrated concept that is more related to activities and processes.

b). Capacity is the subject, while resources are the object. The former is the action force of social subjects, while the latter are the action objects and action products of social subjects. Although tools (such as machines, factories, and computers) can also have action force, they are merely the materialization of human capacity. The effect of these tools is determined by the capacity of their users.

c). The dependence of capacity and resources on people is different. Resources (except human resources) have many carriers, for example, information can be stored in a person's mind, or can be carried on paper, CDs, or audio tapes; Capital can be carried by paper, precious metals, factories, and equipment. But human resources have only one carrier—human beings, so human resources are a special resource.

d). The criteria and methods for measuring capacity and resources are different. The essence of resources is "availability", one of its attributes. Their value can be objectively measured and evaluated before use through trading activities and market rules based on the purpose of use, resource scarcity, and the socially necessary labor time contained in resources. Capacity has a complex structure and formation mechanism, and is in a dynamic state of change, so it is difficult to evaluate its value.

e). Capacity and resources have different ownership. Resources can be permanently transferred and given legal protection of property rights; Capacity, attached to the human body, cannot be transferred permanently in society where slavery is abolished.

f). Capacity and resources have different growth laws. Capacity can grow rapidly through the learning behavior of social subjects themselves. Resources and wealth also have the potential for regeneration or even growth, but the main source of their growth is the capacity utilization of human beings.

(2) In enterprise organizations, competitiveness is the combination of capacity and resources.

a). Resources and capacity are interdependent and can be transformed into each other. Although capacity and resources are different concepts, they are closely related, interdependent, and can be transformed into each other. Resources and capacity can only become the core competency of an enterprise when they are interrelated and closely combined. Firstly, resources are the foundation and prerequisite for the formation and operation of enterprises, and for the ability and role of enterprises. Enterprises has the unique capacity to

allocate resources reasonably. But if there are no resources, capacity is like castles in the air, let alone becoming a competitive advantage for the enterprise; If an enterprise does not have the unique capacity to allocate resources reasonably, even with rich resources, the enterprise will not get sustainable competitive advantages. So, both resources and capacity are indispensable. Without human capacity, resources are difficult to function effectively. Without necessary resources, no matter how strong a person's capacity is, it is difficult to make a difference. Secondly, resources and capacity are mutually transformed. Resources can form capacity, and in turn, capacity can effectively promote the accumulation of resources. Human investment at the cost of resource consumption can improve human capacity. Knowledge, as a resource, can become human capacity through training. People can also turn their capacity into resources and pass them on to others through knowledge products such as design, writing, and systems. Resources can directly replace human capacity in certain aspects, such as using machines to replace human labor to do simple and repetitive physical jobs, and using computers to replace human mental labor to complete prescribed program analysis, and computation. The utilization of capacity can also directly form, develop, and amplify resources, for example, utilizing human innovation capacity to create patents which are important resources for enterprises.

b). Resources and capacity are symbiotic entities. Human resources are a symbiotic entity of resources and capacity. On the one hand, operators, technicians, and workers, as labor forces, have the nature of resources; On the other hand, they are also the carrier of enterprise capacity, and the knowledge and skills of operators, technicians, and workers are the main part of enterprise capacity.

c). Capacity is more important than resources. In enterprise organizations, the core competitiveness of an enterprise is determined by the combination of capacity and resources. But what determines the sustainable development of an organization is not resources, but capacity. No matter how abundant resources a country, an enterprise, or a family has, they cannot develop rapidly without capacity. Human capacity is the most precious asset of an enterprise. When people have different capacity, the wealth they create will vary greatly even if the same resources are consumed. Abundant resources may not necessarily guarantee a sustained leading position for enterprises, and the market position may not be directly proportional to its competitiveness generated by utilizing a certain number of resources.

2.2.4 Dynamic capability theory and its development

2.2.4.1 Development of capability theory

Looking back at the development of Strategic Management Theory, various theories originate from practice, such as swings and pendulums, constantly making choices between internal resources and external environments. Theory oscillates between internal and external matching, from the inside out and from the outside in, while it also acts on practice (Hoskisson et al., 1999). In the 1960s and 1970s, enterprise strategy was defined in enterprise management as the organic combination of internal advantage and external opportunities. While helping an enterprise gain competitive advantages, it protected the weakness of the enterprise and avoided threats from the external environment. And thus, the idea of "internal and external matching" between internal conditions and the external environment emerged; In the 1980s, the focus of enterprise strategic management shifted to external environment analysis. The most famous researchers and managers were Michael Porter and Karl Shapiro. They created Competitive Advantages Model (Diamond Model) and Strategic Conflict Model respectively; In the 1980s and 1990s, the trend of profit averaging among different industries became increasingly significant, and the phenomenon of performance differences between enterprises within the industry being greater than those between industries became increasingly apparent. The research focusses once again shifted towards "from the inside out", leading to the emergence of the Enterprise Resource Capability Theory. The Theory is divided into four relatively independent and complementary parts, including Resource-based Theory, Core Capacity Theory, Knowledge-based Theory, and Dynamic Capability Theory (Min, 2017).

2.2.4.2 Resource-based theory

The enterprise resource school was proposed based on the Theory of Internal Growth advocated by Edith Penrose in 1959. They believe that the main reason why enterprises can win profits and competitive advantages is that different enterprises have different resources, and these resources cannot fully flow, resulting in the scarcity of enterprise resources. This means that enterprises can use scarce resources to produce products with lower costs and higher quality than other enterprises, thereby gaining competitive advantages. Theories from the resource school emphasize that competitive advantages of an enterprise come from within the enterprise, that is, an enterprise creates its own competitive advantages through the accumulation of internal resources (Kor & Mahoney, 2000).

Resource-based Theory was proposed in Enterprise Resource Theory published in the Journal of Strategic Management in the United States. This study pointed out the strategic value of internal resources in helping enterprises to profit and gain competitive advantages, and believed that the analysis of internal environment of enterprises is more important than that of external environment. For enterprises, the key to obtaining excess returns and maintaining competitive advantages is the accumulation of internal organizational capacity, resources, and knowledge. Enterprises can clearly define their development strategies based on their own resource analysis (Wernerfelt, 1984). His views had a huge impact on the research of strategic management throughout the 1990s. And his research, along with later works by Rumelt, Lippman, and others, constitutes the Resource-based Theory. The Resource-based Theory holds that enterprise organizations are a unique combination of resources and capacity, and the combination is the foundation of an enterprise's competitive strategy (Acedo et al., 2006).

2.2.4.3 Core capacity theory

The Resource-based Theory attributes competitive advantages to the resources possessed by the enterprise, which has certain limitations. The Core Capacity Theory holds that an enterprise is a unique collection of capacity, and its long-term competitive advantages come from its core capacity.

In 1990, an article titled The Core Capacity of the Corporation in the Harvard Business Review, marking the rise of the Core Capacity Theory of enterprises. This study defined core capacity as accumulated knowledge within an organization, and believed that the core capacity possessed by an enterprise is the source of long-term competitive advantages. Accumulating, maintaining, and applying core capacity is the fundamental strategy for the long-term development of an enterprise (Prahalad & Hamel, 1999). Dorothy (1992) believe that an enterprise's research and development activities interact with its core capacity. On the one hand, core capacity promotes research and development activities, and on the other hand, when new research and development projects gain new content in the above four aspects, existing core capacity may hinder research and development activities.

Overall, the Core Capacity Theory holds that an enterprise's core capacity stems from knowledge within the enterprise and it is crucial in gaining and maintaining sustained competitive advantages. According to the Theory, core capacity is considered dynamic and constantly changes with the development, utilization, and abandonment of knowledge. Gu and Ding (2009) believe that the Core Capacity Theory is about analyzing the internal

environment of an enterprise, understanding its capability structure, identifying its core capacity, formulating and implementing competitive strategies based on its core capacity to gain competitive advantages. The Core Capacity Theory has expanded the perspective of enterprises in seeking competitive advantages and is a great innovation in enterprise capability theory.

2.2.4.4 Knowledge-based theory

More and more scholars have realized that the key to determining an enterprise's competitive advantages lies in the knowledge that the enterprise possesses, especially the tacit knowledge that is difficult for competitors to imitate and the cognitive learning closely related to knowledge.

Barney (1991) believes that the "unique resources" that can produce competitive advantages are the knowledge that enterprises possess that is difficult to trade and imitate. The Resource-based Theory and the Core Capacity Theory have ultimately moved towards Enterprise Knowledge Theory. The Knowledge-based Theory holds that an enterprise is a collection of knowledge, and tacit knowledge is the foundation of its core capacity. Core capacity can create a unique and competitive knowledge system for the enterprise. Allee (2013) proposed the concepts of core knowledge capability and core operation capability, believing that these two capabilities are completely different but closely related aspects in identifying enterprise advantage. Core operation capability is the process and ability that enable enterprises to produce high-quality products and services at high speed and efficiency; Core knowledge capability refers to unique expertise, knowledge, and skills relative to a specific business. It was proposed that the capability of enterprises arises from the accumulation of implicit experience, the clarification of explicit knowledge, and the co-evolution of knowledge encoding activities (Zott, 2003).

The Knowledge-based Theory holds that updating knowledge is the key to maintaining competitive advantages, and the way to formulate new competitive strategies for enterprises is to build the structure of the enterprise around knowledge. Therefore, enterprises not only need to enhance the current knowledge utility, but also need to acquire future knowledge, which is the basic views of the Knowledge-based Theory.

2.2.4.5 Dynamic capability theory

For enterprises, the environment is dynamic, and the core capacity formed at a certain time cannot be sustained for a long time. Teece et al. (2009) believe that "dynamic capability refers

to the ability of an enterprise to integrate, build, and reconfigure its internal and external competences to adapt to the rapidly changing environment". "Dynamic" refers to the ability of enterprises to constantly update their own capabilities in order to adapt to the constantly changing market environment; "Capability" refers to the crucial role of strategic management in updating an enterprise's own capabilities (integrating, restructuring internal and external organizational skills, and resources) to meet the requirements of environmental changes. Therefore, dynamic capability refers to the ability of an enterprise to maintain or change its ability as the foundation of competitive advantages.

From the early 1990s to the mid-and-late 1990s, the main viewpoints of capability theory include: enterprises are a combination of capabilities, competition is based on capabilities, and the strategic management concept is based on capabilities. The core capacity of an enterprise is the source of maintaining its competitive advantages, and the integration of multiple skills and knowledge. It is a long-term process to establish core capacity. The Dynamic Capability Theory was created by analyzing capabilities from the perspectives of process, position, and path.

Teece et al. (2009) proposed the concept and framework of dynamic capability, and established a strategic paradigm for how enterprises gain competitive advantages. But many scholars have raised doubts about dynamic capabilities. For example, since there is the ability to change, logically there is an ability to change. When analyzing the source of an enterprise's competitive advantages at a certain level of capability, higher-level capability analysis will render low-level analysis ineffective, so capability of the enterprise cannot become the "decisive" source of sustainable development (Collis & Montgomery, 2008). Helfat and Peteraf (2003) highlighted the dynamism of capabilities, but the ability of an enterprise can adapt to changes and the learning, changing, and adaptation of capabilities do not require "dynamic capabilities" to act as intermediaries.

2.2.5 The connotation and extension of dynamic capability

Dynamic capability can be traced back to relevant theories in evolutionary economics that explain organizational evolution. Since Teece and Pisano put forward the Dynamic Capability Theory in 1994, scholars in and beyond China have explained dynamic capability from different perspectives. For example, Teece et al. (2009) believe that dynamic capability is the ability of an enterprise to integrate, construct, and reconstruct internal and external resources and competitiveness to cope with rapid changes in the external environment. Eisenhardt and

Martin (2000a) think that dynamic capability is the organizational fluency and strategic convention that an enterprise adapts to or even creates market changes through a series of behaviors such as acquiring, utilizing, integrating, updating, and restructuring resources. Zollo and Winter (1999) argue that dynamic capability is a stable model learned through collective (learning) activities to systematically create or adjust operational rules and practices in order to improve an enterprise's own efficiency. Winter (2000) holds that dynamic capability is the ability of an enterprise to build, expand, adjust, restructure, or create conventional operational capabilities, and its result is output capability. Helfat (1997) believes that dynamic capability is a capacity that helps an enterprise produce new products or restructure production processes to respond to external environmental changes and market changes. Dong et al. (2006) believe that dynamic capability is the ability to actively innovate activities to overcome the rigidity of organizational core capacity.

If an enterprise cannot update its core capacity, then core capacity will ultimately become core rigidity. Inspired by this argument, the concept was proposed that dynamic capability, which is the ability to change abilities, in 1994. In 1997, they put forward a famous dynamic capability framework, which defined dynamic capability as an ability to integrate, build, and reconfigure internal and external capabilities to respond to rapidly changing environments. The research findings of Teece et al. learn from the viewpoints of resource-based theory school and extend to dynamic markets (Teece et al., 1997). Eisenhardt and Martin (2000a) defines dynamic capability as the process by which an enterprise uses resources to adapt to or even create market changes, particularly the process of integrating, rebuilding, acquiring, and relinquishing resources. It is believed that dynamic capability is a strategic norm of an organization, a set of proprietary and identifiable processes such as product development, strategic decision-making, and alliances. When the market conflicts, splits, evolves, and disappears, the enterprise gains new resources through core capacity. Y. Luo (2000) examined dynamic capability from the perspective of international operations and believed that dynamic capability is the ability of an enterprise to create, accumulate, and enhance unique resources and capabilities that can bring economic returns to the enterprise in the pursuit of sustained competitive advantages in the international market. Dynamic capability requires enterprises to have the ability to extract economic benefits from existing resources and the ability to create new capabilities. Zollo and Winter (2002) believes that dynamic capability is a stable collective activity pattern obtained through learning, from which organizations generate and modify their business routines in pursuit of efficiency improvement. The definition indicates that dynamic capabilities are structured and consistent.

J. S. Huang and Tan (2002) believe that the essence of dynamic capability is to gain competitive advantages through continuous innovation, but this advantage is temporarily present due to the influence of environmental dynamics. X. W. Li and Wang (2004), and Jiao et al. (2008) believe that dynamic capability is a special ability to integrate, coordinate, and reconstruct, which can change the operational practices of enterprises. Qiu et al. (2008) and D. Xu et al. (2008) validated the positive relationship between enterprise dynamic capability and competitive advantages acquisition and found that the role of capability is much greater than that of resources. W. L. Xu et al. (2009) analyzed the connotation of dynamic capability from a micro level (senior management) perspective and proposed a framework for enhancing dynamic capability. Jiao (2011) constructed a dual organizational competitive advantages path based on previous research.

In summary, dynamic capability refers to the ability of an enterprise to integrate, create, and reconstruct internal and external resources to continuously seek and utilize opportunities in a constantly changing external environment. It emphasizes that organizations should comprehensively utilize various resources to improve their adaptability. In the current situation where the dynamic changes in the external environment are intensifying, strategic management and research of core capabilities should seek an effective balance of internal resources.

2.2.5.1 Core elements of dynamic capability

There is no unified consensus on the elements of dynamic capabilities of enterprises according to the literature review in and beyond China. Most scholars elaborate on dynamic capabilities from various dimensions, mainly including theoretical research and practical quantification.

The Dynamic Capability Theory holds that an enterprise's dynamic capability is the source of competitive advantages. "Dynamic" means that enterprises should have strategies to quickly adapt to changes in the environment; "Capability" refers to the internal and external skills, resources, and functions that enable enterprises to adjust and restructure their organization appropriately (Teece & Pisano, 1994). The founder of the dynamic capability school decomposed dynamic capability into three elements: process, position, and path (Teece et al., 1997).

(1) Process. When defining the elements of dynamic capabilities in the initial stage, Teece et al. (1997) classified organizational processes or management functions into three categories: integration and coordination, guidance learning, and restructuring. Organizational processes

integrate development strategies and business models into the daily behavioral norms of employees. Integration refers to integrating external factors such as market relations and environment through various forms such as mergers and acquisitions, alliances, and technological cooperation; Coordination refers to the coordination of various functional modules, resource capabilities, and business activities within the organization. Guidance learning enables organizations to continuously understand and adapt to the dynamic changes in the external environment to maintain their competitive advantages. Restructuring processes help organizations adapt to various changes in a "hyper competitive environment" through asset restructuring, process reengineering, or capability reshaping. Any type of the processes, in essence, is an organization's adaptation to the constantly changing dynamic environment, or even the shaping of the environment (Wilden et al., 2013; Winter, 2003).

(2) Position. Position refers to the resource positioning of an organization, which includes not only the traditional market positioning of the organization, but also its positioning in the entire macroeconomic environment. It was pointed out that resource positioning is not only about the positioning of physical assets such as finance, factories, equipment, and technology, but also includes that of intangible resources such as human resources, knowledge assets, and reputation owned by the organization. Position determines the decisions and competitive advantages of an organization (Eisenhardt & Martin, 2000b; C. L. Wang & Ahmed, 2007).

(3) Path. Previous academic studies often regard path as the "historical process" or "evolutionary process" of the organizational development, which includes both corporate rules or practices and organizational learning. In the research, path selection is reinterpreted as an organizational strategic decision that is closely related to process, position, and capability (Teece, 2014). Strategic decision-making is a coherent process of responding to risk challenges, including analysis, conceptual definition, policy guidance, strategic reasoning, and specific actions (Wilden et al., 2013).

Scholars in China have conducted in-depth research on the quantification of dynamic capabilities of enterprises. X. W. Li (2005) identifies dynamic capabilities from five dimensions: environment, strategy, product (service), resource structure, and competitive advantages. Specifically, dynamic capabilities include environmental insight capabilities, value chain allocation and integration capabilities, and resource allocation and integration capabilities. X. G. He et al. (2006) proposed that the dimensions of dynamic capabilities measurement include market potential, organizational change, organizational learning, organizational flexibility, and strategic isolation from the perspective of Chinese entrepreneurs. Through exploring the structure of organizational dynamic capabilities, Sun

(2008) believes that organizational dynamic capabilities mainly consist of two parts: identifying and judging opportunities in the environment; adapting, integrating and restructuring internal and external resources of the enterprise to capture market opportunities. He divided the organizational dynamic capabilities into opportunity recognition capability, change response capability, and resource integration capability. M. Luo and Liu (2009) used the competitive value method to determine the dimensions of dynamic capabilities, mainly including market-oriented perception capability, organizational learning absorption capability, social network relationship capability, and communication and coordination integration capability. Y. Meng and Yu (2008) pointed out that the dimensions of dynamic capability measurement mainly include customer value orientation, technology and its support system, organizational support system, institutional support mechanism, updated capability, and strategic isolation mechanism.

2.2.5.2 Dimension division of dynamic capabilities

Dynamic capabilities were divided into three dimensions: adaptability, integration, and reconstruction. Resource reconstruction is the essence and purpose of dynamic capabilities, and learning and integration are necessary during resource construction (Alwali, 2023; Teece, 2014). Therefore, they consider resource restructuring capability, organizational learning capability, and integration and coordination capability as dimensions of dynamic capabilities (Alwali, 2023; Eisenhardt & Martin, 2000a; Teece et al., 1997; Zott, 2003).

C. L. Wang and Ahmed (2007) think that absorptive capability, adaptive capability, and innovation capability are three dimensions of dynamic capability. They believe that absorptive capability is the ability of enterprises to acquire new knowledge and skills through learning; Adaptive capability refers to the ability of an enterprise to identify and adapt to external changes in the environment; Innovation capability refers to the ability of an enterprise to innovate by adjusting its strategic innovation orientation in management processes such as new product development and market development. Jiao and Wei (2008) believe that environmental insight capability refers to an enterprise's ability to identify changes in the external industrial environment; Technical flexibility refers to the adaptability of an enterprise's technology; Organizational flexibility refers to the flexibility and resilience of enterprises to adapt to environmental changes; The ability to change and update refers to the innovation and transformation capabilities of an enterprise. X. B. Meng (2008) divided dynamic capabilities into five dimensions. He took international entrepreneurial enterprises as research objects, selected relevant experts for interviews, analyzed the interview content after

obtaining sufficient information, and obtained a multidimensional model of dynamic capabilities. He used large sample data for confirmatory factor analysis to verify the rationality of the dimensions. M. Luo and Liu (2009) reviewed literature and proposed that the dimensions of dynamic capability are market oriented perception capability, organizational learning absorption capability, communication and coordination integration capability, and social network relationship capability. F. Liu et al. (2010) think that perception shaping, learning absorption, integration and reconstruction are three dimensions of dynamic capabilities. Among them, perception shaping capability refers to the ability of an enterprise to perceive, identify, create, and utilize potential business opportunities in the external environment; Learning absorption capability is an important dimension of dynamic capability, reflecting the ability of enterprises to acquire, integrate, and utilize internal and external knowledge; Integration and reconstruction capability refers to the ability to integrate, reconstruct, and extend resources. Kuuluvainen (2011) studied the impact of dynamic capabilities on the internationalization growth of small and medium-sized enterprises. In the study, the author divided the dimensions of dynamic capabilities into opportunity search, resource acquisition, resource restructuring, and among others. Jiang (2018) believes that dynamic capability can be composed of environmental insight capability, research and development capability, and organizational flexibility capability. Dynamic capabilities are classified into cognitive, managerial, and organizational capabilities (Klein et al., 2013). Schilke (2014) divided dynamic capabilities into joint management capabilities, new product development capabilities, and others.

2.2.5.3 Characteristics of dynamic capability

The Dynamic Capability Theory originates from standard capability theory. It refers to many viewpoints from the Core Capacity Theory. So, there are many similarities between dynamic capability and core capability in terms of characteristics, such as value and uniqueness. However, dynamic capability is no longer limited to any standard capability, but rather a high-level and more abstract capability. It enables enterprises to quickly integrate, establish, and reconstruct internal and external resources and skills when facing a changing environment to get new competitive advantages (Kindström et al., 2013).

Specifically, dynamic capability has the following characteristics:

(1) Value. Like other resources and capabilities, dynamic capabilities can become a source of competitive advantages only when they have value. The value of dynamic capabilities lies in the fact that they can change and allocate resources of the enterprise, thereby creating new

competitive advantages. This is no different from the perspectives of the Enterprise Resource Theory and the Core Capacity Theory (Bitencourt et al., 2020; Katkalo et al., 2010).

(2) Transformability. The essence of dynamic capability means transformation, and it is the ability to change capability. The change emphasized in dynamic capability is a path-dependent change that is limited by the existing resources, capabilities (position), and history of the enterprise. The existing technological assets and auxiliary assets of an enterprise are the foundation of its ability to change. In a changing environment, "in dealing with a series of crises, organizations adopt creative but discontinuous methods" (which is not the practice of dynamic capabilities). Therefore, dynamic capabilities are different from strategic leaps (Alwali, 2023; Eriksson et al., 2014; Teece & Pisano, 1994).

(3) Subjective initiative. The Dynamic Capability Theory stresses subjective initiative, believing that subjective initiative is a key factor that helps organizational conventions and processes play a role. Conventions and processes are institutionalized patterns of corporate behavior with inherent inertia, and few people are willing to modify recognized patterns of behavior. Due to the fear of uncertainty in the future, people resist making a change. So, when facing a new situation, enterprises often follow the old rules (Teece, 2014). It may also be difficult for enterprises to change their core capacity. While dynamic capability requires enterprises to proactively adapt to or even predict changes in the environment. In this way, enterprises are prepared to respond to changes ahead of competitors (Mittal, 2019; Ringov, 2017).

(4) Pioneering. Enterprise dynamic capability is pioneering. The driving force of innovation may be regenerative or pioneering. Regenerative power enables enterprises to regenerate their capabilities and resources within limited boundaries and relatively short periods of time, or only to gain added value. Regenerative power plays an important guiding role for enterprises to maintain their existing competitive advantages in a stable environment for a short period of time. Regenerative power is replicable. Replicability means the disappearance of competitive advantages isolation mechanisms, so such competitive advantages are obviously short-lived (Breznik & Hisrich, 2014; Wilden et al., 2013). In a relatively stable environment, regenerative power can reduce costs and improve efficiency through traditional learning experience curves or increase competitiveness of enterprises through gradual innovation in product development, which is a manifestation of static efficiency improvement of enterprises.

(5) Openness. The dynamic capabilities built on pioneering power is characterized by openness. The dynamic capability of an enterprise is the combination of internal knowledge,

absorptive knowledge, or imported knowledge (Helfat & Peteraf, 2015). The Dynamic Capability Theory emphasizes the establishment of special abilities to absorb knowledge from external sources (resources, abilities and opportunities). Absorptive knowledge serves as a bridge between internal and external resources and capabilities within an enterprise (Zollo & Winter, 2002). Compared to the standard capabilities that emphasize the internalization and accumulation of enterprise capabilities, dynamic capabilities are flexible due to their openness.

(6) Emphasis on conventions and processes. The emphasis on conventions and processes is an important feature of dynamic capability. Conventions and processes constitute the special capabilities of an enterprise, including the way in which activities are carried out, behavioral patterns, and learning mechanisms. Like core capacity, dynamic capabilities recognize that an enterprise's processes (coordination and integration) can improve its efficiency, and therefore, the enterprise's practices are one of its sources of competitive advantages (Schilke, 2014). But unlike core capacity, dynamic capabilities focus more on the dynamic effects of processes, that is, the changes to the foundation of enterprise resources and capabilities. Through the learning process, enterprises can reconstruct and change the foundation of their competitive advantages, and even make changes to conventions and processes (Kuuluvainen, 2011). Therefore, processes and conventions involved in dynamic capabilities are much richer in content. Conventions and processes are the foundation of learning of enterprises and create conditions for their continued learning (Zott, 2003).

(7) Emphasis on knowledge and learning. The Dynamic Capability Theory believes that continuous innovation is the source of competitive advantages for enterprises. The role of knowledge in innovation is self-evident. In the era of knowledge economy, knowledge is the source of wealth and the foundation of enterprise innovation. Without the support of relevant knowledge, the innovation of enterprises cannot be achieved. Enterprises acquire knowledge through learning. The evolution of enterprise knowledge and the process of enterprise learning are the focus of research on dynamic capabilities (Zollo & Winter, 2002). The Resource Theory treats knowledge as a strategic resource, and the Core Capacity Theory regards enterprises as a combination of knowledge. The two theories both view the knowledge of the enterprise from a static perspective, viewing it as a stock that determines the competitive advantages of the enterprise. There is no research on the source, accumulation, and evolution process of enterprise knowledge (Helfat, 1997; Nieves & Haller, 2014). The Dynamic Capability Theory uses position and path to illustrate the importance of enterprise knowledge stock, while learning process is used to reveal the flow process of knowledge flow.

So, compared with the Resource-based Theory and Core Capacity Theory, the dynamic capability that focuses on both knowledge stock and flow can better explain the source of an enterprise's competitive advantages, especially in the face of a constantly changing environment (Helfat & Peteraf, 2003).

2.2.5.4 Empirical studies on dynamic capabilities in the healthcare sector

This section synthesizes empirical studies that demonstrate how dynamic capabilities have been implemented in healthcare settings, particularly focusing on advanced practice nurses and hospital systems facing competitive pressures.

Hako et al. (2023) emphasized the pivotal role of Advanced Practice Nurses (APNs) in enhancing the quality of care and improving the efficiency of healthcare systems. Despite extensive research on the competencies associated with APN roles, the concept of capabilities remains under-explored. The study conducted a systematic review assessed by the JBI tool for systematic reviews and followed the PRISMA guidelines for data reporting. It found that APNs' capabilities extend beyond professional knowledge and technical skills to include higher levels of adaptability and innovation. These dimensions involve applying skills in both familiar and unfamiliar contexts, creativity, high self-efficacy, mastery of learning techniques, strong teamwork abilities, and recognizing factors that influence practice scope.

Agwunobi and Osborne (2016) focused on how hospitals utilize dynamic capabilities to establish sustainable competitive advantages in a challenging medical environment characterized by severe financial constraints, patient attrition, increased competition, and uncertainty due to healthcare reforms. Using a case study approach, the research analyzed how Yale New Haven Health System (YNHHS), which includes three hospitals and 70 medical practice facilities, applied a dynamic capabilities framework to enhance hospital performance. The study proposed a dynamic capabilities framework specific to the hospital industry and the microfoundations that support these capabilities in hospitals.

Key dynamic capabilities identified include:

Sensing: Ability to recognize market trends, patient needs, and technological changes.

Shaping: Capability to influence the market environment to favor the hospital's competitive position, such as creating high-end specialty centers to attract patients and shape market demand.

Seizing: Ensuring correct investments are made and effectively capitalizing on new opportunities.

Transforming: Continuously adjusting the organizational structure and resource allocation

to adapt to new conditions.

YNHHS supported the construction of dynamic capabilities through several microfoundations, including enhanced data analytics, leadership reforms among physicians, and collaborative team models. The application of dynamic capabilities allowed YNHHS to reduce healthcare costs and improve the quality of care, thereby achieving sustainable competitive advantage. The study highlighted that competition in the hospital industry has shifted from traditional service scale to dynamic capabilities, suggesting that hospitals can gain long-term advantages by rapidly sensing, shaping, and seizing market opportunities and flexibly adjusting operations.

Key success factors for YNHHS included data-driven decision-making that improves data analysis capabilities. Physician-manager collaboration that empowers physician leadership to enhance management efficiency. Flexible business model adjustments that develops telemedicine and personalized medicine services.

Nurses, as the backbone of the healthcare industry, must continually adapt to new technologies, evidence-based nursing practices, and the diverse needs of patients. However, constrained medical resources and increased nursing workloads often result in a lack of motivation for innovation. Thus, Alwali (2023) examined how nurses' dynamic capabilities influence their work performance through innovative work behaviors. This study utilized a quantitative methodology, employing questionnaire data for empirical analysis and Partial Least Squares Structural Equation Modeling (PLS-SEM) for hypothesis testing. The participants were nurses from ten public hospitals in Iraq. The findings revealed that nurses with strong dynamic capabilities are more inclined to innovate. Dynamic capabilities not only directly affect work performance but also indirectly enhance it by fostering innovative behaviors. Moreover, adaptability to the environment and continuous learning abilities were particularly significant in promoting innovative behaviors among nurses. This research introduced dynamic capability theory into the nursing field, thereby expanding its application scope.

Aboramadan et al. (2021) investigated how management capabilities influence the performance of public hospitals, introducing job involvement as a mediating variable to explain the mechanisms of this impact. Data were collected from 380 healthcare professionals in public hospitals in Jordan, and hypotheses were tested using Structural Equation Modeling (SEM). Management capabilities included dimensions such as logistics systems, cost control, human resource management, financial management, and market planning. Hospital performance was measured using patient satisfaction and financial performance. The study

found that management capabilities did not have a significant direct impact on hospital performance, indicating that management capabilities cannot directly enhance hospital performance but may do so indirectly through other variables. Furthermore, management capabilities had a positive effect on job involvement, and job involvement positively affected hospital performance. This means that job involvement fully mediates the effect of management capabilities on hospital performance. The research suggests that management capabilities alone cannot directly enhance hospital performance; instead, they operate through the work engagement of employees. This finding underscores the importance of fostering employee dedication in guiding hospital operations.

Government hospitals are mandated to adhere to principles of economy, equity, and quality, providing efficient and equitable medical services. With the rapidly changing healthcare environment, hospitals need strategic flexibility to swiftly respond to challenges. Thus, optimizing hospital performance with limited resources is a key issue in current hospital management. Najmi et al. (2018) explored how dynamic capabilities mediate the impact of knowledge management and strategic leadership on organizational performance in hospitals. The study was conducted with 100 management personnel from four public hospitals in Indonesia, employing structural equation modeling and the Sobel test for hypothesis testing. Dynamic capabilities included environmental sensing, opportunity seizing, and resource reconfiguration. Hospital performance was measured from a balanced scorecard perspective, encompassing financial performance, patient satisfaction, internal processes, and learning and growth. The findings revealed that dynamic capabilities are a crucial link between knowledge management, strategic leadership, and hospital performance. Knowledge management and strategic leadership could not directly enhance hospital performance but did so indirectly through dynamic capabilities. This underscores the need for hospitals to systematically enhance their dynamic capabilities, including market insight, resource integration, and organizational transformation. This study extended the application of dynamic capability theory in the field of hospital management, demonstrated the mediating role of dynamic capabilities, and proposed an integrated model of knowledge management—dynamic capability—hospital performance.

Public organizations often involve complex stakeholder interests, ambiguous goals, and less market-driven factors, making the understanding of their capability building and entrepreneurial behavior crucial for policymakers and managers. Klein et al. (2013) analyzed the capability development and entrepreneurial behavior of multiple public organizations to explore how they leverage capabilities for strategic entrepreneurship, creating and capturing

value. The study showed that public organizations are not only managers of resources but also have the potential to create value. There is a dynamic relationship between capability development and value creation; public organizations build new capabilities through internal and external collaborations and use these capabilities for innovation. Public organizations' capability development follows two main paths: accumulation and evolution of capabilities through policy formulation, governance capabilities, information management, and organizational culture; and external acquisition of capabilities through collaborations with private entities. The study concluded that capability development dictates the entrepreneurial behavior of public organizations, impacting their performance, innovation capacity, and public value creation. Public organizations should enhance their adaptability by optimizing governance structures and increasing market sensitivity. This research expanded the theory of strategic entrepreneurship by applying it to public organizations, combining resource-based views and dynamic capability theory to explain how public organizations create value through capabilities.

As the complexity of the healthcare industry increases, hospitals need to optimize supply chain management through close collaboration with suppliers to enhance the efficiency of medical services and the quality of patient care. Mandal (2017) investigated how dynamic capabilities affect hospital-supplier collaboration and hospital supply chain performance. The study surveyed multiple hospitals and their key suppliers, collecting data related to supply chain management and employing structural equation modeling for hypothesis testing. The findings indicated that dynamic capabilities are central to hospital supply chain management, thus hospitals need to enhance their ability to perceive market changes, optimize supply chain management, and improve the stability of medical supply deliveries. Supplier collaboration was found to be a critical factor in enhancing supply chain performance, hence hospitals should strengthen cooperative relationships with suppliers, enhancing information sharing and resource coordination capabilities.

Existing literature has largely focused on experiential learning, but studies suggest that reliance solely on experiential learning may lead to organizational inertia, hindering the effective implementation of new practices. Given the highly dynamic environment of the healthcare industry, there is a need for systematic learning and capability restructuring to adapt to changes. Mittal (2019) explored how deliberate learning influences the development of dynamic capabilities and further promotes the implementation of new practices. The study gathered data from 186 medical units in Southern India that participated in a medical improvement training program. Data analysis was conducted using multilevel regression

analysis for hypothesis testing. The measurement of dynamic capabilities included task flexibility and environmental flexibility. Task flexibility measured whether team members could switch freely between different tasks, while environmental flexibility focused on the organization's ability to quickly adapt to external changes, such as outbreaks of diseases. The study found that deliberate learning is crucial for fostering innovation in medical organizations. Dynamic capabilities served as a bridge for implementing new practices; task flexibility enabled teams to quickly adjust their work methods, enhancing execution efficiency. Environmental flexibility allowed organizations to rapidly adapt to external changes, improving their ability to handle emergencies. This study demonstrated the mediating role of dynamic capabilities and provided new insights for future research in healthcare management.

Leung (2014) explored how social media can help healthcare organizations enhance their dynamic capabilities. As social media becomes increasingly prevalent in the healthcare sector, its impact on organizational management and strategic development remains somewhat unclear. The study employed the concepts of technological adaptability and evolutionary adaptability to analyze how hospitals can leverage social media to expand their influence, strengthen patient interactions, and improve overall operational capabilities. The sample consisted of 164 hospitals in Missouri, USA, with data primarily sourced from Facebook pages, analyzing changes in likes and discussions. The findings indicated that social media can enhance the dynamic capabilities of healthcare organizations. Specifically, in terms of technological adaptability, social media helps to expand the hospital's brand influence and attract new patients. In terms of evolutionary adaptability, social media can facilitate long-term interactions between patients and hospitals, although careful management is required. This research extends the application of dynamic capability theory in the healthcare sector.

The COVID-19 pandemic has exerted tremendous pressure on the global healthcare industry, with shortages of medical resources, increased safety risks for healthcare workers, and limitations on traditional medical models. Against this backdrop, healthcare managers need to employ innovative management strategies and utilize dynamic capabilities to enhance competitiveness and performance. Vrontis et al. (2022) investigated how dynamic management innovation capabilities affect the competitive advantage, financial performance, and non-financial performance of the healthcare sector, with a focus on the challenges during the COVID-19 period. The study involved 284 hospital managers from 48 hospitals in Lebanon, including top executives, doctors, nurses, and administrative staff. The findings revealed that dynamic management innovation capabilities enhance the competitive advantage

of the healthcare industry. Capabilities such as Sensing, Seizing, and Reconfiguration effectively help hospitals adjust strategies, optimize resources, and enhance market competitiveness. However, merely sensing market changes is not sufficient; hospitals also need to take actual action to optimize management processes and resource allocation. Additionally, dynamic capabilities contribute to improving non-financial performance. By optimizing patient experiences and enhancing hospital reputation, competitive advantages can be indirectly strengthened. Enhancements in patient satisfaction and brand impact lay the foundation for financial recovery in the post-pandemic era. However, the impact of dynamic capabilities on financial performance was not significant. During the pandemic, hospitals' main sources of income (non-COVID-19 related services) were severely impacted, and even with enhanced dynamic capabilities, it was difficult to improve financial conditions.

Zawadzki and Montibeller (2023) conducted a study surrounding the COVID-19 pandemic, arguing that the global health security system needs redesigning to better address a variety of health threats, including known epidemics and emerging global pandemics. Existing health capability planning methods do not consider diversified health threat scenarios, lack a systemic perspective, and struggle to identify gaps in capabilities and resources. The study employed a framework development approach, integrating Capability-Based Planning (CBP) concepts with decision analysis methods. The process began with a review of existing definitions and studies of health capabilities and an analysis of the limitations of current methods. Subsequently, a new framework for identifying and structuring health capabilities suitable for complex health threat environments was proposed. Finally, the feasibility of the framework was validated through case studies (covering health threats such as COVID-19, Ebola virus, and influenza).

The research developed a new health capability framework to identify and structure health capabilities to support the planning of health security systems. The framework consists of four main steps:

1. Identification of Potential Health Threat Scenarios: This involves covering a variety of different disease outbreak situations.

2. Analysis of Challenges for Each Threat Scenario and Determination of Required Health Capabilities: This step assesses what capabilities are necessary to address each identified threat.

3. Establishment of a Health Capability Network: Utilizing a Means-End analysis to reveal the interactions between capabilities and their relationship with resources.

4. Definition of Resource Element Attributes: This allows for the measurement of the

resource levels of the health security system and optimizes resource allocation.

The findings indicate that by using this framework, policymakers can conduct more comprehensive planning under conditions of high uncertainty. The framework helps identify gaps in resources and capabilities, thereby enhancing the preparedness of the health system. This method offers a more systematic and structured approach to representing health capabilities and their complex relationships, which can enhance risk analysis and emergency planning.

Murphy and Wilson (2022) explored how dynamic capabilities and stakeholder theory can explain the exceptional performance of hospitals. Their research focused on hospitals that have received the Malcolm Baldrige National Quality Award (MBNQA-HC), analyzing self-assessment reports from ten U.S. hospitals that won the award between 2010 and 2016. These reports provided detailed descriptions of the hospitals' quality management practices, organizational structures, and performance improvement strategies. The study employed a qualitative analysis approach, using thematic analysis to code for dynamic capabilities within the hospitals. The findings revealed that the award-winning hospitals generally possessed strong capabilities in sensing, seizing, and transforming. These capabilities enabled them to quickly adapt to industry changes and enhance their competitiveness. When it comes to managing stakeholders, hospitals with robust dynamic capabilities were more adept at transforming external information into actionable strategies, thereby boosting performance. Additionally, the winning hospitals heavily relied on data analytics. They utilized patient feedback, market trends, and supply chain data to optimize medical services. Hospitals with a patient-centered, data-driven, and collaborative innovation culture tended to perform better.

2.2.6 Theoretical basis of core competence of tertiary general hospitals

2.2.6.1 Core competence

The concept of “core competence” was first put forward in 1990 in an article titled The Core Competence of The Corporation in the Harvard Business Review, referring to the term “core competence”. They defined “core competence” as a collection of skills and competitiveness, a cumulative knowledge in an organization, and a “messy accumulation of learning” that contributed to the success of enterprise competition. Especially on how to coordinate different production skills and organically combine the knowledge of multiple technological schools, the theory of core competence focuses on competence in terms of the analysis of competitiveness, hoping to find the source of maintaining the sustainable competitive

advantage of organizations through the analysis of the unique competitiveness in the "collection of capabilities" (Campbell & Murray, 1996).

Based on the existing literature, there are mainly two kinds of understanding of the core competence of enterprises. One is the core competence based on knowledge and skills, and the other is the core competence based on operation and system.

(1) Core competence based on knowledge and skills

Definition 1: Core competence is cumulative knowledge in an organization, especially knowledge about how to coordinate different production skills and organically combine multiple technological schools (Prahalad & Hamel, 2010).

Definition 2: Core competence is the ability to learn collectively within an organization, especially with regard to coordinating different production skills and integrating multiple technologies (Hamel & Prahalad, 1994).

Definition 3: Core competence is a combination of complementary skills and knowledge within an organization, which enables one or more key businesses of the organization to become world-class (Cheng, 1996). This is the definition of core competence proposed by McKinsey & Company, a famous consulting firm. The above three definitions show that core competence is the combination of a series of complementary skills and knowledge in an organization, with the ability to make one or more key businesses first-class.

(2) Core competence based on operation and system

Definition 4: The best operation and system of a company in the industry can be called core competence (Bowman & Faulkner, 1997). It includes two kinds of capabilities: The first is the operational competence, which refers to the technical ability related to the operation of the organization in the market; the second is system competence, which mainly determines the scope of the major activities engaged in by the organization.

(3) The localization of core competence

Some Chinese researchers have localized this concept. The main points are as follows:

Definition 5: The differential competitive advantage of an enterprise lies in its core competence, which is the ability, in the process of realizing customer value, to provide customers with consumer surplus value that is superior to competitors and not easy to be imitated by competitors, and valued by customers (X. D. Wang, 2006).

Definition 6: The core competence should be unique, and it must be the ability that cannot be bought, stolen, taken away or taken apart (X. D. Wang, 2006). Chinese scholar W. Y. Zhang (2010), explained that "cannot be stolen" means that it is difficult to be imitated and copied; "cannot be bought" means that it is difficult to be traded in the market; "cannot be

taken apart" refers to complementarity; and "cannot be taken away" means that this ability is achieved by the enterprise rather than the individual.

Definition 7: Fan (2003) believes that the core competition of enterprises should be summed up in "five points". The first point is what you should have but you actually lack at present; the second point is what you have more than others; the third point is what makes you ahead of others; the fourth point is what makes you unique among others; and the fifth point is what makes you better than others. These five points refer to five core competences separately, and together they also make up a new core competence.

Definition 8: P. T. Yang and Zhu (2003) believe that the core competence can be technology, management, team, system or culture. In short, it refers to something others do not have, at least the peer enterprises do not have.

2.3 Understanding of the core competence of hospitals

The theory of core competence emerged China in the mid-1990s, which was quickly spread in the economic and management fields; and it was also accepted by acute entrepreneurs to be applied to the daily operation, strategic management and sustainable development of enterprises.

Because theories are always more slowly applied in hospital management than in enterprise management. Hospital managers did not come across the words similar to or same with "core competence" until the beginning of the 21st century, when many hospital leaders or managers still did not know much about the concept. Based on their study and understanding, Chinese scholars Lian and Xu (2008) believe that the essence of hospital core competence should be knowledge and skills, and that even if a hospital does not have an overall advantage, it can be a hospital with its own competitive advantage through one or more key technologies or special knowledge in a few fields. Foreign scholars Kakemam et al. (2021) identified seven core management competences through the study of the core management competence needed by intermediate and senior hospital managers in Iran, including evidence-based decision-making; management of business, administration, and resources; understanding of the medical environment and organization; management of interpersonal and communicative qualities, and relationships; management of leading staff and organizations; promoting and managing changes and reforms; and professionalism. Therefore, the core competence of hospital can be understood as the combination of a series of complementary skills and knowledge, with which the hospital can achieve sustainable

competitive advantage in one or more fields, and the unique ability of the hospital formed through the integration of excellent culture and medical practice when in the face of fierce competition in the medical market.

2.3.1 Characteristics of the core competence of hospitals

(1) Value

Value refers to that the core competence of hospitals can bring more, larger and superior benefits to what are valued by patients, thus contributing to significant competitive advantage to the hospital. The service object of hospital is people, and hospitals form a special group whose sacred duty is to protect and improve the health and quality of life of the people. Thus, the value realized by the core competence of hospitals has a dual nature. As far as the service object is concerned, the core competence of hospitals is patient-centered, meeting the needs of the patients as the core, and realizing the value appreciated by the patients through protecting and promoting the health of the people in the society. As far as hospitals are concerned, the core competence is of strategic value, which can create long-term competitive initiative for hospitals and increase the value of hospitals in the process of realizing value innovation (Douglas & Ryman, 2003; Dressler et al., 2006; Malmoon et al., 2020).

(2) Rarity

Rarity includes scarcity and inimitability. The core competence can become the advantage of hospital competition, first of all, because of its scarcity, which is exclusive to a certain hospital. The core competence is gradually accumulated by a hospital along a specific technological track in its long-term medical practice and business activities. It is not only highly related to the unique skills of the hospital, but also deeply affected by the hospital organization and management, market operation, hospital culture and many other aspects. As the product of the individualized development of a hospital, the core competence of the hospital has both technical and organizational characteristics, which is supported by the operation mode, system and regulations, staff quality, ability, concept and behavior of the hospital (Dressler et al., 2006).

At the same time, medical service behavior involves people’s birth, aging, sickness and death, which has a high risk and requires the use of mature technology. Many advanced, refined and cutting-edge medical technologies, which are obtained through scientific and technological innovation, rely on the continuous learning, creation, and accumulation of individuals and their integration with group knowledge, so they are not easily occupied,

transferred or imitated by others in the short term. In particular, professionals who have mastered high and new technology have a strong value-added nature, and the inherent income increment, self-accumulation, potential creativity and initiative of human capital cannot be simply imitated. Individual behavior, playing an important role in the medical process, is difficult to be as standardized as the manufacture of a material product. Besides, the trust between patients and leading talents with high comprehensive quality is also rare (Boreham et al., 2000; Chrisman, 2007).

(3) Extension

The core competence of a hospital has a strong radiation effect, which can effectively support the extension of the hospital to a new field with more vitality. The core competence of a hospital is a kind of basic ability, a solid "platform" and the leader of other abilities of the hospital, which ensures the success of a diversified development strategy of the hospital. Any medical field, as long as its required key capabilities are in line with the core competence of the hospital, it can be a new field that the hospital can expand into. Core competence is like a "skill source". Through its divergent role, the energy can be continuously extended to the final product, and continue to provide new technology services for patients. The leading discipline of a hospital can bring about the development of related disciplines. The formation of leading core technology is bound to enhance the overall competitive advantage of the hospital (Leal et al., 2018; Pillay, 2008).

(4) Dynamics

Although the core competence of a hospital has strong stability, the knowledge and skills it possesses have a certain life cycle. In other words, the core competence of a hospital is related to the growth stage of the hospital, and is closely related to the health policy, management model and hospital resource in a certain period, that is, different stages will reflect the core competence of the hospital with different contents and forms. After a certain cycle, a core competence can also be transformed into a basic ability or a general ability because of market, demand change, technological progress, market intervention and other factors. With the passage of time, the core competence of the hospital is bound to develop and evolve dynamically, and go through the stages of emergence, growth, maturity, and decline. In general, the life cycle of hospital core competence can be divided into: non-competence stage, common competence stage, primary core competence stage, mature core competence stage, core competence decline stage, and core competence rebirth stage. After the core competence is formed, it is faced with the problem of cultivation and promotion; otherwise, with the intensification of market competition and the development of science and technology, the core

competence will gradually lose its competitive advantage and become a common competence. Therefore, if hospitals want to maintain a sustainable competitive advantage, they must strive to resist the inertia for change (Defloor et al., 2006). Based on the development direction, market demand of medicine, the development trend of management and the development status of resources, the hospital resources and capabilities should be reconfigured and re-directed. The competitive advantage of the hospital should also be maintained and expanded by promoting extensive team learning through effective organization and management, continuing to develop new capabilities and implementing effective integration, timely realizing the leap of hospital core competence, and expanding the connotation and extension of hospital core competence (X. D. Wang, 2003).

The above core competence of hospitals is based on the main characteristics of the core competence summarized by Prahalad and Hamel, that is, value, rarity and extension.

2.3.2 Research on core competence of hospitals

2.3.2.1 Research on core competence of hospitals in China

The research on the core competence of hospitals in China began in 1999, when Professor Wang from the Hospital Management Teaching and Research Office of the Naval Medical University introduced the core competence theory into the teaching of hospital management. This is the earliest document that can be obtained about the research on the core competence of hospitals, so it is regarded as the starting point for the study of core competence of hospitals in China (H. Gao et al., 2009).

As for its application to hospital management, Y. Z. Zhu and Liu (2021) published an article entitled Cultivating Core Competence and Promoting Hospital Sustainable Development on the journal of Health Economics Research in 2000. This study combined core competence with hospital management, and put forward the viewpoint of cultivating hospital core competence from the perspective of fierce competition in medical market and hospital operation. It analyzed the constituent elements of the core competence of hospitals and discussed the question: how to cultivate the core competence of the hospitals? Four suggestions are made on this question.

X. D. Wang (2003) published an article “What is the Core Competence of a Hospital?” on Hospital Administration Journal of Chinese People’s Liberation Army, which elaborated on the term “core competence of a hospital”. This is early research on the core competence of a hospital, which stays in the descriptive stage without in-depth discussion and thinking.

After the early descriptive discussion, the study entered the stage of exploration and development combined with the practice of hospital management. Many scholars have put forward ideas and suggestions on the construction of hospital core competence from different angles. After the search of a large number of literatures, it is found that the research on the construction of hospital core competence is mainly focused on hospital culture construction, talent training and human resources, science and technology and other hot issues. Considering the characteristics, the connotation, and the role and influence of hospital core competence, some Chinese scholars expounded that hospital culture plays an important role in promoting hospital core competence. From then on, the construction of hospital culture has become the key to the fate of hospitals in the fierce competition of the medical market (Gong & Xu, 2004). Through the analysis and study on the basic elements and influencing factors of hospital core competence, some scholars show that hospital core competence is a research framework composed of medical quality and efficiency, hospital operation, innovation and learning ability, hospital staff satisfaction and patient satisfaction, and they believe that hospital performance management can improve the core competence of hospitals (Dressler et al., 2006).

Then, some studies respectively explained how to improve the core competence of the hospital from the perspective of constructing hospital culture system and innovating hospital culture. Tan (2011) used the balanced score card to summarize the connotation, basic characteristics and identification of hospital core competence; and from the aspects of technical research and application ability, resource utilization ability, hospital culture and management ability, they summarized the factors that affect the formation of hospital core competence. On the basis of defining hospital core competence, Wen (2010) used SWOT to analyze the current situation of a people's hospital, and put forward measures for building the hospital core competence. Peng (2012) made SWOT analysis on The First Affiliated Hospital of University of South China, summarizing the factors affecting the competitiveness of the hospital by combining AHP method and SPSS statistical method, and putting forward solutions from the aspects of culture, staff, service, and social responsibility. Starting from the three aspects of human resources input, operation, and output, J. W. Li (2009) used the methods of literature review and expert consultation to establish a comprehensive evaluation index system of hospital human resources based on core competence. He made an empirical study on the human resources of a tertiary hospital in Dalian in the past six years to verify his index system. In the research on how to enhance the core competence of the hospital in the new era, M. H. He and Zhang (2010) proposed that we should strengthen the management

innovation, improve the construction of talents, increase the medical quality, strengthen the innovation of scientific research, and enhance the construction of key disciplines and the construction of culture so as to cultivate the core competence of a hospital. X. Yang et al. (2007) established an evaluation index system from the aspects of resource acquisition ability, factor integration ability and value realization ability, and they used comprehensive scoring method, TOPSIS method and factor analysis method to evaluate the core competence of 14 medical universities. With the exploration of the construction of hospital culture in the past ten years, scholars have continuously made contributions and suggestions on the issues of what kind of hospital culture to build, how to build hospital culture and how to effectively construct and examine the core competence of hospitals.

2.3.2.2 Research on core competence of hospitals outside China

Research on core competence outside China started relatively early, and their research on hospital core competence and hospital management drew lessons from the theory and practice of enterprise management, which is consistent with their ideal in hospital management and mechanism: separation of management and operation. Thus, no matter they are for-profit or non-profit hospitals, if they want to achieve absolute competitive advantage, they must build their own core competence. In contrast to the pure theoretical research of Chinese scholars, foreign scholars use more empirical research methods and their research is more detailed, wide-scope, and in-depth. It involves how the heterogeneity of hospital management team members can support or hinder the organization, and how the links between environment, organizational culture and management strategies play a role in the sustainable development and competitive advantage of hospitals (C. X. Yang & Sun, 2010). Some scholars explored how hospital culture affects hospital performance through a survey of a non-profit hospital (Fratantuono & Sarcone, 2008). Medical Center Hospital (MCH) of Texas in the United States re-evaluated its strategic plan and market, reintroduced talents, adjusted service lines and service products, and positioned itself as the No. 3 referral center in the region. After the implementation of evidence-based strategy management, the hospital has undergone significant changes. From 2006 to 2008, the service volume increased by 19% a year, and the adjusted discipline developed into a regional leader.

Another empirical study on the relationships between information technology competitive advantage and corporate strategy, organizational structure, and organizational performance takes knowledge-intensive and manufacturing industries in Korea as research objects. The results show that the application and innovation of information technology has become an

important strategy for hospitals to gain competitive advantage and it is an important part of competitiveness (Sung, 2008). Huerta et al. (2008) used the empirical method of regression analysis to analyze the relationship between hospital efficiency and hospital quality, and tested the value orientation of the hospital. Lee et al. (2008) explored hospitals' core competence and competitive advantage by using quantitative neural network analysis to study the behavior of consumers choosing hospitals. Another study shows that Korean hospitals rely heavily on customer relationship management. It is found that five factors affect the brand equity by customer relationship, namely trust, customer satisfaction, relationship commitment, brand loyalty, and brand awareness. If hospitals manage customer relationship well, they can successfully create an image and positive brand equity (Kim et al., 2008).

With the rapid advancement of global health systems, Health Services and Policy Research (HSPR) PhD training programs have garnered increasing attention in Canada and other countries. However, current doctoral training systems remain primarily focused on academic research skills, lacking structured training in core competencies for non-academic career paths. This gap has led to challenges in competency alignment for graduates transitioning into the workforce. Bornstein et al. (2018) employed a mixed-methods research approach, integrating both qualitative and quantitative data to enhance the scientific rigor and practical applicability of their study. Through a comprehensive literature review, the study examined existing research on HSPR PhD training and core competency development, identifying gaps in competencies.

To collect firsthand data, in-depth interviews were conducted with HSPR PhD graduates (both in academic and non-academic roles), policymakers, health system leaders, industry employers, and academic mentors. Additionally, focus group discussions and surveys were organized with key stakeholders to gather feedback on the core competency framework. Finally, using the Delphi method, experts participated in multiple rounds of anonymous evaluations to refine and finalize the competency framework. The study ultimately developed an HSPR PhD core competency framework encompassing ten key competency domains: research design and methodology, data analysis and interpretation, policy analysis and application, project management, leadership and change management, interdisciplinary collaboration, health system knowledge, communication and knowledge translation, ethics and social responsibility, and career development and adaptability.

To ensure that residency training and practice meet high-quality standards, the Society of Hospital Medicine (SHM) developed the Core Competencies in Hospital Medicine: Development and Methodology framework (Dressler et al., 2006). The primary objective of

this framework is to standardize the professional competencies of hospitalists, thereby enhancing the quality and safety of inpatient care. This study adopted a systematic expert consensus approach, involving a multi-stage development and review process to establish the final hospital medicine core competency framework. Initially, SHM organized a Core Curriculum Task Force, comprising hospital medicine experts from diverse backgrounds, including academic medical centers, community hospitals, and teaching hospitals, to ensure the framework's applicability across various healthcare institutions. The task force engaged in discussions through virtual meetings and annual in-person conferences to define the preliminary direction of the framework. Following this, a comprehensive literature review was conducted to examine existing residency training standards, clinical competency assessment models, and the latest advancements in hospital medicine. Finally, surveys and interviews were administered to over 250 hospitalists and medical educators to assess their acceptance of the core competency framework and gather feedback for refinements. The study identified three primary competency domains in hospital medicine: Clinical Condition Management, Hospital-Based Procedural Skills, and Healthcare Systems Management. Each domain encompasses multiple subtopics and is structured around three key learning dimensions: knowledge, skills, and attitudes. The findings highlight that hospitalists' competency requirements extend beyond clinical expertise; they also require systems thinking, interdisciplinary collaboration, and rapid decision-making skills to effectively navigate the high-intensity inpatient care environment.

Similarly, the SHM initiated the development of the Pediatric Hospital Medicine Core Competencies to define the roles, skills, and professional requirements for pediatric hospitalists (Stucky et al., 2010). This study employed a systematic expert consensus approach, incorporating a multi-stage development and review process to establish the Pediatric Hospital Medicine Core Competencies framework. The final framework comprises four core domains and a total of 54 chapters. These four domains include: Common Clinical Diagnoses and Disease Management, Core Procedural Skills, Specialty Clinical Services, and Healthcare Systems and Quality Improvement.

2.3.3 Factors affecting the core competence of hospitals

In this study, by combing and summarizing the relevant literature on hospital core competence, it is found that the influencing factors of hospital core competence cover the following aspects:

(1) The ability to learn knowledge

Knowledge is people's understanding of natural and social phenomena and laws, including the accumulation and induction of experience, the processing or understanding of information, knowledge or science. The Organization for Economic Co-operation and Development (OECD) divides knowledge into four categories, namely factual knowledge, principal knowledge, skill knowledge and human resources (including management) knowledge. The first two kinds of knowledge belong to facts and laws, which are explicit knowledge, while the latter two kinds belong to the knowledge of skills and their applications, which are implicit knowledge. Implicit knowledge is obtained through practical activities such as learning and training and is difficult to be transferred. When knowledge is studied and applied in an organized way, it can be transformed into the learning ability of the hospital and form the basic elements of the core competence. Learning ability can continuously input new knowledge for the cultivation of hospital core competence and become the basis of the new core competence. Learning ability lies behind the formation of knowledge and is the new source of hospital core competence (Ji, 2021; Y. C. Zhang et al., 2007).

(2) Resources

Resources refer to a kind of objective existence with a certain amount of accumulation that can be used to create material and spiritual wealth in nature and human society. It includes natural resources (land, mineral, forest, ocean, and oil resources), social resources (human, economic, social relations and information resources). The resources involved in the process of forming hospital core competence include natural resources and social resources, such as material resources for production, service and research and development, hospital human resources, brands, patients, suppliers, and marketing network. When evaluating resources, we should not only evaluate the inventory resources in the balance sheet, but also assess the input process of obtaining resources, such as the cost of maintaining the leading position of products, services and technology, as well as the cost of improving the quality of employees in the future, training costs and costs in compensation system and incentive mechanism to motivate employees (Ji, 2021; C. X. Yang, 2011).

(3) Hospital culture

Hospital culture refers to the sum of values, basic beliefs and codes of conduct that are unique to the hospital and followed by most members of the hospital in the long-term survival and development, as well as their reflection in the hospital. It can also be the general name of group consciousness such as values, code of conduct, team consciousness, way of thinking, work style, psychological expectation and group belonging accepted by all members of the

hospital. Hospital culture has many characteristics, including consciousness, systematicness, cohesion, orientation, plasticity and long-term nature. Hospital culture usually consists of four layers, namely, material layer, behavioral layer, institutional layer and spiritual layer (D. Xu et al., 2008).

Hospital culture includes material culture, behavioral culture, institutional culture and spiritual culture. Material culture refers to the surface organizational culture with materials as the main manifestation, and it is the basis of spiritual layer and institutional layer of hospital culture. Those reflecting the material culture of a hospital includes the development of hospital service items, the quality of service, the reputation of service, and the material manifestation such as hospital service environment, living environment, and cultural facilities. Behavioral culture refers to the activity culture produced by hospital staff in medical practice, medical service, learning and entertainment, including hospital business activities, public relations activities, interpersonal relations activities, entertainment and sports activities. The behavioral culture of a hospital is not only the dynamic embodiment of the hospital management style, spirit and interpersonal relationship, but also the reflection of the hospital ideal and core values. Institutional culture mainly refers to the part that has a normative and binding impact on the behavior of hospitals and employees, and it is the sum of various rules and regulations, ethics and codes of conduct of employees with hospital characteristics. The institutional culture is in the middle layer of the hospital culture, which organically integrates the material culture and spiritual culture of the hospital. It embodies the requirements of the material and spiritual layers of organizational culture on members and organizational behavior. The institutional culture stipulates the code of conduct that hospital staff should abide by in the common medical service activities, including hospital leadership system, organizational structure and organizational management system. Spiritual culture is the psychological set and value orientation of the staff formed in the long-term practice and it is the sum and generalization of the morality and values of the hospital, that is, the philosophy of the hospital. It is the basic belief, value standard, professional ethics and spiritual outlook jointly upheld by the leaders and members of the hospital, which reflects the common pursuit and common understanding of all staff. The spiritual culture of a hospital is the core of hospital values, the crystallization of the fine tradition of the hospital, the spiritual pillar to maintain the survival and development of the hospital, and the core and soul of the hospital culture (C. X. Yang, 2011).

Spiritual culture affects the orientation and value direction of hospital core competence, while institutional culture and behavioral culture are the guarantee for the realization of

spiritual culture and hospital core competence (C. X. Yang, 2011). Some scholars have found that institutional pressure has a negative impact on hospital employees' work motivation and work performance. The relationship between institutional pressure and job performance of employees without management responsibility plays an intermediary role in achieving incentive resource autonomy, ability development and social support. In the leadership team, incentive resources play a complete intermediary role between institutional stress and job performance (Bjaalid et al., 2019).

(4) Management ability

Ability is the force of the social subject, while resources are the object and product of the social subject. From an economic point of view, ability refers to the force that an individual or organization has that can turn one resource into another resource or social wealth. The formation of core competence requires the integration of all kinds of skills, technology, knowledge and resources, and the process of resource integration is essentially the working process of management ability. The essence of integration is to enhance the coordination among the elements of core competence through intervention management, and to realize the multiplication and amplification of the functions of each element. On the basis of previous studies on hospital management competence, Walsh et al. (2020) proposed that competence classification (knowledge, skills, capabilities and attitudes, anything that leads to provable effective performance) can be used as a basis for determining the requirements of hospital management competence. Pihlainen et al. (2016) believe that competence can be assessed by knowledge, skills, attitudes and capacities required for management and leadership. Gunawan et al. (2020) believe that management ability is related to five factors, that is, performance evaluation, career development, recruitment and selection, larger hospital scale, and attendance rate of management training. Therefore, the evaluation of management ability should fully reflect the coordination of the elements of hospital core competence and its outputs in different stages.

Hospital resources and capacities determine the competence of a hospital, and competence is the combination of capacities and resources, which depend on each other and can be transformed into the other (Valdmanis et al., 2010). Excellent talents and human resources are the key factors that determine the competence of hospitals. Human resources are the symbiosis of resources and capacities. On the one hand, as the labor force, operators, technicians and employees have the nature of resources; on the other hand, they are the basic carriers of business ability, because the knowledge and skills of operators, technicians and employees are the main component of hospital capacity. The mutual transformation of

resources and capacities is shown as follows: investment on human resources at the cost of consuming resources can improve people's capacity, and knowledge can be digested into human capacity through training. Capacity can also be transformed into resources. For example, resources can be transferred among people through knowledge products such as design, works, and institutions. Resources can directly replace human capacity in some aspects, such as using machines instead of manpower for repetitive and simple manual work, and using computers instead of human brains for program analysis and operation. Capacities can also directly form, develop and amplify resources, such as patents of human innovative inventions that directly constitute important resources for organizations or hospitals. Hospital competence is determined by both capacities and resources; however, it is not resources but capacities that determine the sustainable development of the organization. With different capacities, the wealth created will be greatly different even with the same resource consumption, so human capacity is the most valuable wealth of the organization. The resources that are constantly transformed into capacities constitute the core resources of the hospital. Therefore, the use of the existing resources of the hospital should serve for the forming of hospital core competence (Hadji et al., 2014; Hasan et al., 2023).

2.4 Research in and beyond China

Infectious diseases have features of contagiousness, prevalence, and endemicity (L. Wang et al., 2021), and are a major burden for the public health and economic stability of the world, threatening human life and health, and are one of the major public health problems in today's society (Y. P. Chen, 2018). The prevention and control of infectious disease is an important part of public health work, which is directly related to social development and people's health, and is also an important indicator for evaluating the socio-economic development and health care services in a country or region (Ding, 2009). In recent years, there are more and more outbreaks of EID due to global warming, ecological changes, accelerated urbanization, and genetic mutations of pathogenic microorganisms. In March 2020, the World Health Organization declared an outbreak of COVID-19, an infectious disease caused by SARS-CoV-2, as a pandemic. This pandemic has affected the investments in structures, equipment acquisition, personal protective equipment, and human resources by many medical institutions. Therefore, decisive measures must be taken to mitigate its effects in order to better manage performance and respond quickly to the communities suffering from this pandemic. As the healthcare sector develops, the role of managers is becoming more

important and more focused on managing the needs of the population (Marques et al., 2021). General hospitals have always been important medical institutions for the prevention, reporting, treatment, and control of infectious diseases in China, which can detect the outbreak of infectious diseases at an early stage and are always at the forefront of clinical treatment. Moreover, as an important part of epidemic prevention in the public health system, general hospitals occupy an outpost in the monitoring of EIDs and undertake the major task of emergency medical treatment, making the prevention and control of nosocomial infection particularly important and necessary.

The functions of medical institutions in infectious disease prevention and control mainly include infectious disease surveillance, infectious disease treatment, infection control, and preventive services (Gong, 2010), which are the top priority in the entire work of public health and epidemic prevention, and are related to the success of infectious disease prevention and control (H. Zhang et al., 2007; Y. C. Zhang et al., 2007).

However, with market economy bearing the brunt, the government has put more efforts into economic development, resulting in the lagging development of China's public health in recent years, unsound response mechanisms, deficient information monitoring and reporting networks, insufficient emergency curing capacity, and weaknesses in disease prevention and control, with one of the more prominent problems being the limited capacity of emergency curing and prevention and control of infectious disease of medical institutions, which led to a series of problems in IPC that were exposed in the early stage of the COVID-19 outbreak (Min et al., 2021). While classical infectious diseases around the world are not yet fully under control, new ones keep emerging, with cholera, yellow fever and meningococcal disease reoccurring in the late twentieth century, SARS emerging in 2003, avian influenza in 2004, A/H1N1 flu in 2009, Middle East respiratory syndrome in 2012, Ebola in 2014, and COVID-19 in 2019, which have caused panic among people in various countries, sounded the alarm about our health system and posed new challenges to traditional surveillance, prevention and control measures. As a country with a high incidence of infectious disease, Chinese governments at all levels have accelerated the construction of a public health system, and increased their investments in public health, now initially forming a system of infectious disease prevention and control combining general hospitals, hospitals for infectious disease, wards (departments) of infectious disease in general hospitals, centers for the prevention and treatment of infectious disease, township hospitals and pre-hospital first aid institutions (Long, 2010). However, we still face some important issues as to how is the exact capacity of the infectious disease prevention and control system of medical institutions in China, whether it

has brought the desired results, and what problems and weaknesses still exist in the system that need to be solved and strengthened. To solve these problems, we must establish a set of scientific and reasonable evaluation index systems to evaluate the capacity of medical institutions in the prevent and control of infectious diseases. Through literature review, we found that at present, there are few detailed and complete index systems at home and abroad for evaluating the capacity of infectious disease prevention and control of medical institutions, and their capacity can only be understood preliminarily but cannot be evaluated and judged explicitly.

2.4.1 Status quo of the evaluation index system of infectious disease prevention and control capacity of foreign medical institutions

Foreign research on the index system for evaluating the capacity of infectious disease prevention and control of medical institutions mainly focuses on evaluating medical institutions' capacity of response to public health emergencies, and is mainly conducted in the United States (X. T. Li et al., 2007). Most scholars have studied the emergency response capacity of foreign hospitals based on the Hospital Capability Assessment for Readiness (HCAR) compiled by the Healthcare Association of Hawaii which consists of eight elements: leadership, the capacity of hazard identification, and analytical control, emergency response plans, the capacity of command and control and coordination, communication systems, resource management, logistics and equipment, training and drills, and performance improvement (Wen et al., 2008).

In 2001, WHO issued The Protocol for the Assessment of National Communicable Disease Surveillance and Response Systems, which called for its member states to conduct an assessment of their respective monitoring system of infectious diseases. The document mainly categorizes the indicators into monitoring and evaluation indicators, and subdivides the indicators into five categories: input indicators, process indicators, output indicators, outcome indicators, and impact indicators according to the logical framework. Including: 1 Priority diseases; 2 Monitoring structure; 3 Monitoring processes and capacity for surveillance and response; 4 Output evaluation; 5 Comprehensive evaluation; 6 Laboratories; 7 Geographical situation; 8 Communication system, a total of 8 aspects and 1.1 Whether the surveillance system has the capacity of monitoring priority diseases; 2.1 Structure of the surveillance organization and response system; 2.2 Comparison of resource inputs, description of interrelationships, and discussion of different levels of surveillance organizations; 3.1

Processes of information transfer and related records; 3.2 The capacity of surveillance for priority or other diseases; 3.3 Surveillance items:3.3.1 Related cases and outbreaks; 3.3.2 Registration; 3.3.3 Epidemiological and laboratory confirmation; 3.3.4 Reporting (early warning and routine); 3.3.5 Analysis and interpretation; 3.3.6 Effectiveness; 3.3.7 Information feedback; 3.3.8 Determination of evaluation criteria; 3.3.9 Training (surveillance capacity, epidemiology, laboratories); 3.3.10 Supervision and management; 3.3.11 Information exchange system; 3.3.12 Resources (human, material, laboratory equipment), a total of 20 evaluation indicators, which were developed by a professional evaluation team based on the notable simplicity, flexibility, applicability, sensitivity, and predictability that a surveillance and response system for infectious diseases should have (S. Z. Zhang & Wang, 2017). In 2004, based on this, WHO summarized a framework for the supervision and evaluation of national surveillance and response systems for infectious disease, stating that the overall evaluation of a national surveillance system for infectious disease should include the significance of public health to monitor diseases, and the structure, features, core and auxiliary functions of the surveillance system. In 2006, WHO issued The Communicable Disease Surveillance and Response Systems: Guide to Monitoring and Evaluating, elaborating on the various aspects and the alternative indicators involved in the framework above.

The eight aspects covered by the Hospital Capability Assessment for Readiness (HCAR) compiled by the Healthcare Association of Hawaii evaluate the emergency response capacity of hospitals for public health emergencies more comprehensively, but further improvement and refinement of the indicators is needed if hospitals are to be evaluated in terms of their capacity to prevent and control public health emergencies. Infectious diseases are different from other public health emergencies in that their patients and carriers have the characteristics of spreading the disease, and the prevention and control measures taken by medical institutions are different from that for other general public health emergencies. In this case, if the questionnaire used for evaluating the capacities of infectious disease prevention and control of medical institutions lacks practicability, comprehensive and effective analysis results will not come up. The Protocol for the Assessment of National Communicable Disease Surveillance and Response Systems issued by WHO shows practicability in terms of its logical framework and categorization of indicators, which is more applicable, predictable, and effective for regional or national infectious disease surveillance systems as it emphasizes the importance of evaluating the function of the surveillance system, and pays more attention to the resource input and return of the infectious disease prevention and control system.

2.4.2 Status quo of the evaluation index system of infectious disease prevention and control capacity of medical institutions in China

At present, the studies on the prevention and control of infectious diseases in China's medical institutions are still inadequate, and mainly focused on the evaluation of a certain aspect of infectious disease prevention and control in general hospitals and individual medical institutions in large cities, such as the evaluation of infectious disease monitoring and early warning capacity, and the evaluation of the quality of notifiable communicable disease reporting. There are relatively less studies on township hospitals and community service stations, mainly focusing on the current situation of health, performance, human resources, and the current situation of infectious disease prevention and control. Viewing from related literature, there are no uniform indicators in China for the comprehensive evaluation of the capacity of medical institutions in the prevention and control of infectious diseases.

There are relatively less studies related to the evaluation of infectious disease prevention and control capacity of general hospitals in China. Ding, in his study of infectious disease prevention and control capacity of general hospitals, mainly focuses on the evaluation of the infectious disease prevention and control capacity of second and tertiary general hospitals, and the evaluation indicators developed are the most comprehensive, which are divided into two parts: one is the evaluation of the current status of the indicators of infectious disease prevention and control, which include the departments of infectious diseases, the settings of wards for infectious disease, personal protective equipment, detection and reporting of infectious diseases, management systems, nosocomial infection inspection and management, laboratory biosafety management in general hospitals, personnel training and drill, a total of 8 aspects and 48 specific indicators; the other is the indicators of the risk of nosocomial transmission of infectious diseases, including the wards for infectious disease, respiratory (fever) outpatient clinics, pediatric departments, transfusion rooms at outpatient departments, intestinal outpatient clinics and wards, endoscopy rooms, operating rooms, stomatological department, biological specimen collection and testing, provision of hand-washing equipment in the hospital, and disposal of wastes, a total of 11 aspects and 81 specific indicators, which is relatively substantial in content with specific indicators (Ding, 2009).

The evaluative research of the capacity of infectious disease prevention and control of medical institutions in China is still in the exploratory stage, and the evaluation indicators of most studies are established by different researchers, with no unified index system and scoring standard, and all of them have some problems to various degrees and in different

aspects. Ding's study mainly focuses on general hospitals, whose evaluation indicators are wide-ranging, detailed, and clear in their roles, and are divided into two parts: the current situation of prevention and control and the risk of transmission. So that the results of the study can be discussed in a stratified manner, which helps identify the weaknesses and loopholes in the prevention and control of infectious diseases in general hospitals, so as to implement remedial measures quickly and effectively, and improve the capacity of preventing and controlling infectious diseases. However, other indicators such as the population of the area where the investigated hospitals are located, the radius of hospital services, service items, testing items, and the cooperation between medical institutions and district/county centers for disease control and prevention in the reporting of epidemic outbreak are not involved in the evaluation index system (Ding, 2009), so the evaluation indicators are not comprehensive enough. In the study, if the distribution, service radius, service items, and monitoring items of medical institutions in each region are learned, the population and demographic characteristics of the region can be comprehensively and systematically analyzed, and existing resources can be reasonably utilized to formulate a low-input, high-return program, which will not only improve the capacity of infectious disease prevention and control, but also improve its efficiency. In conclusion, most of the research indicators of the capacity of infectious disease prevention and control of medical institutions in China are not comprehensive enough, only analyzing the specific situation of one or several indicators, and the indicators lack stratification, independence, completeness, representativeness, and practicality.

2.5 Literature overview

Whether it is the SARS epidemic that first appeared in Guangdong in 2003 or the ongoing COVID-19 pandemic, hospitals have played an important role in IPC and control, but some shortcomings have inevitably been exposed:

(1) The irrationality and irregularity of the layout of hospital buildings: some new or reconstructed hospitals compressed the auxiliary area at the early stage of design, which caused the mixing of human flow and logistics, the disorder of clean-dirt partition, and the mixed flow of doctors and patients in the face of the sudden COVID-19 pandemic. Once a department receives patients with infectious diseases, in order to avoid cross-infection, the whole hospital has to stop or partially stop outpatient (emergency) or inpatient admissions, thus disrupting the original medical order.

(2) Malfunction of the departments of infectious diseases. Due to the changes in the spectrum of diseases, people are currently facing more chronic non-communicable diseases such as high blood pressure, diabetes, cardiovascular and cerebrovascular diseases, and tumors, leading to decreased alertness and attention to infectious diseases, which is evidenced in the gradual decrease in the number and size of infectious disease hospitals, the reduction of financial support by the government, and the continuous reduction in the number of beds in the departments of infectious diseases and the ratios of medical and nursing staff.

(3) Unreasonable settings of infectious disease departments. After the SARS outbreak, China has gradually focused on the establishment of infectious disease departments. The Administrative Measures for Pre-screening and Triage of Infectious Diseases in Medical Institutions requires that second-level general hospitals or above should set up departments of infectious diseases or infectious disease triage sites (L. Wang et al., 2021). However, some general hospitals still have not set up such departments accordingly, and even if they have set up such departments, their architectural layouts do not have the conditions to receive and treat patients with respiratory infectious diseases. At the same time, some hospitals have established fever clinics, but because of their low utilization rates, they are often left unused and fail to play a role in pre-screening and triage.

(4) An emergency plan is merely a formality. Hospitals usually have emergency plans to deal with various emergencies, however, since emergency drills are usually scripted practices, the people involved in the drills fail to truly understand the purpose of the drill. In this case, the implementation of the emergency plan is merely a formality.

(5) Hospitals do not pay enough attention to the infection-control department. Not setting an independent nosocomial infection-control management department, to a certain extent, weakens a hospital's strength of nosocomial infection control, which is not conducive to the related work. The scope of nosocomial infection control has been expanded due to a series of reasons, such as an unreasonable number and structural allocation of personnel, the abuse of antimicrobial drugs, the prevalence of multidrug-resistant bacteria, and the prevention and control of various infectious diseases, and there is an urgent need for the nosocomial infection-control department to absorb talents in pharmacy, testing, public health, and even management, in order to optimize its personnel structure. The performance of the nosocomial infection-control department directly affects the level of nosocomial infection control of the hospital (Q. Li et al., 2020).

(6) Nosocomial infection control involves a wide range of factors (Jenkins, 2017). Epidemic prevention and control involve a series of hospital departments such as clinical and

medical technologies, nursing, general affairs, logistics, management, bidding and purchasing, information, and medical records (Khan et al., 2015). For example, if the general affairs and the logistics departments do not cooperate well, it may result in renovation projects that do not meet the procedural standards and protocols, and non-standardized cleaning and disinfection of surroundings and object surfaces. The bidding and purchasing departments may lead to delayed supply of materials if they cannot simplify the bidding and purchasing process. The Internet of Things and online diagnosis during the period of epidemic control need the support of the information department, and the flow of paper medical records needs the timely development of response procedures by the health record management department (Menegueti et al., 2015).

In summary, in the context of the COVID-19 pandemic, based on the resource-based view, capacity theory, core capacity theory, and dynamic capacity theory in management studies as well as the interrelation between resources and competence, the study aims at the problems of hospital management and the capacity of prevention and control during the COVID-19 pandemic, and seeks to improve the core capacity of tertiary general hospitals, and probe into the factors affecting their core capacity of disease prevention and control. This study establishes the indicators of the core capacity of disease prevention and control of hospitals from four aspects: the ability to learn knowledge, the ability to utilize resources, hospital management system and management capacity, so as to improve the competence of hospital managers and the overall prevention and control capacities of hospitals.

2.6 Shortcomings of current research

EIDs have a wide variety of pathogens, different modes of transmission, and complex and variable forms of infection, which are likely to cause cross-regional, cross-border, trans-continental, and even global pandemics, such as SARS, H1N1, H5N1, Ebola, MERS, and COVID-19. The detection, diagnosis, treatment, and reporting of EIDs are done by hospitals (or simultaneously assisted by the CDC). The discovery of an infectious disease as an indicator case (the earliest case detected and reported, also known as patient zero) is generally reported as a suspected case or a case of fever of unknown origin until the diagnosis is confirmed, and samples are taken for further testing and confirmation.

2.6 Research gap

Identifying gaps in existing research is critical for advancing knowledge and addressing unexplored or under-researched areas. Based on the current literature, several gaps can be

delineated within the realm of dynamic capabilities theory application in healthcare, particularly in managing infectious diseases:

(1) Limited application of DCT in healthcare

While DCT has been extensively applied in areas like business management, technological innovation, and supply chain management, its use in healthcare, particularly in managing EIDs, remains sparse. Most existing studies within healthcare focus on general performance metrics, competitiveness, or innovation capabilities of hospitals. There is a notable scarcity of research specifically addressing dynamic capabilities in response to specific public health events like EIDs control.

(2) Evaluation of the Current Status of Infectious Disease Prevention and Control Capability Assessment Systems in Healthcare Institutions

Currently, the evaluation systems for infectious disease prevention and control capabilities in healthcare institutions are primarily based on standards set by international and national public health organizations, such as the National Health Commission (NHC), the World Health Organization (WHO), and the Centers for Disease Control and Prevention (CDC). These standards are adapted to align with the specific circumstances of different countries and are mainly used to assess the fundamental prevention and control capacities of hospitals, such as ICU equipment availability and nurse-to-patient ratios.

Existing competency models in the medical field primarily define the core competencies required for healthcare professionals throughout their careers to ensure medical quality and patient safety. These models are widely applied in medical education and hospital accreditation processes. However, most existing competency models are static in nature, lacking mechanisms for dynamic adjustments. Furthermore, they fail to account for the dynamic adaptation capabilities, resource optimization abilities, and cross-departmental collaboration competencies required by tertiary comprehensive hospitals in responding to infectious disease outbreaks.

(3) Lack of empirical analysis on tertiary comprehensive hospitals

While much research focuses on general or specialty hospitals, systematic studies on the role of tertiary comprehensive hospitals in controlling EIDs are scarce. Given their unique capabilities in resource integration, policy implementation, and cross-departmental cooperation, tertiary comprehensive hospitals play an irreplaceable role in infectious disease control systems. Researching the impact of dynamic capabilities in these hospitals on infectious disease control can not only fill theoretical gaps but also provide empirical support for future public health emergency management.

(4) Methodological limitations in existing research

Current studies often employ qualitative approaches like case studies, interviews, or policy analyses, which, while useful for understanding hospital operations, lack quantitative validation of the specific impact of dynamic capabilities on control outcomes in tertiary comprehensive hospitals. There is a dearth of research utilizing quantitative methodologies such as structural equation modeling (SEM) or hierarchical regression analysis (HRA) to measure the relationship between dynamic capabilities and performance outcomes in these settings.

Addressing these gaps could significantly enhance the theoretical and practical understanding of dynamic capabilities in healthcare, particularly in how tertiary comprehensive hospitals manage and control infectious diseases. It would also provide a more nuanced view of how these capabilities can be strategically enhanced to improve health outcomes during public health crises.

2.7 Chapter summary

This chapter presents a comprehensive literature review focused on core capabilities, hospital core capability building, and their role in infectious disease control, exploring the application and research gaps of Resource-Based Theory (RBT) and Dynamic Capabilities Theory (DCT) in healthcare institutions, particularly in tertiary comprehensive hospitals.

Initially, the chapter defines the concepts of core capabilities and hospital core capabilities, clarifying their critical role in hospital management, especially in responding to sudden public health events. It also reviews domestic and international research related to hospital infection control, core capability theory, and hospital management capability building, cataloging the current state of research on the core capabilities for infection control in tertiary comprehensive hospitals.

Furthermore, the chapter analyzes the characteristics of tertiary comprehensive hospitals, including their unique capabilities in resource integration, policy implementation, and cross-departmental collaboration. It discusses the construction of hospital infection management institutions. Simultaneously, by integrating Resource-Based Theory (RBT), Dynamic Capabilities Theory (DCT), and core competency theory, the chapter explores the key factors influencing the building of capabilities for infectious disease control in hospitals and analyzes the limitations of existing research. The findings indicate that although dynamic capabilities theory has been widely applied in business management and technological

innovation, its application in the healthcare sector, especially in the field of EID control, remains limited. Current research predominantly focuses on overall hospital performance, technological innovation, and medical supply chain management, with scant studies on how hospitals dynamically adapt to sudden epidemics, optimize resource allocation, and improve emergency management efficiency.

Chapter 3: Research Methods and Design

In this chapter, we detail the methodological framework adopted for this study, which combines qualitative and quantitative research methods aimed at comprehensively assessing the core capabilities of tertiary comprehensive hospitals in controlling emerging infectious diseases (EIDs). This approach is intended to ensure the reliability and depth of the research results, thereby providing scientific and practical recommendations for hospital prevention and control strategies.

The choice to combine qualitative and quantitative methods is driven by the intention to utilize the strengths of each to enhance the rigor and breadth of the study. Qualitative methods enable an in-depth exploration and understanding of complex social phenomena, revealing the deeper meanings and motivations behind the data; quantitative methods provide quantifiable results through numerical analysis, making the research findings more objective and universally applicable. By employing this mixed-methodology, this thesis is able to comprehensively assess and enhance the hospital's infectious disease control strategies from both theoretical and practical perspectives.

3.1 Semi-structured interviews

The interview method, a common and widely used qualitative data collection method, holds unique importance. It typically involves a purposeful conversation where the researcher interacts directly with the respondent to gather insights, understanding, and perceptions regarding a specific topic, event, or behavior. Interviews can be structured, semi-structured, or unstructured, each with its distinct process and characteristics (Fontana & Frey, 2005; Kallio et al., 2016):

Structured interviews are the most standardized form of interviewing, where the sequence and manner of questioning, as well as the way responses are recorded, are strictly uniform across all respondents. The interviewer dominates the process, typically following a pre-determined outline. This interview form is highly standardized and orderly, ensuring consistency and comparability of information gathered (Alshenqeeti, 2014).

Semi-structured interviews represent a compromise between structured and unstructured interviews. Compared to structured interviews, semi-structured interviews are more flexible.

In this method, researchers have pre-designed key themes and questions around which questions are asked, but they can also adjust the order of questions or probe further based on respondents' answers during the interview. The manner of responding and the way interviews are documented are not strictly prescribed, providing more freedom in the interview process and enabling a deeper revelation of respondents' views and experiences (Galletta & Cross, 2013).

Unstructured interviews are the most free-form type of interviewing. Unlike the other two types, unstructured interviews do away with a fixed question order and standardized processes, allowing the researcher to freely interact with the respondent around everyday topics. This method's advantage is that it can maximally stimulate respondents' expression and creativity, with researchers able to adjust questions or delve deeper based on the progression of the conversation, thereby uncovering richer information (Chauhan, 2022).

To obtain sufficient data and engage in-depth with respondents to ensure the applicability of the evaluation system, this study employed the most commonly used semi-structured interview method. We selected two experts in hospital infection control and management, one expert in health supervision, and one expert in infectious disease monitoring and control, conducting semi-structured face-to-face interviews with these four experts. Respondent information is presented in Table 3.1.

Table 3.1 Interviewees' information

Hospital	Department	Gender	Age	Years of Experience	Education Level	Professional Title	Specialty
Guangdong Provincial People's Hospital	Infection Control and Management	Female	37	12.5	Master's Degree	Associate Senior	Deputy Chief Physician
The Second People's Hospital of Guangdong Province	Infection Control and Management	Male	42	19	Master's Degree	Senior	Chief Physician
Guangdong Maternal and Child Health Hospital	Medical Health Supervision	Female	35	3	Master's Degree	Intermediate	Public Health Physician
The Fifth Affiliated Hospital of Guangzhou Medical University	Infectious Disease Monitoring and Control	Female	55	20	Master's Degree	Associate Senior	Public Health

The interview outline for assessing the core capabilities of tertiary comprehensive hospitals in managing EIDs is structured to cover several key areas:

1. Assessment of Core Capabilities: Interviewees are asked about their personal work experiences to evaluate the core capabilities of tertiary comprehensive hospitals in controlling EIDs. They are prompted to discuss both the highlights and areas needing improvement in prevention measures, institutional construction, and management.

2. Measures for Improvement: The discussion includes questions about the key measures needed to address identified deficiencies. Interviewees are asked if there is a need to strengthen aspects such as policy systems, organizational management, or the allocation of health resources like human, financial, material, and information resources.

3. Components of Core Capabilities: Experts are queried about what they consider to be the components of the core capabilities for controlling EIDs in these hospitals.

4. Factors Influencing Core Capabilities: The interview seeks to identify the factors that influence the core capabilities of tertiary comprehensive hospitals in managing EIDs and to determine which of these factors are most critical.

5. Evaluation of Core Capabilities: Experts are asked how they would evaluate the core capabilities for disease control and what challenges they face in the evaluation process, including considerations about evaluators, subjects, tools, and dimensions.

Before starting the interview, the purpose is clearly communicated to the experts, and their informed consent is obtained. The interviews are conducted one-on-one in a relaxed and pleasant atmosphere to encourage open and honest communication. Throughout the interview, emphasis is placed on carefully listening to the experts' responses, and any unclear aspects are discussed promptly for clarification. Each interview is planned to last approximately 60 minutes, with immediate transcription done post-interview. The content is then verified with the interviewee to ensure accuracy and reliability of the information gathered.

3.2 Delphi method

The Delphi method is a scientific tool that extends systematic analysis methods to the domains of cognition and value judgment. Unlike traditional quantitative analysis methods, the Delphi method breaks through the limitations of relying solely on data statistics, providing new pathways and methodological support for more scientific and rational decision-making processes. This method is characterized by its anonymity, iterative rounds of feedback, and the combination of quantitative and qualitative analysis (Linstone & Turoff, 1975).

Originally developed by the RAND Corporation in collaboration with the Douglas Company during a research project, the Delphi method aims to provide reliable decision support in areas characterized by high uncertainty and insufficient data. Unlike traditional expert meetings or panel discussions, the Delphi method employs an anonymous feedback mechanism to prevent the influence of one expert over another, thus enhancing the independence of opinions and the scientific nature of decision-making. The process typically involves multiple rounds of surveys (Vernon, 2009). Each round collects expert opinions which are then summarized and statistically analyzed to compile representative reference materials. Researchers then design a new round of survey questionnaires based on feedback from the previous round, soliciting further judgments and suggestions from experts. As the process advances, expert opinions converge, ultimately leading to robust conclusions (Okoli & Pawlowski, 2004).

Due to its anonymity, expertise, feedback mechanism, and statistical inference, the Delphi method is widely utilized. In practice, the Delphi method continues to evolve to enhance efficiency and reduce time costs. For instance, researchers often use the results of literature reviews or initial expert interviews to design more targeted structured questionnaires for the first round, replacing traditional open-ended questionnaires. This adjustment significantly reduces the number of iterations and shortens the research period. The consultation process can be concluded as soon as expert opinions converge in a given round (Rowe & Wright, 2001).

3.2.1 Expert selection criteria

To ensure that the study could effectively and accurately gather expert opinions, the following criteria were established for selecting experts:

1. Expertise in Hospital Management: Experts should be individuals in charge of management at tertiary comprehensive hospitals and possess extensive experience in their field.

2. Academic Depth in Infectious Disease Control: Alternatively, experts could be scholars with profound academic achievements in the field of hospital infectious disease control, holding positions as researchers or professors.

3. Educational Qualifications: Experts should have at least a bachelor's degree level of education.

4. Experience: Experts are required to have a minimum of 10 years of relevant

professional experience.

5. Commitment: Experts must voluntarily participate and commit to engaging in multiple rounds of consultations.

During the expert selection process, 20 highly authoritative and credible experts in relevant fields were chosen based on the aforementioned criteria. These experts were contacted via email to inquire about their willingness to participate, and all expressed eagerness to engage not only in the initial expert consultation but also in a second round of consultations, actively participating throughout the entire process. After two rounds of expert consultations, a consensus was gradually reached, completing the expert consultation phase. Questionnaires were distributed to all 20 experts in both rounds, and all were retrieved, achieving a 100% response rate. This high response rate, indicating an expert coefficient of 1, underscores the significant level of attention and participation these experts dedicated to this research.

The 20 experts who participated in this consultation came from various institutions, with the majority (13 individuals) from tertiary hospitals. Others were from disease control centers (5 people), research institutes (1 person), and universities (1 person). Regarding professional titles, 13 experts held senior titles (including professors, chief physicians, researchers), 3 had associate senior titles, and 4 held intermediate titles. The majority of the experts had master's or doctoral degrees, and the age group of 40-49 years accounted for 75% of participants. All had more than 10 years of work experience. These factors significantly ensured the reliability and scientific validity of the evaluation outcomes. Specific details can be seen in Table 3.2.

Table 3.2 Expert basic information

Item	Category	Frequency	Proportion
Gender	Male	11	55
	Female	9	45
Age	30-39	3	15
	40-49	15	75
	＞60	2	10
Professional Titles	Senior	13	65
	Associate Senior	3	15
	Intermediate	4	20
Education Level	Bachelor's degree	7	35
	Graduate/Master's degree	7	35
	PhD	6	30
Years of Experience	10-20	13	65
	20-30	4	20
	＞30	3	15
Field of Specialization	Health Management	6	30
	Clinical Medicine	5	25
	Public Health	9	45

3.2.2 Design of the Delphi

The Expert Delphi Questionnaire is meticulously designed to gather precise and comprehensive insights from experts in the field. The main contents of the questionnaire include:

1. Instructions: This section introduces the purpose of the research, its significance, and provides detailed instructions on how to fill out the questionnaire, including any special considerations to keep in mind.

2. Core Capability Indicators: This part of the questionnaire lists primary, secondary, and tertiary indicators for evaluating core capabilities in infectious disease control at tertiary comprehensive hospitals. Experts are asked to score each indicator based on its importance and feasibility using a 5-point Likert scale, where 1 denotes “not important” and 5 denotes “very important” (Jebb et al., 2021). Experts may also provide comments on each indicator in the provided opinion column.

3. Basis for Scores: Experts are requested to justify their scores for the importance and feasibility of each indicator. The justifications should be grounded in theoretical analysis, practical experience, referenced literature, and intuitive judgment. Experts self-assess their inputs based on these four aspects, assigning values to reflect the degree of influence each aspect has on their scoring (Okoli & Pawlowski, 2004; Turoff & Linstone, 2002).

4. Familiarity with Indicator Content: Experts assess their own familiarity with the indicator content across five levels of familiarity, assigning values to each level (Vernon, 2009).

5. Expert Basic Information: This section collects fundamental demographic and professional information about the experts, including gender, age, educational level, years of professional experience, and area of expertise.

3.2.3 Process

The study involves the distribution and collection of the Delphi Questionnaire via email, conducted in two rounds to ensure thoroughness and accuracy. After analyzing the results from the first round of questionnaires and considering the opinions and suggestions from the experts, the research team discusses and makes necessary adjustments to certain indicators for the second round. The second round of the questionnaire also provides feedback on the results from the first round and seeks further opinions and suggestions from the experts. The Delphi process is concluded once a consensus among the expert opinions is reached, ensuring that the

results are scientifically robust and reliable. This iterative process helps refine the evaluation framework and contributes significantly to the development of a validated set of indicators for assessing core capabilities in infectious disease control at tertiary comprehensive hospitals.

3.2.4 Evaluation system and expert opinion assessment method

This study utilized Excel for data entry and SPSS 24.0 for data processing and statistical analysis. In the Delphi method, a well-structured evaluation system is essential to accurately measure expert opinions across different dimensions. To ensure scientific rigor and objectivity, multiple evaluation indicators were employed, as detailed in Table 3.3.

Table 3.3 Delphi method expert opinion assessment method

Evaluation Dimension	Evaluation Indicators
Expert Participation	Response Rate (%)
Expert Authority	Authority Coefficient (Cr)
Degree of Recognition	Indicator Importance: Mean Score
	High Degree of Recognition: Full Mark Rate (K)
Expert Consensus	Score Dispersion: Coefficient of Variation (Cv)
	Ranking Consensus: Kendall's W Coordination Coefficient

3.2.4.1 Expert participation enthusiasm

This study utilized the response rate of the expert consultation questionnaire as a key indicator to measure expert participation. In Delphi studies, response rate is widely recognized as an essential metric for assessing expert engagement. A higher response rate (generally recommended to be $\geqslant$70%) strengthens the representativeness of the study's conclusions, thereby enhancing its scientific validity and reliability (Keeney et al., 2006).

Furthermore, response rate also reflects experts' level of interest and commitment to the research topic, as well as their willingness to engage and collaborate in the study. A high response rate often suggests that experts in the field find the research topic highly relevant and are motivated to contribute their professional insights (Dalkey & Helmer, 1963). Additionally, expert participation rate serves as an indicator of the study's practical significance and applicability—a higher response rate implies that experts recognize the study's relevance to their academic or professional domain and are more inclined to contribute to research closely related to their field of expertise.

3.2.4.2 Expert authority

Expert authority reflects the professional expertise and influence of experts within a specific research domain. The authority coefficient (Cr) serves as a quantitative measure of expert authority (Keeney et al., 2006) and is determined by two key factors: the judgment coefficient

(Ca) and the familiarity coefficient (Cs). The calculation is shown in Formula 3.1.

$$\mathbf{Cr=(Ca+Cs)/2} \quad (3.1)$$

Judgment Coefficient (Ca): This coefficient assesses the extent to which an expert's evaluations are based on theoretical foundations, practical experience, domestic and international literature, and personal intuition. Experts assign ratings to indicators based on these criteria. The degree of influence of each rating criterion is typically classified into three levels: low, moderate, and high (Hsu & Sandford, 2007).

Familiarity Coefficient (Cs): This coefficient evaluates the expert's level of familiarity with specific research domains, including hospital infection control capability, hospital infection risk prediction capability, infection control knowledge and skills training capability, organizational coordination capability, and infection control professional development capability. Familiarity levels are generally categorized into five levels, ranging from "not familiar" to "very familiar" (Hsu & Sandford, 2007).

The Ca and Cs values are determined based on the cumulative self-assessment scores and their arithmetic mean, ultimately yielding the Cr value. Typically, a Cr value of ≥ 0.7 is considered an acceptable threshold, indicating that the expert possesses a sufficient level of authority in the field.

3.2.4.3 Expert recognition

This study evaluates expert recognition of the proposed indicators from two dimensions: indicator importance and high degree of recognition.

(1) Indicator Importance

The mean score (average rating) is calculated based on all experts' ratings of a given indicator. In this study, experts used a Likert scale (1-5 points) to assess the importance of each indicator.

A higher mean score indicates that most experts consider the indicator to be highly important and deserving of a higher weight in the evaluation system.

Conversely, a lower mean score suggests that experts generally perceive the indicator as less important, which may warrant adjustment or removal.

(2) High Degree of Recognition

The full mark rate (K) represents the proportion of experts who assigned the highest possible score to a given indicator. This metric reflects the degree of consensus among experts regarding the critical importance of an indicator (Hsu & Sandford, 2007).

The threshold values for K are defined as follows. When $K \geq 80\%$: Experts highly

recognize the indicator, indicating strong consensus on its importance. When K < 40%, it indicates that experts do not strongly recognize the indicator, suggesting that it may need to be revised or removed.

In summary, the mean score measures the overall recognition of an indicator, reflecting its general importance among experts. The full mark rate (K) measures the high degree of recognition, capturing whether experts universally agree that the indicator is critical. Combining both metrics allows for a comprehensive evaluation of expert consensus on each indicator, ensuring that only the most scientifically valid and widely accepted indicators are included in the evaluation framework.

3.3 Questionnaire survey

The preliminary research established an evaluation index system for the core competencies of tertiary general hospitals in the prevention and control of EIDs. This system defines five core competencies: hospital infection risk prediction ability, hospital infection prevention and control ability, staff training in prevention knowledge and skills, organizational coordination ability, and professional development in disease prevention. Additionally, appropriate weights were assigned to each indicator. However, further empirical research is required to validate the practical application of this index system in effectively predicting the overall prevention and control capacity of hospitals in China. This validation is essential to provide a theoretical basis for enhancing hospital prevention and control capabilities.

Based on the established evaluation index system, and drawing from existing literature and validated scales, this study developed a questionnaire survey to assess the core competencies of tertiary general hospitals in EID prevention and control. The questionnaire was designed by standardizing and quantifying the content of the index system, ensuring its applicability in a structured survey format.

3.3.1 Research hypotheses and conceptual model

This study aims to explore the factors influencing the overall prevention and control level of EIDs in hospitals**.** Specifically, it examines the impact mechanisms of five core abilities on the overall control level. Based on previous research findings, each of these core competencies comprises multiple dimensions, as outlined in Table 3.2.

Table 3.4 Five core competencies and their specific dimensions

Core Competency	Dimensions
Hospital Infection Risk Prediction Ability	Interpretation of Prevention and Control Policies & Regulations
	Infection Risk Identification Ability
	Infection Surveillance Ability
Hospital Infection Prevention and Control Ability	Basic Infection Prevention and Control Competence
	Emergency Response Capability
	Occupational Protection Ability
Competency in Training for Prevention Knowledge & Skills	Feasibility Assessment of Training
	Implementation of Educational Programs
	Evaluation of Teaching Effectiveness
Organizational Coordination Ability	Integration of Prevention Resources
	Communication and Collaboration Skills
Professional Development in Disease Prevention	Self-directed Learning Ability
	Critical Thinking Ability
	Research and Innovation Capacity

Through this framework, the study provides a comprehensive evaluation of hospital EID prevention and control efforts, covering risk prediction, control measures, training support, organizational coordination, and professional development. This holistic approach offers hospitals scientific and systematic guidance for decision-making and management in response to EID threats.

Based on the above analysis, the following research hypotheses are proposed:

H1: Hospital infection risk prediction ability has a significant positive impact on the overall prevention and control level of EIDs.

H2: Hospital infection prevention and control ability has a significant positive impact on the overall prevention and control level of EIDs.

H3: Competency in training for prevention knowledge and skills has a significant positive impact on the overall prevention and control level of EIDs.

H4: Organizational coordination ability has a significant positive impact on the overall prevention and control level of EIDs.

H5: Professional development in disease prevention has a significant positive impact on the overall prevention and control level of EIDs.

To empirically validate these hypotheses, this study employed a multiple linear regression analysis to determine the direction and significance of the impact of each core competency on the overall prevention and control level, and assess the extent of influence of each core competency on the overall control level. The conceptual model of this study is illustrated in Figure 3.1.

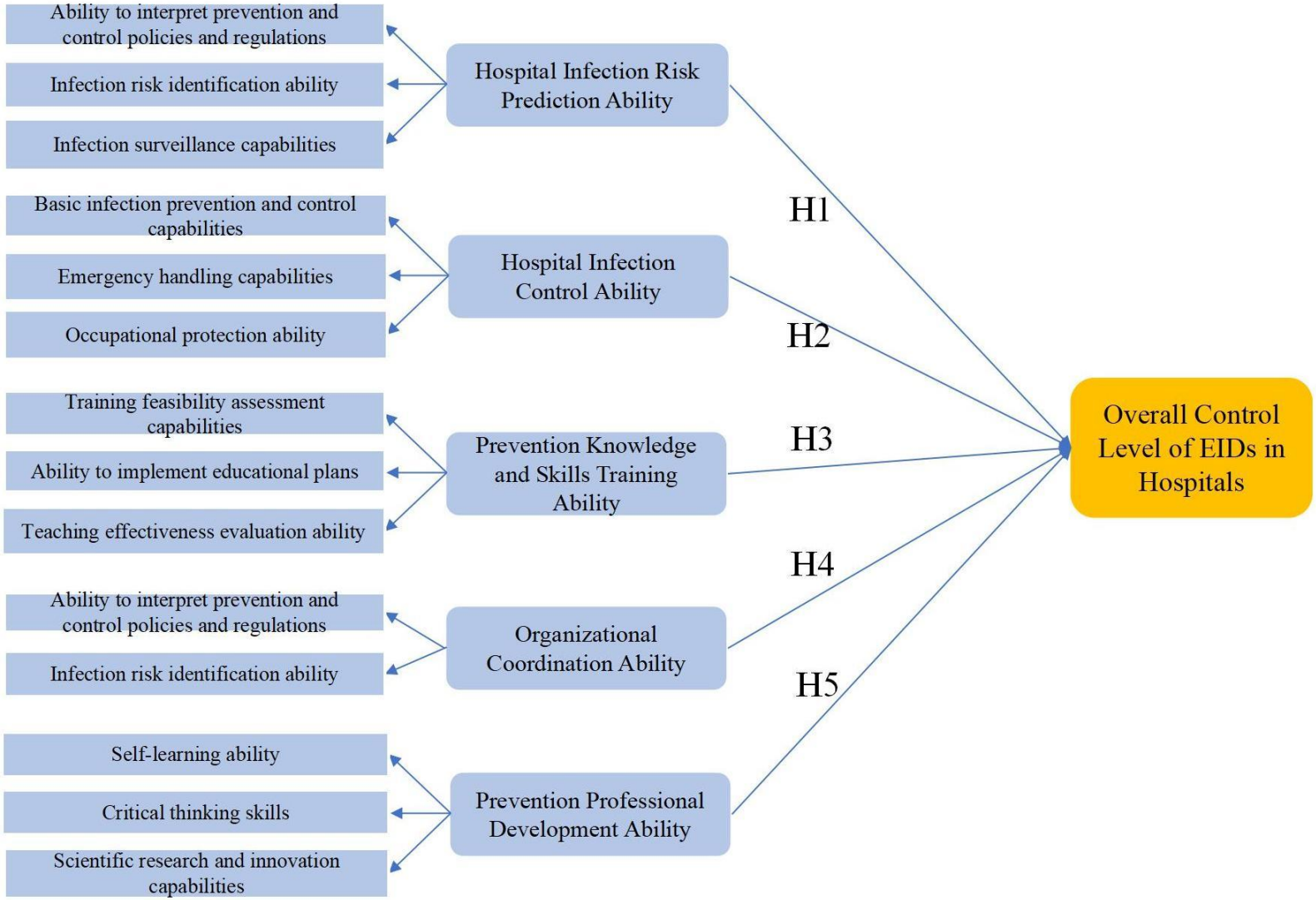

Figure 3.1 Conceptual model of core competence of EIDs prevention and control in tertiary general hospitals

3.3.2 Scale and questionnaire design

Based on prior theoretical foundations and practical needs, this study adopts a questionnaire survey method to quantify the constructed theoretical evaluation index system and design a structured questionnaire (see Annex A for full questionnaire).

The complete questionnaire consists of seven sections:

The first section collects basic information.

The second to fifth sections correspond to the five core competencies discussed earlier, containing a total of 62 items. Each item is evaluated using a 5-point Likert scale, with response options ranging from 1 (“completely disagree”) to 5 (“completely agree”).

There is no universally recognized scale for evaluating the overall prevention and control capacity of EIDs in hospitals. Given the extensive number of items assessing the five core competencies, respondents already face a significant workload. To simplify the survey process and improve response rates, this study measures the overall hospital-level infectious disease prevention capacity using a single-item scale.

The designed single-item scale for measuring the dependent variable is "Overall, my hospital has a high level of EID prevention and control capacity and can effectively respond to public health emergencies." This item is also evaluated using a 5-point Likert scale, allowing for a quantitative assessment of the hospital’s overall prevention and control capacity.

3.3.3 Data collection and processing

3.3.3.1 Inclusion criteria

This study focuses on staff members from five tertiary general hospitals in Guangzhou to investigate their professional background and assess the hospitals’ capabilities in preventing and controlling EIDs. To ensure the accuracy and comprehensiveness of the collected data, participants must meet specific inclusion criteria.

First, participants must have at least one year of work experience in the hospital. This requirement ensures that they possess sufficient professional knowledge and practical exposure to EID prevention and control measures.

Second, the target participants primarily include hospital management personnel, heads of infection prevention and control departments, and frontline healthcare professionals. The latter group consists of doctors and nurses working in emergency departments, intensive care

units (ICU), respiratory medicine, and infectious disease departments, as these individuals are most directly involved in infectious disease prevention and response efforts.

Third, at least 70% of the respondents must have actively participated in EID prevention and control efforts. This involvement includes activities such as screening and diagnosing infectious diseases, treating and managing infected patients, participating in emergency drills and outbreak response exercises, and coordinating or implementing prevention measures within the hospital. By applying these inclusion criteria, the study ensures that the collected data reflects insights from experienced professionals with practical knowledge and hands-on experience in EID prevention and control.

3.3.3.2 Data collection

Prior to the official distribution of the questionnaire, a pilot survey was conducted from August 16 to August 26, 2023. The primary objectives of this preliminary investigation were to evaluate the scientific rigor and clarity of the questionnaire statements, ensuring that each question effectively conveyed the research purpose and core concepts. Additionally, the wording of each question was carefully reviewed to identify any potential ambiguities that could lead to respondent misinterpretation. The pilot survey also served to confirm that the questionnaire covered all key indicators necessary for assessing the five core competencies, ensuring comprehensive measurement without omissions.

Following the pilot study, formal data collection was conducted using an online questionnaire survey. To ensure representativeness across hospitals, a proportionate distribution method was applied, taking into account factors such as the total number of healthcare personnel and hospital bed capacity. Based on these criteria, questionnaires were allocated as follows: 50 responses from Hospital A, 40 from Hospital B, 45 from Hospital C, 35 from Hospital D, and 50 from Hospital E, totaling 220 completed surveys. This distribution strategy allowed the study to accurately reflect the conditions of hospitals of varying sizes, ensuring broad coverage and balanced representation in the collected data, thus strengthening the reliability of subsequent statistical analyses.

The data collection period spanned from September 1 to September 30, 2023, covering a total duration of 30 days. Before participating, all respondents provided informed consent, confirming their understanding of the study's objectives, the intended use of the data, and the anonymity of their responses. The study distributed the survey by sending an online questionnaire link via Wenjuanxing (a professional survey platform) to the targeted hospitals. Each participant was required to complete the questionnaire independently and anonymously,

minimizing potential bias and enhancing the accuracy and reliability of the responses.

To improve response rate and data quality, the study maintained close communication with hospital management throughout the data collection period, regularly monitoring survey completion progress and sending timely reminders to encourage respondents to submit their responses. Upon completion of data collection, all returned questionnaires were screened to ensure completeness and validity before proceeding with further analysis.

3.3.3.3 Data processing

Upon completing data collection, this study utilized SPSS 24.0 for data processing and statistical analysis. Initially, descriptive statistics were performed to calculate mean values, standard deviations, and other key indicators. Additionally, Pearson correlation analysis was conducted to explore preliminary relationships between variables, and the reliability and validity of the questionnaire were examined.

Based on this foundation, a multiple linear regression analysis was applied to determine whether the previously constructed evaluation index system could effectively predict the overall prevention and control level of hospitals. The regression model included five primary indicators (independent variables), 14 secondary indicators, and 62 tertiary indicators, while the dependent variable was the overall hospital-level prevention and control capacity for EIDs. This analysis aimed to assess the impact of each variable on the hospital's overall control level.

To evaluate the model's overall significance, an F-test was conducted, and the coefficient of determination (R^2) was calculated to measure the model's explanatory power, providing an initial validation of the scientific robustness of the evaluation index system. Furthermore, regression coefficients (β values) and their significance levels were analyzed to assess the relative contributions of the five core competencies to the overall prevention and control capacity.

To ensure the robustness of the regression model, this study also computed the Variance Inflation Factor (VIF) to detect potential multicollinearity among the independent variables and evaluate the model's overall fit. Finally, based on the results of the multiple regression analysis, the study provided a comprehensive assessment of the validity of the evaluation system, analyzed the relative importance of the five core competencies, and offered theoretical guidance for enhancing hospitals' capabilities in EID prevention and control.

3.3.4 Correlation analysis

To further explore the relationship between the five core competencies (A1–A5) and the overall prevention and control level of EIDs in hospitals, this study employed Pearson correlation analysis. The Pearson correlation coefficient is a statistical measure used to assess the linear relationship between two continuous variables, with values ranging from -1 to 1. A correlation coefficient closer to ±1 indicates a stronger relationship between variables, while a value near 0 suggests a weak correlation.

In this study, a two-tailed test was conducted to determine whether the correlations were statistically significant at 0.01 or 0.05 significance levels, ensuring the robustness and reliability of the analysis results.

3.3.5 Reliability testing

To evaluate the internal consistency of the questionnaire, this study applied the Cronbach's α coefficient for reliability testing. According to widely accepted reliability standards, a Cronbach's α value exceeding 0.70 is considered acceptable, with higher values indicating greater internal consistency. If the Cronbach's α coefficient falls below 0.70, the questionnaire content generally requires revision and refinement to improve measurement reliability.

3.3.6 Validity testing

The purpose of validity testing in this study was to assess whether the constructed evaluation system could accurately and scientifically measure the targeted constructs. Validity testing ensured that the questionnaire content was reasonable, the factor structure remained stable, and the measurement indicators demonstrated discriminant validity and convergent validity, thereby ensuring the credibility and applicability of the study's conclusions.

Validity testing included content validity, criterion validity, and construct validity. To ensure the scientific rigor of the measurement tool, this study primarily conducted content validity testing and construct validity testing to comprehensively evaluate the rationality of the questionnaire.

3.3.6.1 Content validity

The content validity test aimed to verify whether the evaluation system adequately captured the key aspects of core competencies in EID prevention and control for tertiary general hospitals. In this study, content validity was assessed through a combination of literature

analysis, theoretical discussion, and the Delphi expert consultation method. These approaches ensured that the constructed evaluation system was reasonable, comprehensive, and applicable to real-world hospital settings.

3.3.6.2 Construct validity

(1) KMO and Bartlett's Test of Sphericity

To assess whether the dataset is suitable for Exploratory Factor Analysis (EFA), this study first conducted the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity. The KMO value measures the adequacy of the sample for factor analysis, with interpretation as follows:

KMO > 0.90: The data is highly suitable for factor analysis.

KMO > 0.80: The data is suitable for factor analysis.

KMO > 0.70: Factor analysis can be performed.

KMO < 0.60: The data is not suitable for factor analysis, suggesting a need to adjust variables or increase the sample size.

Additionally, Bartlett's test of sphericity examines whether the correlations among variables are statistically significant. A p-value < 0.05 indicates that there is significant correlation among variables, confirming that the data is appropriate for factor extraction and structural analysis.

(2) Total Variance Explained

To test the structural validity of the measurement questionnaire, this study employed Principal Component Analysis (PCA), a dimensionality reduction technique that extracts key components while preserving as much original data information as possible.

Furthermore, this study applied the Varimax Rotation method, a technique that maximizes variance to optimize factor loadings and minimize correlations among extracted factors. This enhances the interpretability of the factor structure, ensuring that each variable is predominantly associated with a single factor, thereby improving the discriminant validity and convergent validity of the measurement tool.

(3) Factor Loadings

Factor analysis is a technique used to identify latent structures in the data and validate the dimensionality of the measurement tool. The preliminary analysis indicated that the extracted factors aligned well with the evaluation system's predefined indicator structure, demonstrating that the survey items effectively aggregate into their respective core competency dimensions. This supports the rationality and validity of the constructed index system.

(4) Convergent Validity

This study assessed convergent validity using the Average Variance Extracted (AVE) and Composite Reliability (CR). AVE measures the extent to which a latent variable explains the variance of its observed indicators. An AVE $\geqslant$ 0.50 is generally considered acceptable, indicating good convergent validity. CR assesses the internal consistency of measurement items, with CR $\geqslant$ 0.70 suggesting high reliability of the scale.

(5) Discriminant Validity

Discriminant validity evaluates whether the latent variables (factors) are sufficiently distinct from one another, ensuring that the measurement tool effectively differentiates between different constructs rather than measuring overlapping concepts. Following Fornell and Larcker's (1981) criterion, discriminant validity is confirmed if the square root of the AVE of a given latent variable is greater than its correlation with any other variable. To verify this, the study applied the Fornell-Larcker criterion (AVE square root test) in combination with Pearson correlation analysis to examine inter-factor correlations, ensuring that the measurement tool exhibits adequate discriminant validity.

3.3.7 Multiple regression analysis

To further examine the validity and applicability of the evaluation model for the core competencies of tertiary general hospitals in EID prevention and control, this study employed multiple linear regression analysis using SPSS 24.0. The objective was to systematically explore the influence and predictive power of the five core competencies—hospital infection risk prediction ability, hospital infection prevention and control ability, competency in training for prevention knowledge and skills, organizational coordination ability, and professional development in disease prevention—on the overall hospital-level prevention and control capacity for EIDs.

3.3.7.1 Theoretical basis of regression analysis

The Pearson correlation analysis conducted earlier revealed that all five core competencies (A1: Infection Risk Prediction Ability, A2: Infection Prevention and Control Ability, A3: Knowledge and Skills Training Ability, A4: Organizational Coordination Ability, A5: Professional Development in Disease Prevention) exhibited significant positive correlations ($p < 0.01$) with the dependent variable Y (overall hospital-level prevention and control capacity for EIDs).

To further investigate the specific impact and relative contribution of these five core

competencies on Y, this study employed multiple linear regression analysis to test the research hypotheses (H1–H5). The regression model is shown in Formula 3.2.

$$Y=\beta_0+\beta_1A_1+\beta_2A_2+\beta_3A_3+\beta_4A_4+\beta_5A_5+\varepsilon \quad (3.2)$$

Where Y represents the dependent variable (overall prevention and control capacity for EIDs). A1–A5 are the independent variables corresponding to the five core competencies. β0 is the intercept term. β1–β5 are the regression coefficients, representing the influence of each core competency on Y. ε denotes the error term.

Using SPSS 24.0, this study employed the Enter method for regression analysis, performing statistical tests on:

1. Model significance testing (F-test).
2. Coefficient of determination (R^2) to evaluate model explanatory power.
3. Interpretation of the regression model to assess the contribution of each variable.
4. Multicollinearity testing to check for interdependencies among predictor variables.

3.3.7.2 Model fit analysis

Model fit analysis evaluates the overall explanatory power of the constructed regression model. The coefficient of determination (R^2) and the adjusted R^2 serve as key indicators for assessing model fit. Generally, an R^2 value close to 1 indicates a strong explanatory power of the model. $R^2 > 0.7$ is considered excellent, while $R^2 > 0.6$ is deemed acceptable for predictive models in social sciences. This analysis ensures that the model effectively explains the variance in hospital-level prevention and control capacity for EIDs, validating the theoretical structure of the evaluation system.

3.3.7.3 ANOVA results

The overall significance of the regression model was assessed using ANOVA (Analysis of Variance). The model's validity was determined based on the F-test, where if the F-statistic's significance level (p-value) is less than 0.05, the model has statistical significance, confirming that the regression equation is valid for predicting hospital prevention and control capacity. A higher F-value further indicates that at least one of the independent variables significantly contributes to predicting Y.

By conducting this ANOVA test, the study ensures that the regression model is statistically robust and applicable, providing empirical support for the constructed evaluation framework of EID prevention and control in hospitals.

3.3.7.4 Regression coefficients and significance testing

To further evaluate the specific impact of each of the five core competency variables on the overall hospital prevention and control capacity, this study conducted an analysis of regression coefficients. In multiple linear regression analysis, both the unstandardized regression coefficient (B) and the standardized regression coefficient (β) are used to measure the direction and magnitude of an independent variable's effect on the dependent variable.

The unstandardized regression coefficient (B) represents the change in the dependent variable when the independent variable increases by one unit, while the standardized regression coefficient (B) eliminates the effect of different measurement units, allowing for direct comparison of the relative impact of different independent variables.

Additionally, the t-value and its corresponding significance level (p-value) determine whether each independent variable has a statistically significant effect on the dependent variable. A p-value less than 0.05 is typically considered statistically significant, indicating that the independent variable contributes meaningfully to the prediction of hospital prevention and control capacity.

3.3.7.5 Multicollinearity diagnosis

In regression analysis, multicollinearity among independent variables is a critical concern, as high collinearity can lead to unstable estimates and reduce the interpretability of regression coefficients. To assess the severity of multicollinearity, this study employed the Variance Inflation Factor (VIF) as an indicator.

VIF > 10: Severe multicollinearity is present, requiring model adjustment.

5 ⩽ VIF ⩽ 10: Moderate multicollinearity exists but is generally acceptable.

VIF < 5: Weak or no multicollinearity, indicating that the independent variables do not exhibit problematic interdependencies.

By examining the VIF values of all predictor variables, this study ensures the robustness and reliability of the regression model.

3.4 Chapter summary

In Chapter 3, this study primarily explored the use of semi-structured interviews and the Delphi method as two key research methodologies, along with the questionnaire survey for data collection. These methods collectively provided a strong foundation for assessing the core competencies of tertiary general hospitals in EID prevention and control.

In the qualitative research phase, the study first employed a semi-structured interview approach, selecting medical experts for face-to-face discussions. This flexible and open-ended format enabled researchers to gain in-depth insights into expert perspectives on infectious disease prevention and their practical applications.

Subsequently, using the Delphi method, the study effectively aggregated expert opinions, leading to a consensus on the core competencies required for infectious disease prevention and control in tertiary hospitals. The iterative feedback mechanism of the Delphi method ensured the scientific rigor and reliability of the decision-making process.

Finally, integrating findings from the qualitative phase, a quantitative study was designed to empirically evaluate hospitals' core prevention and control competencies. Through this empirical research, this chapter not only validated the rationality of the evaluation index system but also revealed the actual performance of different hospitals in preventing and controlling EIDs.

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Chapter 4: Development of the Core Competency Evaluation System for EID Prevention and Control in Tertiary General Hospitals

This chapter employs a mixed-methods research approach, integrating qualitative semi-structured interviews with quantitative Delphi analysis. The combination of these two methods aims to extract practical insights from frontline healthcare workers and hospital administrators while ensuring the systematic validation of key evaluation criteria through expert consensus.

The semi-structured interviews involved direct discussions with hospital management personnel and healthcare providers, gathering their perspectives on existing infectious disease prevention measures and areas in need of enhancement. Through an iterative Delphi process involving two or more rounds of expert consultation, expert opinions were consolidated to establish the core evaluation indicators for hospital competency in emerging infectious disease (EID) prevention and control. This process emphasized the refinement and validation of the interview findings through expert consensus.

4.1 Results of the semi-structured interviews

Before conducting the semi-structured expert interviews, the study informed the interviewees about the purpose and significance of the study, obtained informed consent, and scheduled the interview sessions at mutually agreed times and locations to ensure a smooth process. The responses from the expert interviews were systematically summarized as follows:

Question 1: According to your own working experience, what do you think of the core capacity for preventing and controlling EIDs in tertiary general hospitals? What aspects do you think are satisfactory and what can be further improved? (You can give your answer from any aspect, like hospital management, systems, prevention and control measures.)

Answer: The core capacity for preventing and controlling EIDs in tertiary general hospitals are strong. Tertiary general hospitals can provide much good experience and highlights for lower-level medical institutions and specialized hospitals. But there is also room for further improvement.

(1) In terms of management, most tertiary general hospitals have a sound organizational structure, with dedicated management departments and part-time personnel. They have clear responsibilities and operating procedures for the prevention and control of EIDs. The hospital management attaches great importance to the prevention and control of EIDs and can quickly activate emergency response mechanisms.

(2) In terms of systems, tertiary general hospitals usually have sound rules and regulations for infectious disease prevention and control, including a case reporting system, isolation system, disinfection system, and occupational safety protection. These systems can ensure the safety of medical staff and patients, and effectively prevent and control the spread of infectious diseases.

(3) In terms of prevention and control measures, tertiary general hospitals are usually able to timely detect, isolate, and treat suspected cases, and adopt strict disinfection and protection measures to prevent the spread of viruses within the hospitals. And they can also standardize the treatment of medical waste to reduce the risk of secondary infections.

(4) Nevertheless, there is still room for further improvement. For example, tertiary general hospitals should be able to timely response to public health emergencies and take measures to deal with them, and design building layouts that are suitable for use both in normal times and during emergency periods. The isolation conditions for respiratory infectious diseases in tertiary general hospitals are not good enough, and there are even no negative pressure wards, negative pressure operating rooms, and negative pressure delivery rooms.

In summary, tertiary general hospitals have a certain core capacity in the prevention and control of EIDs, but there is room for further improvement. To enhance the hospitals' prevention and control capacity, hospital management, doctors, and employees need to work together to continuously improve and optimize prevention and control measures.

Question 2: What do you think is the key to improving? (Which aspects of health resources, such as policy systems, organizational management, human and financial information should be improved?)

Answer: There is also room for improvement. For example, the early warning and rapid response mechanisms for EIDs need to be further improved. Although there are existing prevention and control measures for some known infectious diseases, early warning systems may fail to identify EIDs promptly. In addition, deeper understanding and research for some uncommon infectious diseases may be needed to find more effective prevention and control strategies.

Question 3: What do you think are included in the core capacity for preventing and controlling EIDs in tertiary general hospitals?

Answer: It usually includes the following aspects:

(1) Early warning and rapid response capacity: Hospitals should have an early warning system for timely detection and identification of EIDs, and be able to quickly activate emergency response mechanisms and take effective prevention and control measures.

(2) Isolation and protection capacity: Hospitals should have the ability to isolate and treat suspected or confirmed cases, while taking strict protective measures to protect the safety of medical staff and patients.

(3) Medical treatment capacity: Hospitals should have the ability to provide timely and effective medical treatment for suspected or confirmed cases, including disease assessment, and treatment plan formulation and implementation.

(4) Collaboration and communication capacity: Hospitals should have the ability to communicate and collaborate with relevant departments and institutions in a timely and effective manner to jointly respond to EIDs.

(5) Research and innovation capacity: Hospitals should have the ability to conduct research and innovation on EIDs, and explore new prevention and control strategies and technologies.

(6) Training and educational capacity: Hospitals should have the ability to provide training and education on the prevention and control of EIDs for medical staff, to enhance their awareness and ability in prevention and control.

(7) Material support capacity: Hospitals should have sufficient reserves and supply capacity of epidemic prevention materials to ensure the normal progress of prevention and control.

The core capacity is very important for tertiary general hospitals, as it can ensure that hospitals can quickly and effectively take prevention and control measures when dealing with EIDs to protect the safety of medical staff and patients.

Question 4: What factors do you think affect the core capacity for preventing and controlling EIDs in tertiary general hospitals? What are the key factors?

Answer: There are many factors affecting it. Among them, the key factors include:

(1) The level of attention paid by hospital management: The level of attention paid by hospital management to the prevention and control of EIDs directly affects the implementation and effectiveness of prevention and control. If the management can provide sufficient support and resource investment, the prevention and control can be carried out more

smoothly.

(2) Professional quality of medical staff: Medical staff are the main executors for preventing and controlling EIDs, and their professional quality and sense of responsibility have a crucial impact on the effectiveness of prevention and control. If medical staff have high professional qualities and a strong sense of responsibility, and strictly abide by prevention and control rules and regulations, the prevention and control effect will be more significant.

Hospital facilities and equipment: Hospital facilities and equipment are also important factors affecting the ability to prevent and control EIDs. Hospitals should have complete isolation facilities, protective equipment, and medical treatment equipment to ensure the safety of medical staff and patients.

(3) Internal coordination mechanism in hospitals: As the prevention and control of EIDs involves collaboration among multiple departments, hospitals should have a sound internal coordination mechanism to ensure their effective communication and collaboration.

(4) External support and cooperation: Hospitals should actively seek support and cooperation with the government, relevant institutions, and experts to jointly respond to EIDs. Through cooperation with external institutions, hospitals can obtain more resources and support to improve their prevention and control capacity.

In summary, there are many factors that affect the core capacity for preventing and controlling EIDs in tertiary general hospitals, among which the key factors include the level of attention paid by hospital management to the prevention and control, the professional quality of medical staff, hospital facilities and equipment, internal coordination mechanisms, and external support and cooperation.

Question 5: How do you evaluate the core capacity for preventing and controlling EIDs in tertiary general hospitals? What are the difficulties in the evaluation process? (In terms of evaluation subjects, evaluation objects, evaluation tools, and evaluation dimensions)

Answer: It can be evaluated from the following aspects:

(1) Evaluation subjects: The evaluation team should be composed of government health departments, hospital management, experts, and third-party organizations to ensure the objectivity and comprehensiveness of the evaluation.

(2) Evaluation objects: Evaluation objects are the prevention and control of EIDs, including early warning and rapid response capacity, isolation and protection capacity, medical treatment capacity, as well as collaboration and communication capacity.

Evaluation tools: Evaluation tools include questionnaire surveys, field visits, data review,

and expert review. Among them, questionnaire surveys can be used to know about the satisfaction and understanding of medical staff and patients towards prevention and control; field visits can be helpful to observe the facilities and equipment of hospitals and to know about the actual implementation of prevention and control; data review can be used to understand the hospital's management system and document records; expert review can be used to conduct in-depth analysis and evaluation of prevention and control based on the experience and professional knowledge of experts.

(3) Evaluation dimensions: The core capacity for preventing and controlling EIDs in tertiary general hospitals can be evaluated from multiple dimensions such as organizational management, resource allocation, prevention and control measures, training and education, as well as scientific research and innovation. From the dimension of organizational management, whether the hospital's management system and processes are sound is evaluated; from the dimension of resource allocation, whether hospitals have sufficient resources such as facilities, equipment, and materials is examined; from the dimension of prevention and control measures, the actual work of isolation, protection, medical treatment in hospital is examined; from the training and education dimension, whether the prevention and control awareness and ability of medical staff have been improved is examined; from the dimension of scientific research and innovation, whether hospitals have the ability to conduct scientific research and innovation on EIDs is examined.

The difficulties in the evaluation process mainly include:

(4) Establishment of the indicator system: There are numerous evaluation indicators for the core capacity for preventing and controlling EIDs. How to scientifically and reasonably establish an indicator system is a major challenge in the evaluation process. It is necessary to fully consider the actual situation of the hospital and the characteristics of prevention and control in order to select representative and operable evaluation indicators.

(5) Data collection and organization: During the evaluation process, a large amount of data needs to be collected, including data from questionnaire surveys, field visits, and data review. It is also a major challenge to ensure the authenticity and accuracy of data and to sort out and analyze data.

(6) Determination of evaluation criteria and basis: Due to the complex factors involved in the prevention and control of EIDs, determining scientific and reasonable evaluation criteria and basis is also a major challenge. It is necessary to develop feasible and operable evaluation standards and basis after fully considering the actual situation of the hospital and the characteristics of prevention and control.

(7) The balance between subjective and objective factors: In the evaluation process, it is necessary to consider both objective factors such as hospital facilities and equipment conditions, and subjective factors such as the professional quality and work attitude of medical staff. It is also a big challenge to balance subjective and objective factors and evaluate the hospital's prevention and control capacity comprehensively.

4.2 Results of Delphi expert consultation

This study employed the Delphi method for expert consultation, inviting a total of 20 experts to participate. Data analysis was conducted using SPSS 24.0 software, following the expert opinion evaluation method presented in Table 3.2 to systematically assess the expert consultation results. Multiple dimensions were analyzed to evaluate the expert consultation process, including expert participation, expert authority coefficient, expert opinion consistency (ranking consensus and scoring dispersion), and expert recognition (indicator importance and high-level agreement). Through a comprehensive analysis of the two rounds of expert consultation, the study assessed the level of consensus and recognition among experts regarding each level of indicators, serving as the basis for refining the evaluation system. Following two rounds of questionnaire surveys, the final set of research indicators was confirmed with strong authority and consistency.

4.2.1 Expert participation

The response rate of the expert consultation questionnaire in this study is as follows:

First-round survey: A total of 20 questionnaires were distributed, and 20 were returned, achieving a response rate of 100%.

Second-round survey: A total of 20 questionnaires were distributed, and 20 were returned, maintaining a response rate of 100%.

Since the response rate in both rounds is ≥70%, it indicates a high level of expert engagement and interest in the research topic. The strong participation of experts enhances the representativeness and scientific validity of the study results.

4.2.2 Expert authority

Table 4.1 presents the authority coefficient (Cr) of the participating experts, calculated based on the judgment coefficient (Ca) and familiarity coefficient (Cs). The average Cr value across the

20 experts was 0.88, with all experts scoring Cr ≥ 0.70. These findings indicate that the expert group possesses a high level of authority and influence within their respective fields, thereby ensuring the credibility and reliability of the study's conclusions.

Table 4.1 Authority coefficients of experts

Number	Coefficient of determination Ca	Familiarity coefficient Cs	Authority coefficient Cr
1	1.00	1.00	1.00
2	1.00	0.50	0.75
3	0.90	1.00	0.95
4	1.00	0.80	0.90
5	0.90	0.80	0.85
6	1.00	0.50	0.75
7	0.90	0.80	0.85
8	1.00	1.00	1.00
9	0.90	0.80	0.85
10	0.80	0.80	0.80
11	1.00	1.00	1.00
12	1.00	1.00	1.00
13	0.90	0.50	0.70
14	0.90	0.80	0.85
15	0.90	0.80	0.85
16	1.00	0.80	0.90
17	1.00	0.80	0.90
18	0.90	0.80	0.85
19	0.90	0.80	0.85
20	0.90	1.00	0.95
Arithmetical mean	0.94	0.82	0.88

4.2.3 Results of the first round of expert consultation

4.2.3.1 Expert consensus consistency

The consistency of expert opinions was evaluated using Kendall's W coefficient and the coefficient of variation (Cv). Kendall's W measures the consistency in ranking across experts, whereas Cv assesses the consistency of scores. The combination of these two indicators provides a comprehensive assessment of expert consensus.

Kendall's W coefficient was used to measure ranking consensus among experts. The results from the first round of expert consultation are presented in Table 4.2. For primary-level indicators, Kendall's W coefficient was 0.559, indicating a high level of consensus among experts regarding their rankings. For secondary-level indicators, Kendall's W coefficient was 0.531, which also represents a relatively high level of agreement, though slightly lower than that of primary indicators. This suggests that experts maintained a strong consensus on secondary indicators, with minor differences. For tertiary-level indicators, Kendall's W coefficient was 0.444, signifying a moderate level of consistency. This suggests that experts had

greater variations in ranking more specific and detailed indicators, necessitating further refinement. Notably, the Kendall's W coefficients for all levels of indicators were statistically significant (P = 0.000), indicating a statistically valid consensus among experts and enhancing the credibility of the results. However, the lower consistency of the tertiary indicators may be attributed to several factors: the large number of tertiary indicators (69), which increases the complexity of expert evaluations; the lack of clarity in the definition and connotation of some tertiary indicators; and significant differences in the perception of the importance of certain tertiary indicators among experts. Therefore, in subsequent consultations, specific optimizations should be made to address these issues.

Table 4.2 First-round expert consultation: Kendall's W coefficient

Indicator level	Number of indicators	Kendall's W coefficient	Chi-square value/C2	Degree of freedom/df	Significance/P
Primary indicators	5	0.559	20.690	4	0.000
Secondary indicators	14	0.531	64.804	14	0.000
Tertiary indicators	69	0.444	195.335	68	0.000

The degree of score dispersion was evaluated using the coefficient of variation (Cv). A lower Cv value indicates that expert ratings are more concentrated and consistent. The study results (see Table 4.3) show that among the primary indicators, A2 (Hospital Infection Prevention and Control Ability) had the lowest Cv value of 0.00, indicating that all experts provided identical ratings, demonstrating complete agreement. Next, A1 (Hospital Infection Risk Prediction Ability) (Cv = 0.06) and A4 (Organizational Coordination Ability) (Cv = 0.08) exhibited high consistency among expert ratings. A3 (Knowledge and Skills Training for Prevention and Control) (Cv = 0.09) also had relatively concentrated ratings, although slightly lower than A1 and A4. In contrast, A5 (Professional Development in Prevention and Control) had the highest Cv value (0.11), indicating greater dispersion in expert ratings. This suggests that experts had differing perceptions of its importance, requiring further clarification in subsequent consultations to enhance consensus. Overall, the analysis of Kendall's W and Cv values indicates a high level of agreement among experts. However, discrepancies remain, particularly in tertiary indicators and A5, necessitating further refinement in the optimization phase to improve consensus.

Table 4.3 Evaluation results of the first round of expert consultation on primary indicators

Primary indicators	Mean	SD	Cv	k
A1 Capacity for risk prediction of nosocomial infection	4.90	0.31	0.06	90.00
A2 Capacity for prevention and control of nosocomial infection	5.00	0.00	0.00	100.00
A3 Capacity for training of prevention and control knowledge and skills	4.75	0.44	0.09	75.00
A4 Organization and coordination capacity	4.85	0.37	0.08	85.00
A5 Capacity for prevention and control professional development	4.40	0.50	0.11	40.00

4.2.3.2 Expert recognition

Expert recognition is primarily assessed through two aspects: the mean score (Mean Score) and the full mark rate (Full Mark Rate, K). The mean score evaluates the importance of the indicator, while the full mark rate assesses the degree of high recognition. The combination of these two indicators provides a comprehensive reflection of expert approval of the indicators.

First, indicator importance is evaluated through the mean score. The results of the first-round expert consultation on the importance of the primary indicators (see Table 4.3) show that A2, "Hospital Infection Prevention and Control Capability," received the highest mean score (5.00), indicating that experts generally regard this indicator as a core component of the evaluation system with extremely high importance. A1, "Hospital Infection Risk Prediction Capability" (4.90), and A4, "Organizational Coordination Capability" (4.85), also received high mean scores, demonstrating that these two indicators are highly recognized by the expert group. A3, "Knowledge and Skills Training for Prevention and Control," had a mean score of 4.75, slightly lower than the aforementioned indicators, reflecting that some experts hold relatively reserved opinions regarding its importance, suggesting the need for further optimization. A5, "Professional Development Capability for Prevention and Control," had the lowest mean score (4.40), indicating that experts generally consider this indicator to be of relatively lower importance, necessitating further discussion and refinement of its definition or necessity.

On the other hand, high recognition is assessed through the full mark rate (Full Mark Rate, K), which reflects the proportion of experts who consider the indicator to be extremely important. The results (Table 4.3) show that A2 had the highest full mark rate, reaching 100%, with all experts unanimously agreeing that this indicator is critically important. The full mark rates for A1 and A4 were 90% and 85%, respectively, indicating a high level of expert recognition, though a few experts showed slightly lower approval. A3 had a full mark rate of 75%, suggesting that most experts highly recognize its importance, but some degree of

divergence remains. A5 had the lowest full mark rate at only 40%, demonstrating significant differences in expert opinions regarding the importance of this indicator, with a relatively low level of recognition. Therefore, A5 should receive special attention and reassessment in the next optimization phase.

Overall, the combined evaluation of the mean score and full mark rate indicates that the importance and recognition of primary indicators are generally high. However, differences exist among specific indicators, particularly A5, which exhibits noticeable discrepancies. Further refinement of its definition and content is necessary to enhance the overall rationality and scientific validity of the evaluation system.

4.2.4 Adjustments to indicators following the first round of expert consultation

The results of the first round of expert consultation indicated that experts generally rated the importance of secondary and tertiary indicators highly, with mean scores for all secondary indicators exceeding 4 points, demonstrating a fundamentally rational structure (as shown in Tables 4.4 and 4.5). However, experts provided specific recommendations for modifications to certain indicators. Based on this feedback, the research team refined and adjusted the secondary and tertiary indicators accordingly.

Table 4.4 Evaluation results of the second-level indicators of the first round of expert consultation

Primary indicators	Secondary indicators	Mean	SD	Cv	k
A1 Capacity for risk prediction of nosocomial infection	B1 Capacity for prevention and control policy and regulation interpretation	4.80	0.41	0.09	80.00
	B2 Capacity for recognizing infection risks	4.85	0.37	0.08	85.00
	B3 Capacity for infection surveillance	4.85	0.37	0.08	85.00
A2 Capacity for prevention and control of nosocomial infection	B4 Basic capacity for IPC	4.90	0.31	0.06	90.00
	B5 Capacity for emergency response	4.85	0.37	0.08	85.00
	B6 Capacity for occupational protection	4.85	0.37	0.08	85.00
A3 Capacity for training of prevention and control knowledge and skills	B7 Capacity for training feasibility assessment	4.45	0.69	0.15	55.00
	B8 Capacity for implementing educational programs	4.70	0.47	0.10	70.00
	B9 Capacity for evaluating teaching effectiveness	4.50	0.51	0.11	50.00
A4 Organization and coordination capacity	B10 Capacity for prevention and control resource integration	5.00	0.00	0.00	100.00
	B11 Capacity xfor communication	4.75	0.44	0.09	75.00
	B12 Capacity for collaboration	4.80	0.41	0.09	80.00
A5 Capacity for prevention and control professional development	B13 Capacity for independent learning	4.40	0.68	0.15	50.00
	B14 Capacity for critical thinking	4.45	0.69	0.15	55.00
	B15 Capacity for research and innovation	4.40	0.68	0.15	50.00

Table 4.5 Evaluation results of the three-level indicators of the first round of expert consultation

Tertiary indicators	Mean	SD	Cv	k
C1 Recognize the situation of EIDs in hospitals in and beyond China	4.50	0.61	0.13	55.00
C2 Clarify the relationship between prevention and control policies of nosocomial infection and the IPC situation	4.55	0.69	0.15	65.00
C3 Interpret laws, regulations, systems, and standards about prevention and control of IPC based on practice and above practice, and grasp the core points of nosocomial IPC policies and regulations	4.80	0.52	0.11	85.00
C4 Assess infection risks in building design, construction, and renovation that affect the medical environment (such as ventilation and air conditioning systems, as well as water)	4.90	0.31	0.06	90.00
C5 Understand and evaluate correct processes of cleaning, disinfection, and serilization	4.95	0.22	0.05	95.00
C6 Assess IPC awareness among medical personnel	4.75	0.44	0.09	75.00
C7 Identify high-risk groups and susceptible patients at risk of infection (such as based on age and underlying medical condition)	4.85	0.37	0.08	85.00
C8 Identify the risk of infection in various stages of diagnosis, treatment, and care (such as oral examination; anesthesia and surgery, hand hygiene, aseptic technology, and medical waste disposal)	4.95	0.22	0.05	95.00
C9 Determine IPC monitoring targets based on the risk assessment of nosocomial infection	4.80	0.41	0.09	80.00
C10 Develop a nosocomial IPC monitoring plan for susceptible groups in accordance with national prevention and control policies and regulations	4.50	0.51	0.11	50.00
C11 Conduct nosocomial IPC monitoring, such as comprehensive and objective monitoring of nosocomial infection cases, compliance monitoring of nosocomial IPC, and monitoring of nosocomial IPC by medical personnel (such as the prevalence rate of EIDs)	4.90	0.31	0.06	90.00
C12 Be able to collect nosocomial IPC monitoring data and establish a systematic database	4.70	0.47	0.10	70.00
C13 Verify nosocomial infection monitoring data (methods including data review and clinical visits)	4.55	0.51	0.11	55.00
C14 Calculate the constituent ratio, incidence rate, and prevalence rate of various indicators of nosocomial IPC monitoring	4.65	0.59	0.13	70.00
C15 Be able to critically analyze the significance of nosocomial IPC monitoring results	4.60	0.50	0.11	60.00
C16 Provide recommendations for nosocomial IPC based on the results of nosocomial IPC monitoring	4.90	0.31	0.06	90.00
C17 Be able to modify monitoring strategies based on the evaluation results of IPC monitoring	4.80	0.41	0.09	80.00
C18 Revise and incorporate existing regulations, standards, guiding policies, literature, and publications into nosocomial IPC plans, and establish evidence-based nosocomial IPC strategies and methods	4.75	0.44	0.09	75.00
C19 Provide recommendations for reducing the risk of infection during medical environment design, construction, and renovation processes	4.80	0.41	0.09	80.00
C20 Guide the disinfection and sterilization of different hazardous materials, reusable items, different types of microorganisms, as well as environmental disinfection and air purification in medical institutions	4.90	0.31	0.06	90.00
C21 Supervise the practice of basic techniques for IPC by medical personnel (such as hand hygiene, wearing masks, isolation masks, and isolation gowns), standard prevention and additional prevention, as well as medical waste	4.85	0.37	0.08	85.00

management				
C22 Implement prevention and control of nosocomial infection in key departments, such as admission rooms, endoscopy rooms, operating rooms, delivery rooms, ICU, neonatal wards, dental departments, disinfection supply centers, and dietary departments	4.90	0.31	0.06	90.00
C23 Supervise the implementation of nosocomial IPC strategies in key areas and among key groups such as patients with EIDs in hospitals	4.75	0.64	0.13	85.00
C24 Choose the right quality improvement tools (such as brainstorming, system diagram, and decision process diagram)	4.45	0.51	0.11	45.00
C25 Develop emergency plans for nosocomial infection emergencies in accordance with national IPC policies	4.80	0.41	0.09	80.00
C26 Be able to use epidemiological knowledge to identify risk factors for nosocomial infection outbreaks	4.75	0.55	0.12	80.00
C27 Be able to determine nosocomial infection outbreaks through information monitoring and reporting channels	4.90	0.31	0.06	90.00
C28 Report nosocomial infection outbreaks to the nosocomial infection management committee and hospital leaders	4.85	0.37	0.08	85.00
C29 Collect information and data related to infection outbreaks	4.85	0.49	0.10	90.00
C30 Share the analysis of infection outbreak investigation results and effective prevention and control measures	4.55	0.76	0.17	70.00
C31 Assess the situation of nosocomial infection outbreak and the progress of prevention and control	4.70	0.57	0.12	75.00
C32 Provide advice on nosocomial infection control and investigation	4.70	0.57	0.12	75.00
C33 Assess the risk of occupational exposure to EIDs	4.85	0.49	0.10	90.00
C34 Collaborate with the occupational health departments to discover the risk of transmission among medical staff to patients, colleagues, and society	4.30	0.98	0.23	50.00
C35 Review occupational safety of medical personnel, and develop screening and immunization plans	4.75	0.55	0.12	80.00
C36 Provide guidance and advice after the outbreak of relevant EIDs or occupational exposure, and continue to follow up	4.65	0.59	0.13	70.00
C37 Assist in analyzing the development trend after occupational exposure and share information with occupational health and IPC departments	4.50	0.69	0.15	60.00
C38 Evaluate the needs of medical personnel for IPC knowledge and skills, as well as the learning ability of trainees	4.50	0.61	0.13	55.00
C39 Evaluate the feasibility of IPC knowledge and skill training programs	4.65	0.59	0.13	70.00
C40 Be able to effectively communicate nosocomial IPC policies and regulations to healthcare workers	4.75	0.55	0.12	85.00
C41 Be able to customize corresponding IPC knowledge and skill training programs and develop measurable objective goals based on the needs of doctors, nurses, technicians, health workers, logistics personnel, continuing education personnel, and interns	4.85	0.37	0.08	85.00
C42 Provide education on nosocomial IPC according to different personnel training plans based on the focus of nosocomial IPC	4.85	0.37	0.08	85.00
C43 Provide consultation services for patients, medical staff, and management on nosocomial IPC issues	4.65	0.67	0.14	75.00
C44 Implement effective education and activities for patients, family members, and other personnel related to prevention and control measures	4.70	0.57	0.12	75.00
C45 Objectively evaluate of the effectiveness of IPC related knowledge and skills training program and make improvements	4.50	0.61	0.13	55.00

C46 Assess the learning outcomes of medical personnel participating in IPC education and training (such as operational observation and process testing)	4.60	0.60	0.13	65.00
C47 Actively mobilize and adjust various forces such as medical, nursing, equipment, and logistics to achieve the goal of preventing and controlling EIDs in hospitals	4.90	0.31	0.06	90.00
C48 Reasonably allocate human, material, and financial resources for nosocomial IPC and work together to achieve prevention and control goals	4.90	0.31	0.06	90.00
C49 Provide monitoring results, recommendations, annual reports, policies, and procedures for IPC to the nosocomial infection management committee and relevant management departments, and maintain good communication with the nosocomial infection management committee and management	4.85	0.37	0.08	85.00
C50 Be able to communicate with other healthcare professionals about the purpose, role, and value of IPC plan	4.60	0.50	0.11	60.00
C51 Communicate and exchange nosocomial infection difficulties and prevention and control experiences with medical staff from other medical institutions	4.45	0.51	0.11	45.00
C52 Possess noble industry ethics and selfless dedication to work, a firm stance, gain the trust and understanding of medical staff with its own work enthusiasm and persistence and actively carry out nosocomial IPC work	4.60	0.60	0.13	65.00
C53 Possess a strong sense of responsibility and a high degree of responsibility, strictly demands itself to prevent behaviors that may harm IPC during the supervision process and avoid shirking responsibility for the consequences due to its own negligence and be brave enough to take responsibility	4.75	0.55	0.12	80.00
C54 Coordinate IPC, as well as quality improvement activities across departmental organizations	4.75	0.55	0.12	80.00
C55 have clear division of labor and coordinate with other IPC personnel	4.55	0.83	0.18	75.00
C56 have knowledge related to nosocomial IPC, such as laws, regulations, systems, and standards related to nosocomial infection management; the pathogenesis, clinical manifestations, diagnosis, treatment, and prevention measures of nosocomial infection; hospital cleaning, disinfection, sterilization, and isolation; nosocomial infection monitoring; nosocomial IPC measures in key departments and locations; prevention and control of nosocomial infection outbreaks; methods and standards for evaluating the quality of nosocomial infection management	4.75	0.44	0.09	75.00
C57 Complete the prevention and control training organized by professional IPC personnel and obtain a certificate of qualification	4.65	0.49	0.11	65.00
C58 Be able to improve prevention and control knowledge and skills through continuing education	4.55	0.60	0.13	60.00
C59 Be able to correctly use search engines to search for literature on prevention and control of EIDs, read books related to nosocomial IPC every six months, actively participate in professional conferences, and have the ability to timely capture cutting-edge information on prevention and control	4.30	0.86	0.20	50.00
C60 Use critical thinking skills to comprehensively analyze and judge specific prevention and control action guidelines	4.55	0.76	0.17	70.00
C61 Evaluate the feasibility of nosocomial IPC monitoring, prevention and control needs and plans	4.65	0.59	0.13	70.00
C62 Be able to integrate various prevention and control information and make quick decisions	4.85	0.49	0.10	90.00
C63 Timely grasp the dynamic information on nosocomial infection and respond promptly to sudden emergencies	4.85	0.37	0.08	85.00
C64 Effectively and continuously evaluate monitoring and plans of nosocomial IPC	4.75	0.44	0.09	75.00

C65 Continuously evaluate the quality and satisfaction of nosocomial IPC	4.70	0.47	0.10	70.00
C66 have certain innovative thinking and ability in prevention and control	4.50	0.61	0.13	55.00
C67 Make retrospective analysis of related research on nosocomial infection	4.50	0.61	0.13	55.00
C68 Participate in research on nosocomial IPC and publish relevant research theses	4.25	0.64	0.15	35.00
C69 Apply nosocomial infection research achievements to IPC practice	4.60	0.50	0.11	60.00

For secondary indicators, experts commonly observed an overlap between B10 "Communication Ability" and B11 "Collaboration Ability," suggesting that they should be merged. Following discussions, the research team unanimously agreed to integrate B10 and B11 into a new secondary indicator, "Communication and Collaboration Ability." The corresponding tertiary indicators were also adjusted to eliminate conceptual redundancy and ensure clarity.

Regarding tertiary indicators, experts provided suggestions aimed at improving the precision, comprehensiveness, and operational feasibility of indicator definitions. Based on their feedback, the research team made the following modifications:

C2 was revised to: "Assess the alignment between hospital infection prevention policies and the current infection control landscape, clarifying specific infection control strategies for medical institutions."

C6 was revised to: "Evaluate healthcare workers' awareness and understanding of infection prevention and control through observations, interviews, and surveys."

C10 was revised to: "Develop a hospital infection surveillance plan for vulnerable populations, based on national control policies, regulations, monitoring guidelines, and international standards."

C11 was revised to: "Conduct hospital infection surveillance covering various monitoring areas, including both comprehensive surveillance and targeted surveillance of hospital-acquired infections."

C23 and C24 were merged into: "Supervise and assess the implementation of infection prevention strategies in key areas and populations, such as new infectious disease patients, by selecting appropriate quality improvement methods (e.g., brainstorming, system diagrams, decision trees, PDCA cycles) and conducting corresponding quality improvement activities based on evaluation results."

C28 was revised to: "Promptly report infection outbreaks to the hospital infection management committee and hospital leadership."

C29 was revised to: "Conduct epidemiological investigations to analyze correlations between infection cases and suspected cases, and propose targeted infection prevention measures based on microbiological testing results."

C30 was revised to: "Coordinate relevant departments in responding to infection outbreaks, including eliminating sources of infection, breaking transmission pathways, and encouraging healthcare personnel to participate in policy development."

C31 was revised to: "Continuously monitor hospital infection cases, track new infections,

and evaluate the effectiveness of current prevention measures."

C32 was revised to: "Develop emergency response plans for hospital infection outbreaks in key departments and populations, organize cross-departmental practical drills, and evaluate the outcomes to optimize response strategies."

C34 was revised to: "Ensure that healthcare workers adhere to proper personal protective equipment (PPE) protocols when performing procedures that involve exposure to blood or bodily fluids, and correctly dispose of PPE after patient interactions."

C47 was revised to: "Under the leadership of the hospital director, coordinate departments to provide infection prevention and control technical support to clinical departments, ensuring the achievement of specific hospital infection prevention goals."

C54 was revised to: "Support infection prevention and quality improvement activities organized by different departments, providing both administrative and technical assistance as per the responsibilities of the hospital infection management department."

C55 was revised to: "Work closely with other members of the hospital infection management department to collaboratively complete various infection control tasks."

C35, C44, C52, C53, C58 were deleted.

These modifications clarified indicator definitions and boundaries, reduced conceptual ambiguity and redundancy, and improved the overall structure of the indicator system, making it more scientifically sound. These refinements provided a clearer and more precise set of indicators for the second round of expert consultation.

4.2.5 Results of the second round of expert consultation

Following the feedback from the first round of expert consultation, the indicator system was refined and filtered, leading to the development of the second-round expert consultation questionnaire. This round aimed to further validate and improve the indicator system. The second-round expert consultation continued to utilize SPSS 24.0 software and evaluated the effectiveness of the refined indicators based on two key dimensions: expert consensus (ranking consensus and score dispersion) and expert recognition (indicator importance and high recognition).

4.2.5.1 Expert consensus

The results of the second round of expert consultation demonstrated a significant improvement in both ranking consensus and score dispersion after refining the indicator system, indicating an enhanced level of agreement among experts.

As shown in Table 4.6, the Kendall's W coefficients for all levels of indicators increased compared to the first round. Specifically, the Kendall's W coefficient for primary indicators increased from 0.559 to 0.623. The Kendall's W coefficient for secondary indicators increased from 0.531 to 0.591. The Kendall's W coefficient for tertiary indicators increased from 0.444 to 0.518.

Table 4.6 Kendall's W coefficients from the second round of expert consultation

Indicator Level	Number of Items	Kendall's W Coefficient	Chi-square (χ^2)	Degrees of Freedom (df)	Significance (P)
Primary Indicators	5	0.623	25.818	4	0.000
Secondary Indicators	14	0.591	49.576	13	0.000
Tertiary Indicators	62	0.518	168.058	61	0.000

This improvement indicates that after the first consultation and refinement process, experts reached a higher degree of consensus regarding the ranking of indicators. Furthermore, the Kendall's W coefficients for all indicator levels achieved statistical significance (P = 0.000), confirming a high level of agreement among experts regarding the indicator system. Notably, the number of tertiary indicators was reduced from 69 to 62, reflecting the effectiveness of the refinement process in eliminating redundant indicators and enhancing the overall scientific validity and coherence of the framework.

Score dispersion was assessed using the coefficient of variation (Cv), as shown in Tables 4-7 to 4-9. Overall, the coefficient of variation for all indicator levels decreased significantly in the second round compared to the first round, demonstrating greater consensus in expert ratings. For example, the Cv of the secondary indicator "B7 Feasibility Evaluation of Training Capability" decreased from 0.15 to 0.13. Similarly, the Cv of the secondary indicator "B14 Research and Innovation Capability" decreased from 0.15 to 0.11, reflecting greater consistency in expert evaluations. These findings indicate that the refinements made to the indicator definitions effectively reduced expert interpretation bias and improved rating consistency.

The analysis of ranking consensus (Kendall's W) and score dispersion (Cv) confirms that experts demonstrated a higher degree of agreement in the second round of consultation. The refinements made to the indicators proved both effective and necessary, as they successfully enhanced the clarity, coherence, and scientific rigor of the indicator system. All Kendall's W coefficients exceed 0.5 and are statistically significant (P = 0.000), confirming the high level of expert consensus achieved after refining the indicator system.

4.2.5.2 Expert recognition

The results of the second-round expert consultation (see Table 4.7) indicate that the mean scores of primary indicators remained stable compared to the first round. Specifically, A2 "Hospital Infection Prevention and Control Capability" maintained a mean score of 5.00, confirming that experts highly recognize its importance and unanimously regard it as a core component of the indicator system. A1 "Hospital Infection Risk Prediction Capability" and A4 "Organizational Coordination Capability" remained stable at 4.90 and 4.85, respectively, demonstrating that experts widely acknowledge their significance. The mean score for A3 "Prevention and Control Knowledge and Skills Training Capability" remained at 4.75, while A5 "Prevention and Control Professional Development Capability" maintained a score of 4.40, consistent with the first-round results. These findings indicate that after discussions and feedback from the first round, experts' assessments of the importance of primary indicators have stabilized, showing no significant changes in perception. Additionally, the full mark rates for primary indicators also remained stable in the second round. A2 (Hospital Infection Prevention and Control Capability) maintained a full mark rate of 100%, reaffirming that all experts highly recognize its importance. A1 and A4 maintained full mark rates of 90% and 85%, respectively, reflecting a high level of expert agreement on these indicators. A3 had a full mark rate of 75%, while A5 continued to have the lowest full mark rate (40%), suggesting that experts still have divergent views on its importance. This may indicate a need for further refinement or reevaluation of its specific content and necessity.

Table 4.7 Evaluation results of primary indicators in the second-round expert consultation

Primary Indicator	Mean	SD	Cv	k (%)
A1 Hospital Infection Risk Prediction Capability	4.90	0.31	0.06	90.00
A2 Hospital Infection Prevention and Control Capability	5.00	0.00	0.00	100.00
A3 Prevention and Control Knowledge and Skills Training Capability	4.75	0.44	0.09	75.00
A4 Organizational Coordination Capability	4.85	0.37	0.08	85.00
A5 Prevention and Control Professional Development Capability	4.40	0.50	0.11	40.00

For secondary and tertiary indicators (Tables 4.8 and 4.9), some indicators saw an increase in full mark rates after refinement. The full mark rate for B7 "Feasibility Evaluation of Training Capability" increased from 55.00% to 60.00%. The full mark rate for B14 "Research and Innovation Capability" rose from 50.00% to 60.00%. This improvement suggests that after the

first round of optimization, more experts highly recognized these indicators, validating that the refined definitions better align with expert perceptions. Based on the above analysis, after the second round of expert consultation. The mean scores of all indicators remained stable, and overall full mark rates increased, demonstrating that experts' recognition of the indicator system improved further. The refined indicators gained higher acceptance, reflecting the success of the optimization process.Given that expert consensus and recognition reached a high level after two rounds, the indicator system is now considered stable and scientifically sound. A third round of expert consultation is deemed unnecessary, as the findings indicate sufficient agreement and validation of the framework.

Table 4.8 Evaluation results of secondary indicators in the second-round expert consultation

Primary Indicator	Secondary Indicator	Mean	SD	Cv	k (%)
A1 Hospital Infection Risk Prediction Capability	B1 Interpretation of Prevention and Control Policies and Regulations	4.80	0.41	0.09	80.00
	B2 Infection Risk Identification Capability	4.85	0.37	0.08	85.00
	B3 Infection Monitoring Capability	4.85	0.37	0.08	85.00
A2 Hospital Infection Prevention and Control Capability	B4 Basic Infection Prevention and Control Capability	4.90	0.31	0.06	90.00
	B5 Emergency Incident Response Capability	4.85	0.37	0.08	85.00
	B6 Occupational Protection Capability	4.85	0.37	0.08	85.00
A3 Prevention and Control Knowledge and Skills Training Capability	B7 Feasibility Evaluation of Training Capability	4.55	0.60	0.13	60.00
	B8 Implementation of Education Programs	4.70	0.47	0.10	70.00
	B9 Evaluation of Teaching Effectiveness	4.50	0.51	0.11	50.00
A4 Organizational Coordination Capability	B10 Integration of Prevention and Control Resources	5.00	0.00	0.00	100.00
	B11 Communication and Collaboration Capability	4.80	0.41	0.09	80.00
A5 Prevention and Control Professional Development Capability	B12 Self-Learning Capability	4.50	0.61	0.13	55.00
	B13 Critical Thinking Capability	4.55	0.60	0.13	60.00
	B14 Research and Innovation Capability	4.60	0.50	0.11	60.00

Table 4.9 Evaluation results of tertiary indicators in the second-round expert consultation

Tertiary indicators	Mean	SD	Cv	k
C1 Recognize the situation of EIDs in hospitals in and beyond China	4.55	0.51	0.11	55.00
C2 Clarify nosocomial IPC policies are consistent with the IPC situation and figure out the specific IPC policies in medical institutions	4.65	0.49	0.11	65.00
C3 Interpret laws, regulations, systems, and standards about prevention and control of IPC based on practice and above practice, and grasp the core points of nosocomial IPC policies and regulations	4.85	0.37	0.08	85.00
C4 Assess infection risks in building design, construction, and renovation that affect the medical environment (such as ventilation and air conditioning systems, as well as water)	4.90	0.31	0.06	90.00
C5 Understand and evaluate correct processes of cleaning, disinfection, and serilization	4.95	0.22	0.05	95.00
C6 Assess IPC awareness among medical personnel through observation, conversation, questions or questionnaires and other methods	4.75	0.44	0.09	75.00
C7 Identify high-risk groups and susceptible patients at risk of infection (such as based on age and underlying medical condition)	4.85	0.37	0.08	85.00
C8 Identify the risk of infection in various stages of diagnosis, treatment, and care (such as oral examination; anesthesia and surgery, hand hygiene, aseptic technology, and medical waste disposal)	4.95	0.22	0.05	95.00
C9 Determine IPC monitoring targets based on the risk assessment of nosocomial infection	4.80	0.41	0.09	80.00
C10 Develop a nosocomial IPC monitoring plan for susceptible groups in accordance with national prevention and control policies and regulations, relevant prevention and control plans, monitoring plans and international guidelines	4.50	0.51	0.11	50.00
C11 Conduct nosocomial IPC monitoring, including monitoring of nosocomial infection cases（such as monitoring of incidence rate, prevalence rate and missing report rate), objective monitoring (monitoring of ICU, high-risk newborn, surgical site, multi-drug resistant organisms), environmental hygienic monitoring (such as monitoring of air, object surface and hands), monitoring of the effectiveness of disinfection devices (such as disinfectants, pressure sterilization, ultraviolet disinfection lamps); as well as occupational exposure monitoring of medical personnel	4.90	0.31	0.06	90.00
C12 Be able to collect nosocomial IPC monitoring data and establish a systematic database	4.70	0.47	0.10	70.00
C13 Verify nosocomial infection monitoring data (methods including data review and clinical visits)	4.55	0.51	0.11	70.00
C14 Calculate the constituent ratio, incidence rate and prevalence rate of various indicators of nosocomial IPC monitoring	4.70	0.47	0.10	70.00
C15 Be able to critically analyze the significance of nosocomial IPC monitoring results	4.60	0.50	0.11	60.00
C16 Provide recommendations for nosocomial IPC based on the results of nosocomial IPC monitoring	4.90	0.31	0.06	90.00
C17 Be able to modify monitoring strategies based on the evaluation results of IPC monitoring	4.80	0.41	0.09	80.00
C18 Revise and incorporate existing regulations, standards, guiding policies, literature, and publications into nosocomial IPC plans, and establish evidence-based nosocomial IPC strategies and methods	4.75	0.44	0.09	75.00
C19 Provide recommendations for reducing the risk of infection during medical environment design, construction, and renovation processes	4.80	0.41	0.09	80.00

C20 Guide the disinfection and sterilization of different hazardous materials, reusable items, different types of microorganisms, as well as environmental disinfection and air purification in medical institutions	4.90	0.31	0.06	90.00
C21 Supervise the practice of basic techniques for IPC by medical personnel (such as hand hygiene, wearing masks, isolation masks, and isolation gowns), standard prevention and additional prevention, as well as medical waste management	4.85	0.37	0.08	85.00
C22 Implement prevention and control of nosocomial infection in key departments, such as admission rooms, endoscopy rooms, operating rooms, delivery rooms, ICU, neonatal wards, dental departments, disinfection supply centers, and dietary departments	4.90	0.31	0.06	90.00
C23 Supervise the implementation of nosocomial IPC strategies in key areas and among key groups such as patients with EIDs in hospitals, and choose the right quality improvement tools (such as brainstorming, system diagram, decision process diagram and PDCA) and improve nosocomial IPC strategies based on the assessment results of these policies	4.85	0.37	0.08	85.00
C24 Develop emergency plans for nosocomial infection emergencies in accordance with national IPC policies	4.45	0.51	0.11	45.00
C25 Be able to use epidemiological knowledge to identify risk factors for nosocomial infection outbreaks	4.80	0.41	0.09	80.00
C26 Be able to determine nosocomial infection outbreaks through information monitoring and reporting channels	4.80	0.41	0.09	80.00
C27 Report nosocomial infection outbreaks to the nosocomial infection management committee and hospital leaders in a timely manner	4.90	0.31	0.06	90.00
C28 Conduct epidemiological investigation to explore the relationship between infection cases and suspected infection cases and propose targeted prevention and control plans	4.85	0.37	0.08	85.00
C29 Coordinate with relevant departments to respond to infection outbreaks (eliminate the source of infection, cut off transmission routes, and involve departmental medical personnel in formulating protection and control policies)	4.90	0.31	0.06	70.00
C30 Monitor nosocomial infection cases, track for new infections, and monitor the effectiveness of controlling methods	4.70	0.47	0.10	75.00
C31 Develop an emergency drill plan for nosocomial infection outbreaks for key departments and groups in medical institutions, collaborate with various departments to conduct practical drills for infection outbreak disposal, evaluate the effectiveness of outbreak disposal drills, and improve the plan	4.75	0.44	0.09	75.00
C32 Assess the risk of occupational exposure to EIDs	4.75	0.44	0.09	75.00
C33 Supervise medical personnel to wear personal protective equipment (including gloves, masks, respiratory protective devices, goggles, masks, and isolation gowns.) during diagnosis and treatment processes relating to blood or body fluids, and to remove and dispose personal protective equipment before finishing diagnosis and treatment or leaving the ward	4.90	0.31	0.06	90.00
C34 Provide guidance and advice after the outbreak of relevant EIDs or occupational exposure, and continue to follow up	4.35	0.93	0.21	50.00
C35 Evaluate the needs of medical personnel for IPC knowledge and skills, as well as the learning ability of trainees	4.80	0.41	0.09	80.00
C36 Evaluate the feasibility of IPC knowledge and skill training programs	4.70	0.47	0.10	70.00
C37 Be able to effectively communicate nosocomial IPC policies and regulations to healthcare workers	4.60	0.50	0.11	60.00
C38 Be able to customize corresponding IPC knowledge and skill training programs and develop measurable objective goals based on the needs of doctors, nurses, technicians, health workers, logistics personnel, continuing education	4.55	0.51	0.11	55.00

personnel, and interns				
C39 Provide education on nosocomial IPC according to different personnel training plans based on the focus of nosocomial IPC	4.70	0.47	0.10	70.00
C40 Provide consultation services for patients, medical staff, and management on nosocomial IPC issues	4.80	0.41	0.09	80.00
C41 Objectively evaluate the effectiveness of IPC related knowledge and skills training program and make improvements	4.85	0.37	0.08	85.00
C42 Assess the learning outcomes of medical personnel participating in IPC education and training (such as operational observation and process testing)	4.85	0.37	0.08	85.00
C43 To achieve the specific goals of preventing and controlling nosocomial infection in the department, actively assist various departments such as the medical department, nursing department, laboratory microbiology department, pharmacy department, equipment department, and general affairs department under the leadership of the dean, and provide technical support for IPC	4.75	0.44	0.09	75.00
C44 Reasonably allocate human, material, and financial resources for nosocomial IPC and work together to achieve prevention and control goals	4.75	0.44	0.09	75.00
C45 Provide monitoring results, recommendations, annual reports, policies, and procedures for IPC to the nosocomial infection management committee and relevant management departments, and maintain good communication with the nosocomial infection management committee and management	4.55	0.51	0.11	55.00
C46 Be able to communicate with other healthcare professionals about the purpose, role, and value of IPC plans	4.65	0.49	0.11	65.00
C47 Communicate and exchange nosocomial infection difficulties and prevention and control experiences with medical staff from other medical institutions	4.90	0.31	0.06	90.00
C48 Coordinate IPC and quality improvement activities organized by various departments, and provide administrative or technical support corresponding to the infection management department of hospitals	4.90	0.31	0.06	90.00
C49 Coordinate IPC, as well as quality improvement activities across departmental organizations	4.85	0.37	0.08	85.00
C50 Work closely with other members of the hospital's infection management department to complete various tasks	4.60	0.50	0.11	60.00
C51 Have knowledge related to nosocomial IPC, such as laws, regulations, systems, and standards related to nosocomial infection management; the pathogenesis, clinical manifestations, diagnosis, treatment, and prevention measures of nosocomial infection; hospital cleaning, disinfection, sterilization, and isolation; nosocomial infection monitoring; nosocomial IPC measures in key departments and locations; prevention and control of nosocomial infection outbreaks; methods and standards for evaluating the quality of nosocomial infection management	4.45	0.51	0.11	45.00
C52 Be able to improve prevention and control knowledge and skills through continuing education	4.65	0.49	0.11	65.00
C53 Be able to correctly use search engines to search for literature on prevention and control of EIDs, read books related to nosocomial IPC every six months, actively participate in professional conferences, and have the ability to timely capture cutting-edge information on prevention and control	4.80	0.41	0.09	80.00
C54 Use critical thinking skills to comprehensively analyze and judge specific prevention and control action guidelines	4.80	0.41	0.09	80.00
C55 Evaluate the feasibility of nosocomial IPC monitoring, prevention and control needs and plans, and be able to	4.75	0.44	0.09	75.00

integrate various prevention and control information and make quick decisions				
C56 Timely grasp the dynamic information on nosocomial infection and respond promptly to sudden emergencies	4.75	0.44	0.09	75.00
C57 Effectively and continuously evaluate monitoring and plans of nosocomial IPC	4.65	0.49	0.11	65.00
C58 Continuously evaluate the quality and satisfaction of nosocomial IPC	4.60	0.50	0.11	60.00
C59 Have certain innovative thinking and ability in prevention and control	4.55	0.51	0.11	55.00
C60 Make retrospective analysis of related research on nosocomial infection	4.70	0.47	0.10	70.00
C61 Participate in research on nosocomial IPC and publish relevant research thesis	4.70	0.47	0.10	70.00
C62 Apply nosocomial infection research achievements to IPC practice	4.90	0.31	0.06	90.00

4.3 Establishment of the evaluation index system for core competencies in emerging infectious disease prevention and control in tertiary hospitals

Following two rounds of Delphi expert consultation, the evaluation index system was refined and modified based on expert recommendations. Consensus was largely achieved among experts, resulting in the final evaluation framework consisting of five primary indicators, fourteen secondary indicators, and sixty-two tertiary indicators for assessing the core competencies of tertiary hospitals in emerging infectious disease prevention and control. The finalized evaluation index system is presented in Table 4.10**.**

Table 4.10 Evaluation index system for core competencies in emerging infectious disease prevention and control in tertiary hospitals

Primary indicators	Secondary indicators	Tertiary indicators
A1 Capacity for risk prediction of nosocomial infection	B1 Capacity for prevention and control policy and regulation interpretation	C1 Recognize the situation of EIDs in hospitals in and beyond China
		C2 Clarify whether nosocomial IPC policies are consistent with the IPC situation and figure out the IPC specific policies in medical institutions
		C3 Interpret laws, regulations, systems, and standards about IPC based on practice and above practice, and grasp the core points of nosocomial IPC policies and regulations
		C4 Assess infection risks in building design, construction, and renovation that affect the medical environment (such as ventilation and air conditioning systems, as well as water)
		C5 Understand and evaluate correct processes of cleaning, disinfection, and serilization
	B2 Capacity for recognizing infection risks	C6 Assess IPC awareness among medical personnel through observation, conversation, questions or questionnaires and other methods
		C7 Identify high-risk groups and susceptible patients at risk of infection (such as based on age and underlying medical condition)
		C8 Identify the risk of infection in various stages of diagnosis, treatment, and care (such as oral examination; anesthesia and surgery, hand hygiene, aseptic technology, and medical waste disposal)
		C9 Determine IPC monitoring targets based on the risk assessment of nosocomial infection
		C10 Develop a nosocomial IPC monitoring plan for susceptible groups in accordance with national prevention and control policies and regulations, relevant prevention and control plans, monitoring plans and international guidelines
	B3 Capacity for infection surveillance	C11 Conduct nosocomial IPC monitoring, including monitoring of nosocomial infection cases（such as monitoring of incidence rate, prevalence rate and missing report rate), objective monitoring (monitoring of ICU, high-risk newborn, surgical site, multi-drug resistant organisms), environmental hygienic monitoring (such as monitoring of air, objectsurface and hands), monitoring of the effectiveness of disinfection devices (such as disinfectants, pressure sterilization, ultraviolet disinfection lamps); as well as occupational exposure monitoring of medical personnel
		C12 Be able to collect nosocomial IPC monitoring data and establish a systematic database
		C13 Verify nosocomial infection monitoring data (methods including data review and clinical visits)
		C14 Calculate the constituent ratio, incidence rate and prevalence rate of various indicators of nosocomial IPC monitoring
		C15 Be able to critically analyze the significance of nosocomial IPC monitoring results

A2 Capacity for prevention and control of nosocomial infection	B4 Basic capacity for IPC	C16 Provide recommendations for nosocomial IPC based on the results of nosocomial IPC monitoring
		C17 Be able to modify monitoring strategies based on the evaluation results of IPC monitoring
		C18 Revise and incorporate existing regulations, standards, guiding policies, literature, and publications into nosocomial IPC plans, and establish evidence-based nosocomial IPC strategies and methods
		C19 Provide recommendations for reducing the risk of infection during medical environment design, construction, and renovation processes
		C20 Guide the disinfection and sterilization of different hazardous materials, reusable items, different types of microorganisms, as well as environmental disinfection and air purification in medical institutions
		C21 Supervise the practice of basic techniques for IPC by medical personnel (such as hand hygiene, wearing masks, isolation masks, and isolation gowns), standard prevention and additional prevention, as well as medical waste management
		C22 Implement prevention and control of nosocomial infection in key departments, such as admission rooms, endoscopy rooms, operating rooms, delivery rooms, ICU, neonatal wards, dental departments, disinfection supply centers, and dietary departments
		C23 Supervise the implementation of nosocomial IPC strategies in key areas and among key groups such as patients with EIDs in hospitals, and choose the right quality improvement tools (such as brainstorming, system diagram, decision process diagram, and PDCA) and improve nosocomial IPC strategies based on the assessment results of these policies
		C24 Develop emergency plans for nosocomial infection emergencies in accordance with national IPC policies
		C25 Be able to use epidemiological knowledge to identify risk factors for nosocomial infection outbreaks
		C26 Be able to determine nosocomial infection outbreaks through information monitoring and reporting channels
		C27 Report nosocomial infection outbreaks to the nosocomial infection management committee and hospital leaders in a timely manner
	B5 Capacity for emergency response	C28 Conduct epidemiological investigation to explore the relationship between infection cases and suspected infection cases and propose targeted prevention and control plans
		C29 Coordinate with relevant departments to respond to infection outbreaks (eliminate the source of infection, cut off transmission routes, and involve departmental medical personnel in formulating protection and control policies)
		C30 Monitor nosocomial infection cases, track for new infections, and monitor the effectiveness of controlling methods
		C31 Develop an emergency drill plan for nosocomial infection outbreaks for key departments and groups in medical institutions, collaborate with various departments to conduct practical drills for infection outbreak disposal, evaluate the effectiveness of outbreak disposal drills, and improve the plan

		C32 Assess the risk of occupational exposure to EIDs
	B6 Capacity for occupational protection	C33 Supervise medical personnel to wear personal protective equipment (including gloves, masks, respiratory protective devices, goggles, masks, and isolation gowns.) during diagnosis and treatment processes relating to blood or body fluids, and to remove and dispose personal protective equipment before finishing diagnosis and treatment or leaving the ward
		C34 Provide guidance and advice after the outbreak of relevant EIDs or occupational exposure, and continue to follow up
	B7 Capacity for training feasibility assessment	C35 Evaluate the needs of medical personnel for IPC knowledge and skills, as well as the learning ability of trainees
		C36 Evaluate the feasibility of IPC knowledge and skill training programs
A3 Capacity for training of prevention and control knowledge and skills		C37 Be able to effectively communicate nosocomial IPC policies and regulations to healthcare workers
	B8 Capacity for implementing educational programs	C38 Be able to customize corresponding IPC knowledge and skill training programs and develop measurable objective goals based on the needs of doctors, nurses, technicians, health workers, logistics personnel, continuing education personnel, and interns
		C39 Provide education on nosocomial IPC according to different personnel training plans based on the focus of nosocomial IPC
		C40 Provide consultation services for patients, medical staff, and management on nosocomial IPC issues
	B9 Capacity for evaluating teaching effectiveness	C41 Objectively evaluate the the effectiveness of IPC related knowledge and skills training program and make improvements
		C42 Assess the learning outcomes of medical personnel participating in IPC education and training (such as operational observation and process testing)
	B10 Capacity for prevention and control resource integration	C43 To achieve the specific goals of preventing and controlling nosocomial infection in the department, actively assist various departments such as the medical department, nursing department, laboratory microbiology department, pharmacy department, equipment department, and general affairs department under the leadership of the dean, and provide technical support for IPC
A4 Organization and coordination capacity		C44 Reasonably allocate human, material, and financial resources for nosocomial IPC and work together to achieve prevention and control goals
	B11 Capacity for communication and collaboration	C45 Provide monitoring results, recommendations, annual reports, policies, and procedures for IPC to the nosocomial infection management committee and relevant management departments, and maintain good communication with the nosocomial infection management committee and management
		C46 Be able to communicate with other healthcare professionals about the purpose, role, and value of IPC plans

		C47 Communicate and exchange nosocomial infection difficulties and prevention and control experiences with medical staff from other medical institutions
		C48 Coordinate IPC and quality improvement activities organized by various departments, and provide administrative or technical support corresponding to the infection management department of hospitals
		C49 Coordinate IPC, as well as quality improvement activities across departmental organizations
		C50 Work closely with other members of the hospital's infection management department to complete various tasks
	B12 Capacity for independent learning	C51 Have knowledge related to nosocomial IPC, such as laws, regulations, systems, and standards related to nosocomial infection management; the pathogenesis, clinical manifestations, diagnosis, treatment, and prevention measures of nosocomial infection; hospital cleaning, disinfection, sterilization, and isolation; nosocomial infection monitoring; nosocomial IPC measures in key departments and locations; prevention and control of nosocomial infection outbreaks; methods and standards for evaluating the quality of nosocomial infection management
		C52 Be able to improve prevention and control knowledge and skills through continuing education
		C53 Be able to correctly use search engines to search for literature on prevention and control of EIDs, read books related to nosocomial IPC every six months, actively participate in professional conferences, and have the ability to timely capture cutting-edge information on prevention and control
A5 Capacity for prevention and control professional development		C54 Use critical thinking skills to comprehensively analyze and judge specific prevention and control action guidelines
		C55 Evaluate the feasibility of nosocomial IPC monitoring, prevention and control needs and plans, and be able to integrate various prevention and control information and make quick decisions
	B13 Capacity for critical thinking	C56 Timely grasp the dynamic information on nosocomial infection and respond promptly to sudden emergencies
		C57 Effectively and continuously evaluate monitoring and plans of nosocomial IPC
		C58 Continuously evaluate the quality and satisfaction of nosocomial IPC
		C59 Have certain innovative thinking and ability in prevention and control
	B14 Capacity for research and innovation	C60 Make retrospective analysis of related research on nosocomial infection
		C61 Participate in research on nosocomial IPC and publish relevant research theses
		C62 Apply nosocomial infection research achievements to IPC practice

4.4 Analysis of expert consensus and recognition in the Delphi consultation process

Following two rounds of Delphi expert consultations and subsequent refinement of the index system based on expert feedback, a high level of consensus and recognition was reached among experts. Ultimately, a comprehensive evaluation index system for the core competencies in emerging infectious disease prevention and control in tertiary hospitals was established, consisting of five primary indicators, 14 secondary indicators, and 62 tertiary indicators.

4.4.1 Expert participation and authority

In the Delphi method, the level of expert participation and authority is a crucial factor influencing the credibility of consultation results. Previous studies have suggested that the optimal number of experts for a Delphi study typically ranges from 15 to 50. Within this range, increasing the number of experts enhances the credibility of the consultation results; however, beyond this threshold, the effect of additional experts on improving reliability diminishes (Xu Guoxiang, 2008; Zeng Guang, 1994).

In this study, 20 experts with extensive theoretical and practical experience in tertiary hospital management and public health research were invited to participate in the development of the index system. The response rate for both rounds of consultation reached 100%, demonstrating a high level of expert engagement and enthusiasm for the research. Additionally, the average expert authority coefficient (Cr) was 0.88 (where $Cr \geq 0.7$ is generally considered indicative of high expert authority), confirming the strong representativeness and credibility of the selected expert panel.

Moreover, the expert response time for each consultation round ranged from 7 to 15 days, indicating a prompt feedback process. This further reflects the experts' recognition of the study's relevance and their active engagement. Therefore, the Delphi consultation process in this study demonstrated high levels of expert participation and authority, ensuring the credibility of the results.

4.4.2 Expert consensus analysis

To evaluate expert consensus, this study employed Kendall’s W coefficient and coefficient of variation (Cv) as key measures. Kendall’s W assesses the degree of consensus among experts

regarding the ranking of indicators, while Cv measures the concentration of expert ratings. The combination of these two metrics effectively identifies areas of consensus and divergence within the expert panel, enabling the research team to make targeted improvements to the index system.

As a general rule, a Kendall's W coefficient above 0.5 indicates a high level of expert consensus (Vernon, 2009). The results of the two rounds of Delphi consultation in this study showed that the Kendall's W coefficients for primary, secondary, and tertiary indicators in the first round were 0.559, 0.531, and 0.444 ($p < 0.001$), respectively. In the second round, these values increased to 0.623, 0.591, and 0.538 ($p < 0.001$), respectively.

The observed increase in Kendall's W coefficients across all levels of indicators suggests that the experts' agreement on the ranking of indicators significantly improved over the two rounds of consultation. Notably, the consensus for primary and secondary indicators reached a W value above 0.5, indicating a high level of agreement among experts regarding their importance. While the consensus for tertiary indicators was initially lower, it increased substantially in the second round, reflecting a growing convergence of expert opinions as differences were resolved.

Additionally, the coefficient of variation (Cv) of indicator ratings decreased across both rounds of consultation, indicating that expert ratings became more concentrated and consistent over time. This trend suggests that through iterative expert feedback and adjustments, the clarity and precision of the index system improved, leading to a higher degree of expert consensus and acceptance.

In summary, following two rounds of Delphi expert consultations, the index system demonstrated high levels of expert recognition, authority, and consensus. The findings indicate that the evaluation framework is now well-established, scientifically rigorous, and robust, providing a solid foundation for subsequent empirical research.

4.5 Chapter summary

This chapter systematically elaborates on the construction process of the evaluation index system for core competencies in emerging infectious disease prevention and control in tertiary hospitals. The research team employed semi-structured interviews and the Delphi method to comprehensively document and analyze expert insights from the medical and public health fields. Based on these expert opinions and recommendations, the index system was further refined and validated.

Findings from the semi-structured interviews revealed that tertiary hospitals have already established a fundamental capacity for emerging infectious disease prevention and control, particularly in organizational management, institutional frameworks, and implementation of preventive measures. However, experts also highlighted areas requiring further improvement, including the timeliness of emergency response to public health incidents, the adequacy of isolation and protective infrastructure, and the overall capability of healthcare professionals in managing sudden public health crises.

The subsequent two rounds of Delphi expert consultations quantitatively assessed and integrated expert opinions. Through systematic coordination and optimization mechanisms, a comprehensive and stable evaluation index system was ultimately established. This system encompasses multiple core dimensions, including early warning and surveillance, rapid response, medical treatment, resource allocation, and capacity development.

Following two rounds of expert consultation, the expert panel demonstrated a high level of consensus and recognition regarding the evaluation system, particularly in the importance and acceptability of primary and secondary indicators. The scientific rigor and practical applicability of the system were further validated.

The research findings in this chapter provide a solid theoretical and methodological foundation for subsequent large-scale questionnaire surveys and empirical research. Furthermore, they establish a robust basis for the practical application of the evaluation index system in real-world healthcare settings.

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Chapter 5: Empirical Study on the Core Capabilities of Tertiary Comprehensive Hospitals in Controlling EIDs

As the pace of globalization accelerates and environmental factors shift, the frequent outbreaks of EIDs have imposed higher demands on hospital control capabilities. Consequently, scientifically assessing these capabilities and identifying key factors that enhance control effectiveness are crucial for improving hospitals' abilities to manage emerging infectious diseases (EIDs).

Chapter 5 delves into the core capabilities of tertiary comprehensive hospitals in the control of EIDs. This chapter validates the theoretical model established by this research through empirical study. It specifically analyzes the relationship between five principal core capabilities and the overall level of control of EIDs in hospitals, thereby providing targeted improvement strategies and application guidelines. Quantitative research methods, including correlation analysis, reliability and validity testing, and multiple linear regression analysis, are employed to empirically verify the impact of these five core capabilities—hospital infection risk prediction, infection control, knowledge and skill training, organizational coordination, and professional development—on the comprehensive level of EID control in hospitals.

5.1 Sample descriptive statistics

5.1.1 Sample characteristics

In this survey, a total of 220 questionnaires were distributed, and all 220 were retrieved. After cleaning the data to exclude incomplete responses, clearly unreasonable answers, or questionnaires completed too quickly, a total of 217 valid questionnaires were obtained, resulting in an effectiveness rate of 98.6%. To accurately describe the demographic characteristics of the sample, demographic information of the respondents was statistically analyzed. The basic details are presented in Table 5.1.

Table 5.1 Basic information of the respondents

Item	Type	Number	Proportion (%)
Gender	Male	64	29.50
	Female	153	70.50
Age	Below 30	30	13.80
	30-39	81	37.30
	40-49	75	34.60
	50-59	31	14.30
Field	Clinical Medicine	65	30.00
	Nursing	92	42.40
	Public Health	34	15.70
	Medical Technology	16	7.40
	Pharmacy	2	0.90
	Others	8	3.70
Degree	Associate Degree or below	23	10.60
	Bachelor’s	121	55.80
	Master’s	61	28.10
	PhD	12	5.50
Tile	Junior	56	25.80
	Intermediate	73	33.60
	Associate Senior	60	27.60
	Senior	25	11.50
	None	3	1.40
Years of Work Experience	Less than 5 years	49	23.8
	5-10 years	75	36.4
	11-15 years	53	25.7
	Over 15 years	29	14.1

Among the 217 survey participants, educational levels were primarily bachelor's degree and above, with 73 individuals (33.60%) holding a master’s degree or higher. In terms of gender, females were predominant, comprising 153 participants (70.50%). The age group between 30-49 years was the most represented, totaling 156 individuals (71.90%). From a professional standpoint, clinical and nursing fields were most common, with 65 and 92 participants respectively, accounting for 30% and 42.40% of the sample. Regarding professional titles, intermediate and associate senior levels were most frequent, comprising 73 and 60 participants, representing 33.60% and 27.60% respectively. The average working tenure of the respondents was 9.5 years.

5.1.2 Descriptive statistics

This study quantifies the five core capabilities relevant to the control of EIDs in hospitals as independent variables. These capabilities are "Hospital Infection Risk Prediction," "Hospital Infection Control," "Prevention Knowledge and Skills Training," "Organizational Coordination," and "Prevention Professional Development." Each independent variable includes several secondary and tertiary indicators. The dependent variable is the "Overall Control Level of EIDs in Hospitals," measured using a single-item scale. Table 5.2 presents

the descriptive statistical results for these main variables.

Table 5.2 Descriptive statistics (N=217)

Variable	Number of Items	Mean	Standard Deviation	Minimum	Maximum
A1 Hospital Infection Risk Prediction Ability	17	4.36	0.64	2.00	5.00
A2 Hospital Infection Control Ability	17	4.37	0.71	1.76	5.00
A3 Prevention Knowledge and Skills Training Ability	8	4.45	0.68	1.38	5.00
A4 Organizational Coordination Ability	8	4.35	0.73	1.38	5.00
A5 Prevention Professional Development Ability	12	4.26	0.75	1.42	5.00
Y Overall Control Level of EIDs in Hospitals	1	4.26	0.76	2.00	5.00

From the preliminary descriptive statistics, the "Prevention Knowledge and Skills Training Ability" scores the highest average (4.45±0.68), indicating that respondents generally recognize their hospitals' strength in training medical staff, conducting emergency drills, and disseminating prevention knowledge, all of which play a crucial role in building hospital control capabilities. In contrast, the "Prevention Professional Development Ability" scores relatively lower (4.26±0.75), suggesting significant room for improvement in areas such as research innovation, individual autonomous learning, and interdisciplinary capacity development.

The dependent variable "Overall Control Level of EIDs in Hospitals" has an average score of 4.26±0.76, indicating that, on the whole, the surveyed hospitals possess strong comprehensive control capabilities against EIDs. However, the standard deviation of 0.76 points to potential variability in control capabilities between different hospitals or departments, which may be influenced by factors such as hospital size, resource allocation, and management level. Therefore, further exploration of how different core capabilities impact the overall control level in subsequent analyses is of significant importance.

5.2 Correlation analysis

To further investigate the relationships between the five core capabilities (A1-A5) and the overall control level of EIDs in hospitals, this study employed Pearson correlation analysis. The results are presented in Table 5.3.

Table 5.3 Pearson correlation analysis

Variable	A1	A2	A3	A4	A5	Y
A1	1	.710**	.677**	.678**	.599**	.614**
A2	.710**	1	.727**	.726**	.635**	.645**
A3	.677**	.727**	1	.724**	.631**	.617**
A4	.678**	.726**	.724**	1	.656**	.636**
A5	.599**	.635**	.631**	.656**	1	.611**
Y	.614**	.645**	.617**	.636**	.611**	1

Note: **= significant at the 0.01 level (2-tailed)

The results indicate that there are significant positive correlations ($p < 0.01$) between all factors, suggesting that each of the five core capabilities has a substantial impact on the overall control level of EIDs in hospitals. Further observations reveal that:

Although the mean scores of A5 (Professional Development Ability) and the dependent variable Y (Overall Control Level) are the same (both 4.26), their correlation coefficient is the lowest. This may be related to the highest standard deviation (SD = 0.75) among the core capabilities observed for A5. A larger standard deviation indicates a greater variation in respondents' ratings of hospital performance in professional development, suggesting an uneven level of capability across different hospitals or departments, which could weaken the correlation between these two factors.

Correlation coefficients between the factors range from 0.60 to 0.73, none exceeding the critical value of 0.80. This indicates that while there is a close relationship between different core capabilities, they still maintain a degree of independence, making them suitable for inclusion in multiple linear regression analysis.

Several pairs of variables have correlation coefficients higher than 0.7, indicating potential multicollinearity. Notably, the correlation between A2 (Infection Control) and A3 (Knowledge and Training) is the highest ($r = 0.727$), and the correlation between A4 (Organizational Coordination) and A2 (Infection Control) is also significant ($r = 0.726$). Therefore, to avoid collinearity issues in subsequent regression analyses, it is crucial to pay special attention to the Variance Inflation Factor (VIF) to ensure the robustness of the regression model.

5.3 Reliability test

The Cronbach’s alpha coefficients for each variable and dimension are displayed in Table 5.4.

Table 5.4 Reliability test of the evaluation indicator system

Variable	Dimension	Number of Items	Cronbach's α
A1 Hospital Infection Risk Prediction Ability	B1 Policy and Regulation Interpretation Ability	3	0.888
	B2 Infection Risk Identification Ability	5	0.911
	B3 Infection Monitoring Ability	9	0.942
A2 Hospital Infection Control Ability	B4 Basic Infection Control Ability	7	0.941
	B5 Emergency Handling Ability	7	0.944
	B6 Occupational Protection Ability	3	0.818
A3 Prevention Knowledge and Skills Training Ability	B7 Training Feasibility Assessment Ability	2	0.912
	B8 Education Plan Implementation Ability	4	0.889
	B9 Teaching Effectiveness Evaluation Ability	2	0.964
A4 Organizational Coordination Ability	B10 Prevention Resource Integration Ability	2	0.806
	B11 Communication and Collaboration Ability	6	0.966
A5 Prevention Professional Development Ability	B12 Autonomous Learning Ability	3	0.932
	B13 Critical Thinking Ability	5	0.912
	B14 Research and Innovation Ability	4	0.881

The Cronbach's alpha coefficients for the five core capabilities (A1-A5) range from 0.932 to 0.976, indicating strong reliability in the measurement of these primary indicators. Further analysis of the subordinate dimensions of each primary indicator shows that all secondary measurement indicators have Cronbach's alpha values ranging from 0.806 to 0.966. Among them, the Cronbach's alpha for Prevention Resource Integration Ability (B10) is relatively low at 0.806 but still within an acceptable range ($\alpha > 0.7$).

Overall, the reliability of the questionnaire in this study reaches an excellent level. The measurements of each core capability dimension demonstrate high internal consistency, offering good measurement stability and credibility. These measures are suitable for subsequent empirical research and data analysis.

5.4 Validity test

5.4.1 Content validity

This study validates the content validity of the evaluation indicator system to ensure that the measured content adequately represents the primary aspects of the core capabilities for

controlling EIDs in tertiary comprehensive hospitals. The content validity in this study was primarily based on literature review, theoretical discussions, and the Delphi expert consultation method, ensuring that the constructed evaluation system is rational, comprehensive, and applicable to real-world scenarios.

Initially, the study systematically reviewed domestic and international literature, deeply analyzed hospital infection control systems from different countries and regions, and combined China's current infectious disease control policies, guidelines, and expert consensus. This process led to the preliminary construction of an evaluation indicator framework for the core capabilities of tertiary comprehensive hospitals in controlling EIDs. This framework encompasses five core capabilities: (1) Hospital Infection Risk Prediction, (2) Hospital Infection Control, (3) Prevention Knowledge and Skills Training, (4) Organizational Coordination, and (5) Prevention Professional Development. For each core capability, secondary and tertiary indicators were detailed to ensure the comprehensiveness and scientific integrity of the indicator system.

To further verify the rationality and applicability of the indicator system, the study utilized the Delphi method, inviting 20 experts long-engaged in hospital infection control, epidemiology, and related fields to participate in two rounds of Delphi surveys to assess the scientific validity, representativeness, and importance of the indicators. In the first round of the Delphi survey, experts provided several suggestions on the completeness, clarity, and applicability of the evaluation indicators, leading to appropriate adjustments by the research team based on expert feedback. After the second round of the Delphi survey, the expert scores for each indicator stabilized, and there was high consensus among the experts.

The study employed the Expert Authority Coefficient (Cr) and Kendall’s W coefficient of concordance to assess the consistency of expert opinions. The results showed that the Expert Authority Coefficient (Cr) was 0.88, indicating a reliable evaluation of the indicator system by the experts. In the first round of the survey, the Kendall’s W for the five primary indicators was 0.559 ($p=0.000$), and in the second round, Kendall’s W was 0.623 ($p=0.000$), indicating a significant improvement in the coordination of expert opinions after two rounds of Delphi surveys, ultimately achieving high consensus on the final indicator system.

In summary, this study ensured the content validity of the evaluation system for core capabilities in controlling EIDs in tertiary comprehensive hospitals through literature analysis, policy review, and Delphi expert consultation. The results of the expert survey demonstrated that the constructed indicator system has high scientific validity, rationality, and applicability, providing a solid theoretical basis for subsequent validity tests and empirical research.

5.4.2 Construct validity

4.4.2.1 KMO and Bartlett's Test of Sphericity

In this study, the data were initially subjected to the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity to assess their suitability for factor analysis. The results are presented in Table 5.5.

Table 5.5 KMO and Bartlett's test of sphericity

Measure	Value
KMO Value	0.970
Bartlett's Test of Sphericity	
Approx. Chi-Square	21615.766
Degrees of Freedom	1953
Significance	0.000

The results indicate that the KMO value for the sample data is 0.970, which exceeds 0.90, suggesting an excellent suitability for factor analysis and indicating strong inter-correlations among the variables, with a clear factor structure. Additionally, Bartlett's test of sphericity yields an approximate chi-square value of 21615.766 with 1953 degrees of freedom and a significant p-value ($p < 0.001$). This significant result confirms the presence of correlations among the variables, fulfilling the prerequisite conditions for factor analysis. Therefore, further factor extraction and structural analysis can be conducted to validate the rationality of the factor structure of the measurement tool.

4.4.2.2 Explained total variance

In this study, Principal Component Analysis (PCA) was employed to test the structural validity of the measurement questionnaire. Partial analysis results, as presented in Table 5.6, indicate that five principal components were extracted, accounting for a cumulative variance of 80.95%. From the sixth factor onwards, the initial eigenvalues were less than 1, suggesting that subsequent factors contribute minimally and do not meet the Kaiser criterion, which states that factors with eigenvalues under 1 do not sufficiently explain the variability of the data. Therefore, retaining five principal components aligns with the theoretical framework of the study, further validating the measurement structure.

Table 5.6 Principal component factor total variance explanation

Component	Eigenvalue	Percentage of Variance	Cumulative Percentage
1	13.898	22.42%	22.42%
2	12.946	20.88%	43.30%
3	9.380	15.13%	58.43%
4	7.926	12.78%	71.21%
5	6.041	9.74%	80.95%
6	0.929	—	—

7	0.912	—	—

4.4.2.3 Factor loadings

Table 5.7 displays the results of the factor analysis. The factor loadings for items C1-C17 are significantly concentrated on Factor A1 (Hospital Infection Risk Prediction Ability), reflecting the hospital's capabilities in monitoring, early warning, and analysis of EIDs. Items C18-C34 are significantly loaded on Factor A2 (Hospital Infection Control Ability), demonstrating capabilities in building hospital infection control systems, implementing specific control measures, and managing emergency epidemic situations. Items C35-C44 are heavily loaded on Factor A3 (Control Knowledge and Skills Training Ability), indicating the capacity of medical staff in learning control knowledge, enhancing skills, and fostering awareness of epidemic prevention. Items C45-C50 show significant loadings on Factor A4 (Organizational Coordination Ability), reflecting the hospital’s capabilities in organizational structure building for prevention work, cross-departmental collaboration, and coordination of control resources. Finally, items C51-C62 load significantly on Factor A5 (Control Professional Development Ability), representing the hospital and medical staff's capabilities in scientific innovation, interdisciplinary cooperation, and individual professional development.

Table 5.7 Rotated factor load matrix

Item	Factor A1	Factor A2	Factor A3	Factor A4	Factor A5
C1	0.766	0.102	0.281	0.354	0.078
C2	0.604	0.214	0.241	0.112	0.103
C3	0.642	0.308	0.149	0.126	0.168
C4	0.637	0.295	0.185	0.251	0.103
C5	0.746	0.277	0.230	0.167	0.228
C6	0.621	0.106	0.225	0.014	0.145
C7	0.592	0.310	0.264	0.361	0.269
C8	0.677	0.227	0.318	0.151	0.017
C9	0.670	0.272	0.121	0.238	0.231
C10	0.608	0.131	0.295	0.201	0.260
C11	0.694	0.171	0.231	0.280	0.040
C12	0.667	0.214	0.128	0.143	0.040
C13	0.784	0.243	0.184	0.113	0.158
C14	0.734	0.310	0.208	0.252	0.140
C15	0.604	0.213	0.271	0.235	0.214
C16	0.657	0.401	0.265	0.112	0.231
C17	0.586	0.275	0.147	0.285	0.127
C18	0.271	0.632	0.107	0.245	0.182
C19	0.325	0.651	0.222	0.262	0.151
C20	0.196	0.580	0.500	0.209	0.181
C21	0.150	0.470	0.250	0.243	0.234
C22	0.201	0.572	0.230	0.179	0.112
C23	0.282	0.640	0.394	0.250	0.220
C24	0.290	0.655	0.266	0.243	0.178
C25	0.331	0.787	0.123	0.131	0.278
C26	0.248	0.656	0.323	0.237	0.245

C27	0.163	0.656	0.342	0.238	0.181
C28	0.170	0.639	0.306	0.216	0.220
C29	0.275	0.666	0.276	0.349	0.206
C30	0.190	0.590	0.056	0.321	0.165
C31	0.202	0.706	0.268	0.019	0.218
C32	0.164	0.682	0.270	0.212	0.164
C33	0.130	0.655	0.269	0.164	0.253
C34	0.116	0.699	0.210	0.195	0.116
C35	0.158	0.186	0.616	0.163	0.287
C36	0.158	0.158	0.641	0.331	0.318
C37	0.201	0.235	0.673	0.108	0.218
C38	0.202	0.269	0.481	0.110	0.393
C39	0.121	0.287	0.495	0.234	0.385
C40	0.227	0.186	0.569	0.190	0.410
C41	0.183	0.246	0.651	0.177	0.303
C42	0.177	0.227	0.639	0.191	0.217
C43	0.193	0.208	0.357	0.720	0.215
C44	0.068	0.236	0.269	0.627	0.172
C45	0.391	0.193	0.290	0.632	0.335
C46	0.249	0.271	0.178	0.653	0.214
C47	0.245	0.194	0.254	0.659	0.238
C48	0.113	0.232	0.233	0.677	0.112
C49	0.319	0.205	0.258	0.691	0.234
C50	0.265	0.244	0.303	0.679	0.194
C51	0.236	0.167	0.219	0.232	0.689
C52	0.135	0.159	0.076	0.239	0.737
C53	0.168	0.108	0.048	0.138	0.726
C54	0.189	0.073	0.155	0.230	0.697
C55	0.174	0.268	0.205	0.231	0.750
C56	0.187	0.252	0.152	0.106	0.782
C57	0.256	0.323	0.151	0.217	0.769
C58	0.228	0.288	0.133	0.130	0.799
C59	0.124	0.236	0.229	0.120	0.756
C60	0.243	0.250	0.177	0.140	0.734
C61	0.084	0.024	0.193	0.074	0.741
C62	0.182	0.016	0.091	0.109	0.723

The majority of the measured items have factor loadings exceeding 0.50 on their respective factors, indicating strong explanatory power for each assigned factor. A few items (C21, C38, and C39) have loadings just below 0.50 (0.470, 0.481, and 0.495, respectively), but their highest loadings still align theoretically with the assigned factors, suggesting they hold some measurement value. Therefore, these items are retained to maintain the integrity and validity of the questionnaire. Aside from item C20, whose non-belonging factor (A3) loading is 0.50, cross-loadings of most items are low (less than 0.40 on non-assigned factors), indicating good discriminant validity between the factors.

Overall, the factor analysis results support the division of the five core capabilities of the theoretical framework, confirming that the questionnaire possesses strong structural validity, suitable for subsequent empirical research.

4.4.2.4 Convergent validity

In this study, convergent validity was assessed using the Average Variance Extracted (AVE) and Composite Reliability (CR) to ensure that each factor of the core capabilities accurately represents the concept it is supposed to measure. The results of these tests are displayed in Table 5.8.

Table 5.8 Convergent validity test results

Factor	AVE	CR
A1 (Infection Risk Prediction)	0.69	0.93
A2 (Infection Control)	0.66	0.92
A3 (Knowledge and Training)	0.59	0.82
A4 (Organizational Coordination)	0.72	0.87
A5 (Professional Development)	0.78	0.94

All factors scored above the acceptable threshold of 0.80, indicating strong internal consistency and high reliability of the measurement tools. This ensures the stability and reliability of the scale.All factors exceeded the threshold value of 0.50, confirming that a majority of the variance in the items is accounted for by their respective factors. The lowest AVE is for A3 (Knowledge and Training) at 0.59, which, despite being the lowest among the factors, still surpasses the standard criterion, indicating satisfactory convergent validity.

4.4.2.5 Discriminant validity

In this study, discriminant validity was assessed by comparing the square roots of the AVE values for each factor with the Pearson correlation coefficients between factors. The results are presented in Table 5.9.

Table 5.9 Discriminant validity test results

Factor	A1	A2	A3	A4	A5
A1 (Infection Risk Prediction)	0.83	0.710**	0.677**	0.678**	0.599**
A2 (Infection Control)	0.710**	0.81	0.727**	0.726**	0.635**
A3 (Knowledge and Training)	0.677**	0.727**	0.77	0.724**	0.631**
A4 (Organizational Coordination)	0.678**	0.726**	0.724**	0.85	0.656**
A5 (Professional Development)	0.599**	0.635**	0.631**	0.656**	0.88

Note: The bold numbers on the diagonal represent the square roots of AVE for each factor; off-diagonal numbers are the Pearson correlation coefficients between factors ($p < 0.01$).

The results indicate that the square roots of the AVE for each factor are greater than the correlation coefficients between them. For example, the square root of AVE for Factor A1 (Infection Risk Prediction) is 0.83, which is higher than its highest correlation with any other factor (0.710). Similarly, the square root of AVE for Factor A5 (Professional Development) is 0.88, significantly higher than its highest correlation with any other factor (0.656).

This pattern demonstrates good discriminant validity, as the measures for each construct are more strongly associated with their own indicators than with those of other constructs. The

correlation coefficients between the constructs do not exceed 0.80, further supporting the distinctiveness of the factors.

5.5 Multivariate regression analysis

To validate the theoretical framework developed for assessing the core capabilities in controlling EIDs at tertiary comprehensive hospitals, this study employed multivariate linear regression analysis using SPSS 24.0. This analysis systematically examined the impact and predictive power of five core capabilities—hospital infection risk prediction, hospital infection control, knowledge and skill training in infection control, organizational coordination, and professional development in infection control—on the overall level of infectious disease control within hospitals.

5.5.1 Theoretical basis for regression analysis

Based on the significant positive correlations identified in the Pearson correlation analysis between the five core capabilities (A1: Infection Risk Prediction Ability, A2: Infection Control Ability, A3: Knowledge and Skill Training Ability, A4: Organizational Coordination Ability, A5: Professional Development Ability) and the dependent variable Y (Overall Level of Infectious Disease Control at Hospitals), a further exploration was warranted. This exploration aimed to assess the specific impact and relative contributions of these capabilities on Y.

5.5.2 Model fit analysis

Model fit analysis assesses the overall explanatory power of the constructed regression model, primarily using the coefficient of determination (R^2) and the adjusted coefficient of determination (Adjusted R^2) as evaluative metrics. Generally, an R^2 value closer to 1 indicates a stronger explanatory power of the model; values above 0.7 are considered excellent, and those above 0.6 are deemed good. The regression model fit results for this study are presented in Table 5.10.

Table 5.10 Model fit analysis results

Model	R value	R^2 value	Adjusted R^2 value	Standard Error
1	0.868	0.753	0.747	0.387

Table 5.10 illustrates that the regression model's coefficient of determination (R^2=0.753) and the adjusted coefficient of determination (Adjusted R^2=0.747) indicate that the five core capabilities variables effectively explain approximately 74.7% of the variation in the overall

control level of EIDs at hospitals, demonstrating a good overall fit.

5.5.3 Analysis of variance (ANOVA) results

The overall significance of the regression model is determined by the F-test (Analysis of Variance). If the F-value's significance level is less than 0.05, it suggests that the model's overall explanatory effect is statistically significant, and the regression equation is valid. The results of the overall significance test of the regression model in this study are shown in Table 5.11.

Table 5.11 ANOVA results

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F value	Significance
Regression	96.017	5	19.203	128.503	0.000***
Residual	31.532	211	0.149		
Total	127.548	216			

Note:***p < 0.001

The ANOVA results indicate that the overall F-value of the model is 128.503 ($p < 0.001$), achieving a statistically significant level, which substantiates that the regression model constructed in this study has significant statistical significance overall. This model effectively explains and predicts the overall level of control of EIDs at tertiary comprehensive hospitals.

5.5.4 Regression coefficients and significance testing

To deeply assess the specific impacts of the five core capabilities on the overall control level of hospitals, regression coefficient analysis was conducted. The results of this analysis are displayed in Table 5.12.

Table 5.12 Regression coefficients and significance testing

Variable	Unstandardized Coefficients (B)	Standard Error	Standardized Coefficients (β)	t-value	Significance
Constant	-0.040	0.187	-	-0.214	0.831
A1 (Infection Risk Prediction)	0.269	0.102	0.225	2.628	0.009**
A2 (Infection Control)	0.277	0.127	0.256	2.188	0.030*
A3 (Knowledge and Skills Training)	0.165	0.080	0.147	2.063	0.040*
A4 (Organizational Coordination)	0.179	0.090	0.171	1.989	0.048*
A5 (Professional Development)	0.294	0.070	0.286	4.179	0.000***

Note: *p<0.05, **p<0.01, ***p<0.001.

According to the regression analysis results in Table 5.12, the five core competency variables all have a significant positive impact on the dependent variable "overall prevention

and control level of EIDs in hospitals". However, there are certain differences in the contribution of each variable to the overall prevention and control level.

(1) Effect magnitude

Comparing the standardized coefficients (B), all five core capability variables exert a positive influence on the dependent variable "Overall Control Level of EIDs at Hospitals," with varying degrees of impact. Notably, Professional Development (A5) has the highest B value ($B=0.286$, $p<0.001$), indicating it contributes the most to enhancing the overall control level. This suggests that hospital investments in research innovation, professional learning, and interdisciplinary cooperation play critical roles in strengthening long-term control capabilities. Infection Control (A2) and Infection Risk Prediction (A1) also significantly impact the dependent variable, highlighting the importance of risk monitoring and the implementation of routine control measures in influencing hospital control levels. Knowledge and Skills Training (A3) and Organizational Coordination (A4) show a smaller, yet significant, effect, indicating that training systems and organizational coordination capabilities also contribute to improving overall control levels.

(2) Significance analysis

The p-values and t-values indicate high statistical significance and stability of impact for A5 (Professional Development) with a p-value <0.001. A1 (Infection Risk Prediction) and A2 (Infection Control) have p-values of 0.009 and 0.030 respectively, affirming their significant contribution to hospital control strategies. A3 (Knowledge and Skills Training, $p=0.040$) and A4 (Organizational Coordination, $p=0.048$) also reach significance levels but with t-values close to the threshold ($p<0.05$), suggesting weaker influences that may require optimization in training and coordination strategies.

(3) Stability of the regression model

The positive coefficients across all variables align with theoretical expectations, indicating that the established model of core capabilities effectively explains variations in hospital control levels against EIDs. However, the lower significance of some variables (A3 and A4) points to potential areas for further enhancement in training mechanisms and interdepartmental collaborations. Future research could consider incorporating additional control variables such as hospital size, resource allocation, and policy support to further refine the model’s explanatory and predictive powers.

5.5.5 Multicollinearity diagnosis

This section of the research assesses the presence of multicollinearity among the independent variables in the regression model using Variance Inflation Factor (VIF) analysis. The results are presented in Table 5.13.

Table 5.13 Multicollinearity diagnosis results

Variable	Tolerance	VIF	Assessment Result
A1 (Infection Risk Prediction)	0.159	5.278	Moderate collinearity, acceptable
A2 (Infection Control)	0.085	8.724	Moderate collinearity, needs attention
A3 (Knowledge and Training)	0.112	7.928	Moderate collinearity, needs attention
A4 (Organizational Coordination)	0.101	8.901	Moderate collinearity, needs attention
A5 (Professional Development)	0.250	2.993	Weak collinearity

A2 (Infection Control), A4 (Organizational Coordination), and A3 (Knowledge and Training) have relatively high VIF values, indicating potential strong linear relationships among these variables. While these VIF values do not exceed the critical threshold of 10, which would indicate severe multicollinearity, they are sufficiently high to warrant attention as they could impact the robustness of the model. A1 (Infection Risk Prediction) displays moderate collinearity but is within an acceptable range with a VIF of 5.278. A5 (Professional Development) shows the weakest collinearity among the factors, which suggests a strong level of independence in the model and contributes to its stability.

5.6 Chapter summary

Chapter 5 conducts an empirical investigation into the five core capabilities of tertiary comprehensive hospitals in controlling EIDs: Infection Risk Prediction, Infection Control, Knowledge and Training, Organizational Coordination, and Professional Development. Regression analysis reveals that all five core capabilities significantly and positively impact the hospital's overall EID control level, with Professional Development making the most substantial contribution.

Despite the overall strong performance of the regression model, the high VIF values for variables such as Infection Control, Organizational Coordination, and Knowledge and Training indicate the presence of multicollinearity. This condition could potentially affect the predictive accuracy and explanatory power of the model. Future studies may need to address this by optimizing the independence among the predictors or adjusting the model structure to better manage the multicollinearity without compromising the integrity of the theoretical framework.

Chapter 6: Discussion and Conclusion

6.1 Discussion

6.1.1 Discussion on core competencies

6.1.1.1 Hospital infection risk prediction ability

In hospital responses to emerging infectious diseases (EIDs), infection management plays a critical role in ensuring patient safety and maintaining healthcare quality. Conducting risk assessments for EIDs not only helps identify potential risk factors in hospital-acquired infections but also reveals key vulnerabilities in infection prevention and control (IPC) measures. This process is essential for implementing proactive preventive measures, safeguarding patient safety, improving healthcare service quality, and promoting the high-quality development of hospitals. Therefore, comprehensive hospital infection risk prediction is an integral part of modern hospital management.

By scientifically interpreting relevant laws, regulations, and standards, hospitals can establish infection risk prediction mechanisms that identify high-risk departments, critical points, and susceptible populations. This enables the scientific and rational allocation and optimization of prevention and control resources (L. Y. Li & Xu, 2016). Furthermore, extensive research has demonstrated that hospital infection surveillance is a fundamental competency for infection control professionals and a crucial foundation for effective IPC efforts.

For example, the hospital infection risk prediction model proposed by the Centers for Disease Control and Prevention's Certified in Infection Control (CBCI) framework (Murphy et al., 2012) in the United States includes key elements such as the identification of infectious diseases, infection surveillance, and epidemiological investigation. These components align closely with China's infection management strategies. Specifically, the identification of infectious diseases not only involves distinguishing between colonization, infection, and contamination by pathogens but also requires recognizing factors such as incubation periods, infectious periods, transmission routes, clinical manifestations, and susceptible populations.

6.1.1.2 Hospital infection prevention and control ability

Basic IPC abilities encompass guidance on cleaning, disinfection, and sterilization of various objects, microorganisms, and hospital environments. Additionally, these capabilities involve supervising the implementation of hand hygiene measures within the hospital, enforcing infection prevention and control protocols for high-risk departments, key populations, and critical areas. Moreover, essential components of IPC abilities include the management of multidrug-resistant organisms (MDROs), the clinical application of antimicrobial agents, and infectious disease prevention and control. These aspects align closely with findings from both domestic and international research (Ma, 2011; Ye et al., 2016).

Furthermore, the Certified in Infection Control (CBCI) competency model developed by Murphy et al. (2012) in the United States emphasizes that infection control professionals should not only possess expertise in infectious disease prevention but also be equipped with skills to promote occupational health. Compared to China, international requirements for infection control personnel tend to be broader. Specifically, in addition to formulating and reviewing infection prevention policies and protocols, infection control professionals are expected to engage in community collaborations and design response strategies for pathogenic microorganisms.

Hospital infection control strategies must be integrated throughout the entire patient care and recovery process, including patient placement, hand hygiene compliance, cleaning, disinfection, and sterilization. Additionally, managing infection risks related to clinical procedures, medical equipment, and patient care plays a crucial role in IPC efforts. In China, current hospital infection prevention and control measures are primarily focused within healthcare institutions, with an emphasis on guiding and monitoring the clinical practices and procedural compliance of medical personnel.

6.1.1.3 Ability of knowledge and skills training for prevention and control

Deng (2010), in his study on hospital infection management in Singapore, highlighted that both healthcare workers and patients in Singapore exhibit a strong awareness of infection prevention. One of the key reasons for this heightened awareness is the significant emphasis placed on IPC within Singapore's healthcare institutions. Patients receive infection prevention knowledge through multiple channels, and to some extent, they also play a supervisory role in assessing whether healthcare workers adhere to IPC measures appropriately.

6.1.1.4 Organizational coordination ability

As a crucial functional department in hospitals, the Infection Control Department plays an essential role in ensuring effective hospital-wide infection prevention efforts. Infection control personnel not only require specialized IPC knowledge but must also possess strong organizational and coordination capabilities. Specifically, they are responsible for coordinating efforts across different hospital departments, ensuring smooth IPC operations.

Administrative departments play a pivotal role in this coordination process. Effective communication between the Medical Affairs Department, Nursing Department, Laboratory Department, and other relevant units is crucial to ensure the accurate transmission of information and the successful implementation of upper-level decisions. Therefore, the effectiveness of IPC strategies largely depends on cross-departmental cooperation and efficient communication.

G. M. Huang (2003), have emphasized the multifaceted nature of infection control personnel's responsibilities, which extend beyond direct engagement with medical staff and nurses to close interactions with hospital logistics and technical support departments. Consequently, infection control personnel must demonstrate exceptional communication and coordination skills to ensure IPC initiatives are effectively implemented. Similarly, X. L. Wang (2010) stressed the importance of infection control professionals maintaining active engagement and communication with various hospital departments to reinforce IPC measures and ensure interdepartmental collaboration.

6.1.1.5 Professional development in IPC ability

To ensure that hospital infection management teams remain aligned with international standards, infection control personnel must continuously engage in self-directed learning. This involves not only traditional learning methods but also active participation in academic activities, regular attendance at professional conferences, and the utilization of search engines, professional literature, and other information sources to stay updated with the latest policies, regulations, standards, and developments in domestic and international infection control research. Through these efforts, infection control professionals can enhance their expertise and practical competencies.

Beyond knowledge acquisition, infection control personnel must also develop the ability to integrate new and existing knowledge effectively. Critical thinking skills are particularly vital in hospital infection management, as they enable professionals to analyze complex situations systematically and make independent judgments (H. Z. Wu, 2004). Infection control personnel

frequently encounter urgent and multifaceted infection control challenges, necessitating rapid and accurate assessments followed by effective decision-making to mitigate risks and uphold hospital safety standards.

6.1.2 Discussion on dynamic capabilities

6.1.2.1 Discussion on sensing capability

Existing literature widely recognizes sensing capability as the first stage of the dynamic capability framework, serving as the foundation for organizations to identify external environmental changes and detect new opportunities or risks (Teece, 2007; Teece & Pisano, 1994). This study incorporates "hospital infection risk prediction capability" as a core indicator to assess hospitals' sensitivity and early warning capabilities in the control of EIDs. This aligns with the emphasis on sensing capability in the literature, highlighting its critical role in proactive risk detection.

While most prior research on sensing capability has been applied in corporate strategy, market competition, and technological transformation (Teece, 2014)—focusing on the identification of macro-environmental and market signals—this study contextualizes it within public health, specifically in tertiary hospitals' preparedness and response to EIDs. Thus, "hospital infection risk prediction capability" is more concerned with early warnings of internal hospital risks and regional public health threats, making its evaluation framework highly relevant to actual medical practice.

In traditional dynamic capability research, sensing capability is often treated as an independent dimension, illustrating an organization's responsiveness to external information (Katkalo et al., 2010). However, this study integrates infection risk prediction as one of several core hospital capabilities, alongside infection control measures, knowledge and skills training, organizational coordination, and professional development, which together shape the hospital's overall EID control effectiveness.

Empirical results indicate that infection risk prediction capability has a significant positive impact on improving hospitals' EID control performance. However, its effect size is relatively weaker compared to professional development capability, which has the strongest impact on overall control levels. This suggests that in hospital-based EID prevention and control, sensing capability alone may not be sufficient—it must be complemented by resource integration, interdisciplinary collaboration, and professional skill development to translate risk awareness into tangible infection control outcomes.

In summary, both the literature review and this study acknowledge the fundamental role of sensing capability within the dynamic capability framework, but notable differences exist in its application. This study operationalizes sensing capability as "hospital infection risk prediction capability", specifically focusing on early risk detection in public health emergencies, whereas traditional studies emphasize broader environmental and market signal identification. Furthermore, this study's empirical findings reveal that hospitals cannot rely solely on sensing capability to enhance their overall EID control effectiveness—instead, professional development and cross-departmental coordination play a more critical role. This insight offers new empirical evidence and theoretical perspectives for how healthcare institutions can develop and optimize dynamic capabilities in complex public health environments.

6.1.2.2 Discussion on seizing capability

The literature review indicates that seizing capability is a critical stage within the dynamic capability framework, emphasizing an organization's ability to rapidly respond to environmental changes and new opportunities by implementing effective strategies, reallocating resources, and transforming them into strategic outcomes (Augier & Teece, 2007). In this study, "hospital infection prevention and control capability" is designated as a core dimension within the evaluation framework, reflecting a hospital's ability to take timely and efficient infection control measures after identifying risks, thereby converting risks into effective infection prevention and control outcomes. Both perspectives highlight that in a dynamic environment, only by translating perceived risks or opportunities into tangible actions can organizations achieve positive performance improvements.

Existing literature on seizing capability predominantly focuses on corporate or healthcare organizations from a strategic perspective (Teece et al., 2009), emphasizing how correct investment decisions, resource integration, and rapid responses enable organizations to capitalize on external opportunities (Agwunobi & Osborne, 2016). However, this study applies the concept to practical IPC measures in tertiary hospitals. Unlike traditional strategic management discussions, "hospital infection prevention and control capability" in this study not only requires hospitals to take timely preventive actions but also involves concrete IPC techniques, standardized processes, and operational protocols, making it more practice-oriented and operationally specific.

In conventional dynamic capability studies, seizing capability is often treated as an independent strategic dimension, primarily focusing on opportunity capture at an

organizational level (Bitencourt et al., 2020) or at an individual level in the healthcare sector (Alwali, 2023; Leung, 2014; Mandal, 2017). In contrast, this study further dissects IPC capability into multiple dimensions, including knowledge and skills training, organizational coordination, and professional development capabilities. Notably, "prevention and control professional development capability" stands out as a key factor, reflecting a hospital's ability to seize opportunities through research innovation, continuous learning, and interdisciplinary collaboration. This granularity not only illustrates the hospital's overall opportunity-seizing capacity but also reveals the synergistic effects among various infection control measures, offering comprehensive empirical evidence for improving IPC performance.

Overall, both the literature review and this study recognize the pivotal role of seizing capability in converting environmental awareness into actual performance outcomes . However, while existing studies primarily discuss seizing capability from a strategic management perspective, this research focuses on public health, particularly tertiary hospitals' IPC practices for EIDs. Empirical findings confirm that all core capabilities positively influence infection prevention and control performance, with professional development capability (which encapsulates a hospital's ability to seize opportunities, innovate, and execute effectively) exhibiting the greatest impact. This provides new theoretical perspectives and empirical evidence on how healthcare institutions can enhance their IPC strategies in response to public health emergencies by strengthening seizing capability.

6.1.2.3 Discussion on reconfiguring capability

The literature review identifies reconfiguring capability as a core dimension of dynamic capability, emphasizing an organization's ability to continuously adapt to environmental changes through organizational learning, resource integration, and internal adjustments, ultimately achieving dynamic resource optimization (Easterby Smith & Prieto, 2008; Helfat, 1997; Mittal, 2019). While this study does not establish "reconfiguring capability" as a separate indicator, its essence is embedded in the "prevention and control professional development capability" dimension of the hospital's core capability evaluation framework for EID control. This dimension highlights how hospitals adjust and optimize their IPC strategies through scientific research innovation, professional learning, and interdisciplinary collaboration, which closely aligns with the resource reconfiguration and continuous transformation processes emphasized in reconfiguring capability.

In existing literature, discussions on reconfiguring capability primarily focus on corporate (Helfat, 1997; Teece, 2014) and healthcare institutions (Agwunobi & Osborne, 2016) from a

strategic management perspective, exploring how organizations restructure internal resources and implement long-term transformations to build sustainable competitive advantages (C. L. Wang & Ahmed, 2007). In contrast, this study focuses on applications in public health emergency contexts, positioning hospitals' professional development capability as a key indicator. This highlights that in the context of EID control, hospitals need to continuously update infection prevention knowledge, strengthen interdepartmental coordination, and enhance professional skills to enable timely reallocation of IPC resources and optimization of response processes.

Traditional reconfiguring capability research often treats it as an independent dimension within the dynamic capability framework, primarily evaluating organizations' agility in responding to external changes. However, this study conceptualizes overall hospital IPC performance as a dependent variable, integrating multiple dimensions, including infection risk prediction, implementation of preventive measures, training, coordination, and professional development. The professional development capability inherently involves knowledge renewal and resource reconfiguration, functioning as a more integrated and comprehensive mechanism in specific public health settings compared to a standalone reconfiguring capability.

Both the literature and this study recognize reconfiguring capability as essential for adapting to dynamic environments. However, existing studies primarily discuss it from a strategic perspective, focusing on long-term organizational transformation. In contrast, this research applies the concept to public health emergency preparedness and hospital IPC capability, illustrating how hospitals reconfigure resources, knowledge, and coordination mechanisms in response to EIDs. The empirical findings suggest that hospitals' ability to develop and integrate professional competencies plays a crucial role in their capacity to effectively respond to emerging infectious diseases, offering new insights into how healthcare institutions can optimize their resource reconfiguration and strategic adjustments in real-world public health scenarios.

6.2 Research conclusion

6.2.1 Development of a core capability evaluation system for infectious disease control in tertiary comprehensive hospitals

Utilizing semi-structured interviews and the Delphi expert consultation method, this study

constructed an evaluation system for the core capabilities of infectious disease control in tertiary comprehensive hospitals. This system includes five primary indicators: hospital infection risk prediction, infection control, knowledge and skill training for infection control, organizational coordination, and professional development in infection control; along with 14 secondary indicators and 62 specific tertiary indicators. The constructed evaluation system is characterized by its scientific validity, reliability, systematic approach, and objectivity. The conslusion addresses Research Question 1.

6.2.2 Empirical application of the core capability evaluation system in tertiary comprehensive hospitals

The core capability evaluation system developed for tertiary comprehensive hospitals was applied to assess the infectious disease control capabilities across selected hospitals in Guangdong Province. The empirical analysis identified professional development in infection control as a critical capability. However, the study also indicates a need for continuous improvement in hospital infection risk prediction, infection control, knowledge and skill training, and organizational coordination to enhance responsiveness to EIDs, especially in enhancing organizational coordination and professional development.

6.3 Research contributions

6.3.1 Theoretical contributions

The principal theoretical contributions of this study are as follows:

Firstly, the research systematically proposed and validated a framework for the core capabilities of infectious disease control in tertiary comprehensive hospitals, covering risk prediction, infection control, knowledge training, organizational coordination, and professional development. This framework expands the existing research landscape and provides a systematic set of measurement tools and scales.

Secondly, the study specifically identified professional development in infection control as the most crucial capability, validating the notion that strengthening research innovation and professional development can significantly enhance the overall hospital infection control level. This provides new empirical evidence for research in related fields.

Lastly, compared to previous studies domestically and internationally, this research, through its quantitative empirical approach, explored the relative importance of different

capabilities, particularly detailing the mechanisms of personnel training and organizational coordination. This provides a more actionable theoretical framework and empirical basis for subsequent research.

6.3.2 Practical contributions

The practical contributions of this study are reflected in the following aspects:

(1) Development of a Comprehensive and Scientific Evaluation Index System

Through semi-structured interviews and Delphi expert consultations, this study has developed a core competency evaluation index system for the prevention and control of emerging infectious diseases (EIDs) in tertiary general hospitals. The system encompasses five primary dimensions: hospital infection risk prediction, implementation of preventive measures, knowledge and skills training, organizational coordination, and professional development in infection control. These dimensions are further refined into 14 secondary indicators and 62 tertiary indicators. This structured framework not only addresses the existing gaps in the detailed assessment of hospital infection control capabilities but also provides a quantitative tool and standardized reference for internal hospital capability diagnosis and improvement.

(2) Providing Empirical Evidence for Hospital Resource Optimization and Capability Enhancement

By employing multiple linear regression analysis, this study empirically examines the impact of core competencies on overall hospital infection control effectiveness. The results indicate that all core competencies have a significant positive impact on infection control outcomes, with the professional development capability exerting the most substantial influence. This finding offers a scientific basis for hospital decision-making regarding resource allocation, personnel training, and interdepartmental collaboration, enabling hospitals to focus on key areas that most effectively enhance overall infection control levels within the constraints of limited resources.

(3) Advancing the Application of Dynamic Capability Theory in Public Health

By integrating dynamic capability theory into the practice of EID prevention and control, this study not only validates the applicability of traditional dynamic capability theory in the healthcare sector but also proposes a more targeted approach to developing infection control competencies. This theoretical perspective provides hospitals with new insights and practical guidance on capability renewal, resource integration, and process optimization when

responding to public health emergencies.

(4) Enhancing Public Health Emergency Management Capabilities

The evaluation index system and empirical analysis findings established in this study serve as diagnostic tools and improvement pathways for healthcare authorities and hospital administrators in managing public health emergencies. By conducting comprehensive assessments of hospital infection control capabilities, relevant institutions can promptly identify and address deficiencies, thereby strengthening the overall healthcare system's emergency response capacity and infection control effectiveness when faced with emerging infectious diseases.

6.4 Managirial recommendations

Based on the conclusions of this study, specific, feasible, and actionable improvement measures and suggestions are proposed for different aspects of core capabilities in controlling EIDs in tertiary comprehensive hospitals. Initially, it is crucial to strengthen the construction and implementation of the routine infection control system within hospitals, particularly emphasizing the strict enforcement of in-hospital isolation, disinfection, professional protection for medical staff, and emergency response plans. These measures are fundamental and critical to enhancing the overall control level of the hospital. Furthermore, addressing the relatively weaker links in knowledge training and organizational coordination, it is advisable to establish a tiered, job-specific training system, regularly conduct skill training and emergency drills, and strengthen inter-departmental coordination and resource integration capabilities to improve overall response efficiency. Lastly, there should be an emphasis on enhancing the capability for professional development in control measures, encouraging medical staff to actively participate in scientific research, academic exchanges, and the development and application of new technologies, thereby enhancing the proactivity and foresight of hospital control efforts through innovation.

Specific management recommendations include:

6.4.1 Enhancing the disease monitoring and early warning capabilities of tertiary comprehensive hospitals

To enhance the capability for monitoring and early warning of EIDs, it is recommended that tertiary comprehensive hospitals strengthen communication and collaboration with disease control departments, health departments, and other medical institutions to timely acquire and

report relevant information about EIDs, thus improving the timeliness and accuracy of epidemic detection and reporting. Additionally, it is suggested that hospitals enhance their own laboratory testing capabilities by equipping advanced testing facilities and personnel to improve the identification and characterization of pathogens of EIDs, providing a scientific basis for epidemic prevention and control. Furthermore, hospitals should leverage new technologies such as big data and artificial intelligence to establish a smart, multi-trigger infectious disease monitoring and early warning system, enabling dynamic assessment and forecasting of epidemic risks to support decision-making.

6.4.2 Enhancing the emergency response capabilities of tertiary comprehensive hospitals

To improve the emergency response capabilities for EIDs, it is recommended that tertiary comprehensive hospitals develop comprehensive emergency plans for infectious disease epidemics, clearly defining emergency response levels, procedures, responsibilities, and tasks, and regularly conduct emergency drills to enhance the speed and effectiveness of emergency responses. Additionally, hospitals should strengthen coordination with other medical institutions, disease control agencies, and government departments to establish effective emergency material allocation and transportation mechanisms, ensuring adequate and timely supply of emergency materials. Moreover, hospitals should enhance the training and development of emergency teams to improve the professional quality and response capabilities of personnel, providing human resource support for epidemic prevention and control.

6.4.3 Enhancing the treatment capabilities of tertiary comprehensive hospitals for EIDs

To enhance the treatment capabilities for EIDs, it is recommended that tertiary comprehensive hospitals optimize the diagnostic and treatment processes for infectious diseases, implementing a tiered, layered, and streamlined treatment model to enhance the efficiency and quality of care. Additionally, hospitals should strengthen clinical research on infectious diseases to explore effective treatment protocols and medications, aiming to improve recovery rates and reduce mortality rates. Furthermore, hospitals should promote the integration of traditional Chinese and Western medicine in the prevention and treatment of infectious diseases, utilizing the advantages of traditional Chinese medicine in prevention, treatment, and rehabilitation, offering a diverse range of options for epidemic prevention and control..

6.4.4 Enhancing public health intervention capabilities for EIDs in tertiary comprehensive hospitals

To enhance the public health intervention capabilities for EIDs, it is recommended that tertiary comprehensive hospitals strengthen public health interventions targeting key populations and areas. This includes increasing vaccination rates, health education coverage, and health management service rates to reduce the incidence and transmission of infectious diseases. Additionally, hospitals should enhance monitoring and assessment of environmental, occupational, and food hygiene to promptly identify and eliminate health hazards, reducing the risk of disease outbreaks. Furthermore, hospitals are encouraged to strengthen comprehensive interventions for chronic diseases and mental health to enhance population immunity and resistance, providing a health safeguard for epidemic prevention and control.

6.4.5 Enhancing administrative law enforcement capabilities for EIDs in tertiary comprehensive hospitals

To enhance the administrative law enforcement capabilities for EIDs, it is recommended that tertiary comprehensive hospitals strengthen the learning and dissemination of legal regulations related to infectious disease prevention. This will enhance the legal awareness and compliance among medical staff and patients, maintaining medical order and doctor-patient relations. Additionally, hospitals should reinforce their administrative law enforcement related to infectious disease prevention, legally addressing violations of infectious disease prevention regulations to protect public interests in disease prevention. Moreover, hospitals should enhance the training and management of administrative law enforcement personnel to improve the professionalism and standardization of administrative law enforcement, providing legal support for epidemic prevention and control.

6.4.6 Enhancing educational and outreach capabilities for EIDs in tertiary comprehensive hospitals

To improve educational and outreach capabilities for EIDs, it is recommended that tertiary comprehensive hospitals strengthen the dissemination and education of scientific knowledge and preventive measures for EIDs. This will enhance disease prevention awareness and self-protection capabilities among medical staff and the public, alleviating panic and misconceptions. Additionally, hospitals should enhance the release of epidemic information and guide public opinion, promptly responding to societal concerns to boost social confidence

and cohesion. Furthermore, hospitals are encouraged to intensify public health education and outreach about EIDs, promoting healthy lifestyles and sanitary habits, providing reference bases and strategic support for the prevention and control of new infectious diseases.

6.5 Research limitations and future directions

While this study has achieved notable theoretical and practical values, it possesses certain limitations that necessitate further refinement in future research:

(1) Limited sample size

The empirical analysis was based on 217 valid questionnaires from five tertiary comprehensive hospitals in Guangzhou, which may limit the generalizability and applicability of the findings. Future research should expand the survey scope and sample size to include hospitals of various types, levels, and regions to enhance the external validity of the study.

(2) Insufficient control variables

The study did not account for potentially significant control variables such as hospital size, level of medical resources, and staffing, which might have led to omitted variable bias. Future studies should incorporate more key control variables to enhance the explanatory power and practical relevance of the models.

(3) Single measurement method for the dependent variable

The study measured the overall control level of hospitals using a single subjective item, which may be prone to self-reporting bias. Future research should consider integrating objective indicators or external evaluations (such as actual rates of hospital-acquired infections, patient satisfaction, emergency response efficiency, and third-party expert assessments) to construct a multidimensional measurement system that enhances the objectivity and robustness of the data.

(4) High multicollinearity among variables

The regression models in this study exhibited high multicollinearity (as indicated by high VIF values for some variables). Future research should further refine the item structure of the original indicator system through exploratory factor analysis and principal component analysis, re-extract key factors, and merge similar items to reduce item redundancy and mitigate multicollinearity issues. Additionally, structural equation modeling (SEM) and other methods could be employed to clarify the structural relationships among variables, thereby enhancing the theoretical explicability and empirical robustness of the models.

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Annex A: Questionnaire

Dear Participant,

Thank you for taking the time to complete this questionnaire. This survey is designed as part of a research study aimed at evaluating the core capabilities of tertiary hospitals in the prevention and control of emerging infectious diseases (EIDs). Your responses will provide valuable insights into hospital infection risk prediction, prevention and control measures, knowledge and skills training, organizational coordination, and professional development in infection control.

The questionnaire consists of multiple sections, beginning with basic demographic information followed by specific questions related to infection prevention and control capabilities. The data collected will be strictly confidential and used solely for academic research purposes. Your participation is voluntary, and you may withdraw at any time without any consequences.

Your input is greatly appreciated and will contribute to the enhancement of hospital infection control strategies and the overall public health response to emerging infectious diseases.

If you have any questions or concerns regarding the survey, please feel free to contact the research team.

Thank you for your valuable contribution!

Part I: Basic information

Please fill in the following information. All data will be used for research purposes only and will remain anonymous.

1. Gender

- ☐ Male
- ☐ Female

2. Age

- ☐ Below 25
- ☐ 25-34
- ☐ 35-44
- ☐ 45-54
- ☐ 55 and above

3. Major

- ☐ Medicine
- ☐ Nursing
- ☐ Public Health
- ☐ Hospital Management
- ☐ Other (please specify): _____

4. Education Level

- ☐ Associate Degree or Below
- ☐ Bachelor's Degree
- ☐ Master's Degree
- ☐ Doctorate

5. Professional Title

- ☐ Junior
- ☐ Intermediate
- ☐ Associate Senior
- ☐ Senior
- ☐ None

6. Job Position

- ☐ Clinical Doctor
- ☐ Nurse
- ☐ Infection Control Specialist
- ☐ Hospital Administrator
- ☐ Other (please specify): _____

Part 2:

In this section, please select the most appropriate option based on your actual situation. Your honest responses will help ensure the accuracy and reliability of the research findings. 1means not important at all. 5 means very important.

Items	1	2	3	4	5
Recognize the situation of EIDs in hospitals in and beyond China					
Clarify nosocomial IPC policies are consistent with the IPC situation and figure out the specific IPC policies in medical institutions					
Interpret laws, regulations, systems, and standards about prevention and control of IPC based on practice and above practice, and grasp the core points of nosocomial IPC policies and regulations					
Assess infection risks in building design, construction, and renovation that affect the medical environment (such as ventilation and air conditioning systems, as well as water)					
Understand and evaluate correct processes of cleaning, disinfection, and serilization					
Assess IPC awareness among medical personnel through observation, conversation, questions or questionnaires and other methods					
Identify high-risk groups and susceptible patients at risk of infection (such as based on age and underlying medical condition)					
Identify the risk of infection in various stages of diagnosis, treatment, and care (such as oral examination; anesthesia and surgery, hand hygiene, aseptic technology, and medical waste disposal)					
Determine IPC monitoring targets based on the risk assessment of nosocomial infection					
Develop a nosocomial IPC monitoring plan for susceptible groups in accordance with national prevention and control policies and regulations, relevant prevention and control plans, monitoring plans and international guidelines					
Conduct nosocomial IPC monitoring, including monitoring of nosocomial infection cases（such as monitoring of incidence rate, prevalence rate and missing report rate), objective monitoring (monitoring of ICU, high-risk newborn, surgical site, multi-drug resistant organisms), environmental hygienic monitoring (such as monitoring of air, object surface and hands), monitoring of the effectiveness of disinfection devices (such as disinfectants, pressure sterilization, ultraviolet disinfection lamps); as well as occupational exposure monitoring of medical personnel					
Be able to collect nosocomial IPC monitoring data and establish a systematic database					
Verify nosocomial infection monitoring data (methods including data review and clinical visits)					
Calculate the constituent ratio, incidence rate and prevalence rate of various indicators of nosocomial IPC monitoring					
Be able to critically analyze the significance of nosocomial IPC monitoring results					
Provide recommendations for nosocomial IPC based on the results of nosocomial IPC monitoring					
Be able to modify monitoring strategies based on the evaluation results of IPC monitoring					
Revise and incorporate existing regulations, standards, guiding policies, literature, and publications into nosocomial IPC plans, and establish evidence-based nosocomial IPC strategies and methods					

Provide recommendations for reducing the risk of infection during medical environment design, construction, and renovation processes					
Guide the disinfection and sterilization of different hazardous materials, reusable items, different types of microorganisms, as well as environmental disinfection and air purification in medical institutions					
Supervise the practice of basic techniques for IPC by medical personnel (such as hand hygiene, wearing masks, isolation masks, and isolation gowns), standard prevention and additional prevention, as well as medical waste management					
Implement prevention and control of nosocomial infection in key departments, such as admission rooms, endoscopy rooms, operating rooms, delivery rooms, ICU, neonatal wards, dental departments, disinfection supply centers, and dietary departments					
Supervise the implementation of nosocomial IPC strategies in key areas and among key groups such as patients with EIDs in hospitals, and choose the right quality improvement tools (such as brainstorming, system diagram, decision process diagram and PDCA) and improve nosocomial IPC strategies based on the assessment results of these policies					
Develop emergency plans for nosocomial infection emergencies in accordance with national IPC policies					
Be able to use epidemiological knowledge to identify risk factors for nosocomial infection outbreaks					
Be able to determine nosocomial infection outbreaks through information monitoring and reporting channels					
Report nosocomial infection outbreaks to the nosocomial infection management committee and hospital leaders in a timely manner					
Conduct epidemiological investigation to explore the relationship between infection cases and suspected infection cases and propose targeted prevention and control plans					
Coordinate with relevant departments to respond to infection outbreaks (eliminate the source of infection, cut off transmission routes, and involve departmental medical personnel in formulating protection and control policies)					
Monitor nosocomial infection cases, track for new infections, and monitor the effectiveness of controlling methods					
Develop an emergency drill plan for nosocomial infection outbreaks for key departments and groups in medical institutions, collaborate with various departments to conduct practical drills for infection outbreak disposal, evaluate the effectiveness of outbreak disposal drills, and improve the plan					
Assess the risk of occupational exposure to EIDs					
Supervise medical personnel to wear personal protective equipment (including gloves, masks, respiratory protective devices, goggles, masks, and isolation gowns.) during diagnosis and treatment processes relating to blood or body fluids, and to remove and dispose personal protective equipment before finishing diagnosis and treatment or leaving the ward					
Provide guidance and advice after the outbreak of relevant EIDs or occupational exposure, and continue to follow up					
Evaluate the needs of medical personnel for IPC knowledge and skills, as well as the learning ability of trainees					
Evaluate the feasibility of IPC knowledge and skill training programs					
Be able to effectively communicate nosocomial IPC policies and regulations to healthcare workers					
Be able to customize corresponding IPC knowledge and skill training programs and develop measurable objective goals based on the needs of doctors, nurses, technicians, health workers, logistics personnel, continuing education personnel, and interns					

Provide education on nosocomial IPC according to different personnel training plans based on the focus of nosocomial IPC					
Provide consultation services for patients, medical staff, and management on nosocomial IPC issues					
Objectively evaluate the effectiveness of IPC related knowledge and skills training program and make improvements					
Assess the learning outcomes of medical personnel participating in IPC education and training (such as operational observation and process testing)					
To achieve the specific goals of preventing and controlling nosocomial infection in the department, actively assist various departments such as the medical department, nursing department, laboratory microbiology department, pharmacy department, equipment department, and general affairs department under the leadership of the dean, and provide technical support for IPC					
Reasonably allocate human, material, and financial resources for nosocomial IPC and work together to achieve prevention and control goals					
Provide monitoring results, recommendations, annual reports, policies, and procedures for IPC to the nosocomial infection management committee and relevant management departments, and maintain good communication with the nosocomial infection management committee and management					
Be able to communicate with other healthcare professionals about the purpose, role, and value of IPC plans					
Communicate and exchange nosocomial infection difficulties and prevention and control experiences with medical staff from other medical institutions					
Coordinate IPC and quality improvement activities organized by various departments, and provide administrative or technical support corresponding to the infection management department of hospitals					
Coordinate IPC, as well as quality improvement activities across departmental organizations					
Work closely with other members of the hospital's infection management department to complete various tasks					
Have knowledge related to nosocomial IPC, such as laws, regulations, systems, and standards related to nosocomial infection management; the pathogenesis, clinical manifestations, diagnosis, treatment, and prevention measures of nosocomial infection; hospital cleaning, disinfection, sterilization, and isolation; nosocomial infection monitoring; nosocomial IPC measures in key departments and locations; prevention and control of nosocomial infection outbreaks; methods and standards for evaluating the quality of nosocomial infection management					
Be able to improve prevention and control knowledge and skills through continuing education					
Be able to correctly use search engines to search for literature on prevention and control of EIDs, read books related to nosocomial IPC every six months, actively participate in professional conferences, and have the ability to timely capture cutting-edge information on prevention and control					
Use critical thinking skills to comprehensively analyze and judge specific prevention and control action guidelines					
Evaluate the feasibility of nosocomial IPC monitoring, prevention and control needs and plans, and be able to integrate various prevention and control information and make quick decisions					
Timely grasp the dynamic information on nosocomial infection and respond promptly to sudden emergencies					
Effectively and continuously evaluate monitoring and plans of nosocomial IPC					
Continuously evaluate the quality and satisfaction of nosocomial IPC					

Have certain innovative thinking and ability in prevention and control					
Make retrospective analysis of related research on nosocomial infection					
Participate in research on nosocomial IPC and publish relevant research thesis					
Apply nosocomial infection research achievements to IPC practice					

Part 3: How Do You Assess Your Hospital's Overall Infection Control Capability?

In this section, please evaluate your hospital's overall level of infection prevention and control (IPC) based on your personal experience and professional judgment. Select the most appropriate option for each statement.

1. Overall Risk Prediction Capability

How well is your hospital’s overall level of Infection control?

- ☐ Very Poor
- ☐ Poor
- ☐ Average
- ☐ Good
- ☐ Excellent

If you have any additional comments or suggestions regarding your hospital's infection prevention and control capability, please provide them below:

Thank you for your valuable feedback!