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Impact of Vaccine Quality Monitoring and Management on Vaccination Improvement

ZHANG Yan

Doctor of Management

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BUSINESS SCHOOL

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Abstract

Background and Objective: Vaccination has been vital to China's public health since 1950 and reaffirmed as a priority in 2019. Despite progress, service quality varies, and no cohesive evaluation system exists. This study aims to develop and assess a quality monitoring system for vaccination clinics. **Methods:** A mixed-methods approach combined bibliometric analysis, interviews, and the Delphi and Analytic Hierarchy Process (AHP) methods to build the indicator system. Fifty clinics across four provinces were assessed using descriptive statistics. An intervention study in Heilongjiang Province randomly divided 20 clinics into intervention and control groups, using a quasi-experimental design. Data were collected via surveys, observations, and archival analysis, with t-tests and variance analysis for evaluation. **Results:** The system included four domains — professional services, personnel management, social services, and information management — with 61 indicators. The average management score was 6.12 (9-point scale), with information management scoring lowest. Interventions significantly improved vaccination rates, adverse reaction rates, complaints, satisfaction, and public awareness. 85% of personnel found training valuable, and 89% reported improved standardization and motivation. **Contribution:** The system provides a structured framework for clinic management, with recommendations to strengthen systems, enhance training, improve information management, raise public awareness, and foster inter-departmental collaboration.

Keywords: Vaccination, Outpatient clinic, Quality monitoring management system, Evaluation system, Intervention effect

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Resumo

Contexto e Objetivo: A vacinação tem sido essencial para a saúde pública na China desde 1950, sendo reafirmada como prioridade nacional em 2019. Apesar dos avanços, a qualidade dos serviços varia e não existe um sistema de avaliação coeso. Este estudo visa desenvolver e avaliar um sistema de monitorização da qualidade para clínicas de vacinação. **Metodologia:** Foi adotada uma abordagem metodológica mista, que combinou uma análise bibliométrica, entrevistas e os métodos Delphi e *Analytic Hierarchy Process* (AHP) para construir um sistema de indicadores. Cinquenta clínicas de quatro províncias chinesas foram avaliadas através de estatísticas descritivas. Um estudo de intervenção na província de Heilongjiang dividiu aleatoriamente 20 clínicas em grupos de intervenção e controlo, utilizando um desenho quase-experimental. Os dados foram recolhidos por meio de inquéritos, observações no local e análise documental, sendo analisados com testes *t* e análise de variância. **Resultados:** O sistema inclui quatro domínios — serviços profissionais, gestão de pessoal, serviços sociais e gestão da informação — com 61 indicadores. A pontuação média de gestão foi de 6.12 (escala de 9 pontos), com a gestão da informação a apresentar a pontuação mais baixa. As intervenções melhoraram significativamente as taxas de vacinação, reações adversas, reclamações, satisfação e sensibilização pública. 85% do pessoal considerou a formação valiosa e 89% relataram maior padronização e motivação no trabalho. **Contribuição:** O sistema oferece um sistema estruturado para a gestão das clínicas, com recomendações para fortalecer os sistemas, aprimorar a formação, melhorar a gestão da informação, aumentar a sensibilização pública e promover a colaboração interdepartamental no contexto do presente estudo.

Palavras-chave: Vacinação, Clínica de Atendimento, Sistema de Gestão de Monitorização da Qualidade, Sistema de Avaliação, Efeito da Intervenção

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摘　要

背景与目标： 自1950年以来，疫苗接种一直是中国公共卫生的重要组成部分，并在2019年被再次确认为国家优先事项。尽管取得了进展，但服务质量仍存在差异，且缺乏统一的评估体系。本研究旨在构建和评估中国预防接种门诊的质量监测体系。**方法：** 本研究采用混合研究方法，结合文献计量分析、半结构化访谈，以及德尔菲法和层次分析法（AHP）构建指标体系。通过分层整群抽样，选取了四个省份的50家诊所进行现状评估，并使用描述性统计进行差异分析。在黑龙江省开展了干预研究，随机将20家诊所分为干预组和对照组，采用准实验设计评估干预效果。数据收集包括问卷调查、现场观察和档案分析，采用*t*检验和方差分析进行综合评估。**结果：** 监测体系涵盖四个核心领域：专业服务、人员管理、社会服务和信息管理，共61个指标。50家诊所的平均管理质量评分为6.12分（9分制），其中信息管理得分最低。干预措施显著提高了疫苗接种率，降低了不良反应率、投诉率，并提升了满意度和公众认知。85%的工作人员认为培训内容合理，89%表示管理标准化和工作积极性有所提升。**贡献：** 该体系为诊所管理提供了结构化、有效的框架，并提出了加强制度建设、推进人员培训、优化信息管理、提高公众认知，以及促进部门间协作的改进建议，以持续支持诊所质量提升和公共卫生发展。

关键词：预防接种，门诊，质量监测管理体系，评估体系，干预效果。

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致　谢

提笔至此，心情无比激动，处在这里即将完成我博士学习生涯的最后一个重要环节。回首五年的求学之路，感慨万千。在这个特殊的时刻，我要向所有帮助和支持过我的人表达最诚挚的谢意。

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衷心感谢所有关心、帮助和支持过我的人！是你们的爱点亮了我的人生之路，我爱你们！

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Chapter 1: Introduction

1.1 Research background

Vaccination, recognized as one of the most economical public health measures (Bergmann, 2016; Ferreira et al., 2022), was crucial for preventing and curbing the spread of infectious diseases, acting as a primary shield for public health. This principle has gained global acceptance and has been hailed by the World Health Organization (WHO) as a landmark achievement in public health during the 20th century (Centers for Disease Control and Prevention [CDC], 2021). In China, vaccination is enshrined as a fundamental national policy, serving as an essential tool for infectious disease prevention and a cornerstone of the country's disease control strategy (People's Congress of the People's Republic of China, 2019; Wu et al., 2012). Since 2009, it has been integrated into the basic public health services, offering free vaccinations to all residents. This important policy not only reflects the universality and equity of services but also demonstrates its public welfare nature, significantly improving the health level of Chinese residents and laying a solid foundation for achieving the strategic goals of "Healthy China". In June 2019, the Vaccine Management Law of the People's Republic of China was passed by the 11th session of the Standing Committee of the 13th National People's Congress and came into effect in December of that year. The law introduces stringent and comprehensive guidelines for healthcare professionals providing preventive vaccinations, with the goal of elevating the quality and safety of these services to better safeguard public health (Chen et al., 2024). As China's immunization program evolves and the vaccine portfolio expands, so does the public's demand for vaccination services. This is particularly evident in the context of China's evolving fertility policies, where there is a notable surge in demand for pediatric vaccinations (Cao et al., 2018). Moreover, in light of recurrent global health crises, public interest in vaccination is on the rise (Thangaraju & Venkatesan, 2019). The COVID-19 pandemic exemplifies the pivotal role of vaccination in disease prevention and has spurred nations to bolster their vaccine research and immunization efforts (Lurie et al., 2020). Against this backdrop, China's vaccination efforts are confronted with new challenges and simultaneously present vast opportunities for advancement.

As global public health consciousness rises, vaccinations have emerged as a critical tool

for safeguarding public health. This heightened public interest in vaccination services has led to enhanced standards for the delivery of these services (Larson et al., 2014). Vaccination clinics, being the primary venues for administering vaccines, play a pivotal role in safeguarding the health of individuals and the stability of communities. Yet, despite growing recognition of the value of vaccinations, some individuals remain underinformed about their significance, mistakenly believing they can avoid illness without being vaccinated (Wang, 2019). Consequently, increasing vaccination coverage rates is a significant challenge. Moreover, some vaccination clinics lack standardized procedures, such as omitting essential pre-vaccination health assessments and physical examinations, which could potentially raise the risk of adverse post-vaccination reactions (Chen et al., 2024). There are also issues with inadequate medical infrastructure; a shortage of qualified vaccination technicians, leading to varying service quality and heavy workloads (Yuan et al., 2019); lagging modernization and patient-centered design in vaccination clinics; and vulnerabilities in vaccination management, including substandard vaccine storage and transportation in some primary care settings (Ren et al., 2018).

The current shortcomings in vaccination clinics' service capabilities, including personnel, facilities, management, and service quality, struggle to keep pace with the escalating demands of the public, significantly impeding the enhancement of vaccination services (Ma et al., 2023). Addressing how to bolster the quality monitoring and management capacity of vaccination clinics, ensuring a secure and efficacious vaccination setting, and increasing public satisfaction with vaccination policies are pressing concerns for the advancement and successful execution of national immunization initiatives (Cao et al., 2018). Prior to this, scientifically and objectively assessing the quality monitoring and management capabilities of vaccination clinics is essential for guaranteeing their effectiveness. Developing a comprehensive and systematic quality monitoring and management framework for vaccination clinics is imperative for addressing these challenges. By instituting and refining such a system, the quality of services can be thoroughly and methodically appraised, identifying and resolving issues promptly, thereby elevating service standards. Moreover, a robust quality monitoring management system can inform managerial decisions with data, streamline resource allocation, foster communication, build public confidence, and enhance the overall vaccination effort (Shen et al., 2014). In the context of China's ongoing health system reforms, there is an increased demand for high-quality and efficient services in vaccination clinics. However, the existing quality assessment criteria for vaccination clinics are not standardized, leading to varying evaluation standards across regions and a lack of comparability in results (Li et al., 2023). The evaluation scope is not comprehensive, potentially skewing the outcomes, and the methods

employed are not sufficiently scientific, often relying on subjective judgments or overly simplistic metrics (Zhu et al., 2013). Consequently, the evaluations lack the necessary objectivity and precision, and their application is limited, failing to fully leverage their potential to guide improvements in vaccination service quality. The absence of a dynamic monitoring and feedback mechanism means that issues are not identified and addressed in a timely manner, as assessments are often static or periodic (Wang et al., 2003). This approach falls short of meeting current evaluative needs. Thus, researching and developing a quality monitoring management system for vaccination clinics holds significant practical and theoretical importance.

Enhancing the quality management of vaccination services and elevating the level of care are crucial for the successful implementation of national immunization strategies and the protection of public health (World Health Organization [WHO], 2020) Establishing a scientific and standardized quality monitoring and management system for vaccination clinics is a vital foundation for ensuring quality (Jiang et al., 2022). Internationally, extensive research has been conducted on vaccine quality monitoring and management. Matthias et al. (2007) have distilled the best practices from developed nations' vaccine quality management, proposing a comprehensive quality control framework that encompasses all stages from production to procurement, distribution, storage, and administration. Iwu et al. (2019), drawing from systematic review evidence, have recommended bolstering immunization program management in low-income countries by focusing on resource allocation, vaccine availability, vaccinator training, and monitoring of adverse reactions. Lois Privor-Dumm et al. (2020) have underscored the significance of vaccine quality regulation for achieving global immunization coverage and have advocated for the establishment of consistent international standards. Gurnani et al. (2018) have shared India's experience with digital management in its national immunization program, which has enhanced vaccine traceability and the quality of vaccination data through the use of information technology.

Domestic researchers have begun to delve into the quality monitoring management system for vaccination clinics. For instance, Chen (2016) has proposed improvements to the vaccination process for school-age children, focusing on a service-oriented approach; Liu et al. (2016) have investigated the potential of digitalization models in vaccination clinics and their impact on adverse reaction management. While these studies have provided a preliminary foundation, the current evaluation systems lack comprehensive dimensionality, and some indicators are challenging to quantify and operationalize, limiting their practical applicability (Yuan et al., 2019).

In light of these issues, it is essential to consider a holistic approach to vaccination outpatient services, encompassing hardware facilities, staffing, vaccine management, vaccination procedures, service attitudes, and communication, among others. This should be done by building upon previous research and aligning with the unique characteristics and evolving demands of vaccination services in the contemporary context (Ren et al., 2018). The aim is to develop a comprehensive, logical, and straightforward quality monitoring management system for vaccination outpatient services, and to assess its practical effectiveness. This endeavor is intended to offer a scientific theoretical framework and actionable guidance for the quality management of vaccination services, thereby positively contributing to the safeguarding of public health and the maintenance of social stability.

1.2 Research questions

Following the research background presented in the previous point, the research questions are as follows.

(1) What are the components required to establish a scientific quality monitoring management system for vaccination clinics, and what dimensions and indicators should the evaluation system encompass?

The development of a quality assessment framework for vaccination clinics is a fundamental aspect of this research endeavor. An effective evaluation system should comprehensively address the various facets of vaccination services, respect the specialized nature of vaccination practices, and consider the practicality of its implementation. The design of this evaluation system should draw extensively from relevant research findings and standards both domestically and internationally, and be tailored to the realities of China's vaccination services. By employing the Delphi method and other rigorous scientific techniques, the system should aim to gather extensive expert feedback, undergo iterative testing and refinement, and ultimately result in an index system that is well-structured, all-encompassing, and highly operational. The goal is to make the evaluation system a guiding "baton" that fosters the standardized, meticulous, and high-quality progression of vaccination services.

(2) Utilizing the developed evaluation system, what is the current state of quality monitoring and management in China's preventive vaccination outpatient clinics? Do variations exist in the quality monitoring and management across different regions and levels of vaccination clinics?

Once the quality monitoring management system is in place, it should be employed to

conduct a thorough investigation and assessment of the current quality monitoring and management practices within China's vaccination outpatient clinics. By employing a scientific sampling technique, a selection of representative provinces and vaccination clinics will be chosen for the study. A comprehensive evaluation and scoring will be performed using methods such as questionnaire surveys, field investigations, and data reviews. This will allow for an assessment of each clinic's performance across various quality dimensions and an analysis of common and unique issues. The assessment should address the following inquiries: What is the overall adherence to the quality indicators? Which indicators show the best and worst performance? Further analysis should be conducted to determine if there are significant disparities in the quality monitoring and management between clinics in different regions and at various levels. Delve into the underlying causes of these differences and formulate targeted strategies for quality enhancement.

(3) What intervention measures are most effective in addressing the main shortcomings of vaccination clinic quality monitoring and management? Can the work quality of vaccination clinics be significantly improved after implementing improvement measures?

The ultimate goal of the quality status investigation is to identify problems, improve practices, and enhance quality. Based on a comprehensive assessment of the current status of vaccination clinic quality monitoring and management and identification of key weaknesses, this study designed and implemented a series of targeted intervention measures. Through comparative analysis of indicator changes across different dimensions before and after intervention, the research evaluated the actual effectiveness of various improvement measures, verifying the efficacy of intervention strategies including professional service optimization, personnel capacity enhancement, social service expansion, and information technology application. These empirical research findings provide a basis for developing feasible vaccination clinic quality improvement plans. The study holds significant practical guidance for promoting the standardization and normalization of vaccination clinic services, increasing vaccination rates and population immunity levels, and reducing the incidence of vaccine-preventable diseases.

1.3 Research significance

1.3.1 Theoretical significance

(1) This study enriches and advances the theoretical framework of quality management in

vaccination clinics. By constructing evaluation indicators across various dimensions—including professional services, staff training, community collaboration, and the application of information technology—the research broadens the theoretical scope of previous studies and offers a novel analytical framework for a more comprehensive grasp of quality management within vaccination outpatient services.

(2) It offers a theoretical instrument for assessing the quality of vaccination clinics. The quality monitoring and management system, developed through literature reviews and expert consultations, is characterized by its high reliability, validity, and operability, serving as a scientifically sound and practical theoretical tool. This system provides a theoretical foundation and standard benchmarks for the quality assessment of preventive vaccination outpatient services.

(3) The study validates the theoretical pathways for enhancing vaccination clinic quality. Identifying issues from prior evaluations, the research proposes a multi-faceted intervention strategy, including systemic improvements, training, and information technology. The effectiveness of these measures is empirically tested, offering fresh empirical evidence that elucidates the theoretical pathways and patterns of quality enhancement in preventive vaccination clinics.

(4) It deepens the theoretical comprehension of preventive healthcare service quality management. The research contributes to a more profound understanding of the commonalities and inherent patterns of preventive healthcare services within primary care settings, providing fresh theoretical support for the enrichment and evolution of the theory surrounding the quality management of preventive healthcare services.

1.3.2 Practical significance

(1) This study offers a practical assessment tool for the quality oversight of vaccination clinics. The four-dimensional evaluation system, with its robust operability and broad applicability, serves as a functional instrument for health authorities and disease control centers to conduct quality supervision and performance evaluations of vaccination clinics. This aids in establishing a regular and detailed quality assessment mechanism.

(2) It furnishes a roadmap for ongoing quality enhancement in vaccination clinics. By conducting systematic assessments, identifying quality deficiencies, and formulating diagnostic improvement recommendations, the system can encourage vaccination clinics to pinpoint critical areas and issues. This enables them to develop targeted corrective actions, continuously strengthen weak points, and elevate the overall service quality.

(3) It lays a policy foundation for the high-quality development of pediatric health services. Uncovering the underlying causes that affect vaccination quality can assist health and disease control departments in formulating scientifically sound vaccination policies. This includes optimizing resource allocation, increasing investment in personnel training and information infrastructure, and enhancing the capacity to deliver high-quality preventive health services for children.

(4) It contributes insights for bolstering the capabilities of primary healthcare services. As a vital element of the primary healthcare system, the quality management practices of vaccination clinics can offer exemplary guidance for other primary healthcare providers. This can stimulate a comprehensive improvement in the quality and effectiveness of the entire primary healthcare service sector.

1.4 Research framework and technical route

This study ensures the systematic and scientific nature of the research work by developing a detailed technical roadmap. Figure 1.1 displays the specific implementation steps and research framework of this study. The technical roadmap of this research mainly includes four key stages: current situation analysis, construction of the quality evaluation system, current situation survey, and research on quality improvement strategies.

During the current situation analysis phase, a deep understanding of the current state of service quality evaluation systems for vaccination outpatient services both domestically and internationally is gained through literature research and questionnaire surveys. In the construction of the quality evaluation system phase, methods such as literature research, semi-structured interviews, and the Delphi expert consultation method are used to build an evaluation index system suitable for China's national conditions.

In the current situation survey phase, questionnaire surveys and field research methods are employed to conduct a comprehensive assessment of the current state of service quality in vaccination outpatient services. Finally, in the research phase on quality improvement strategies, specific improvement strategies are proposed from macro, meso, and micro levels based on the results of the previous research stages.

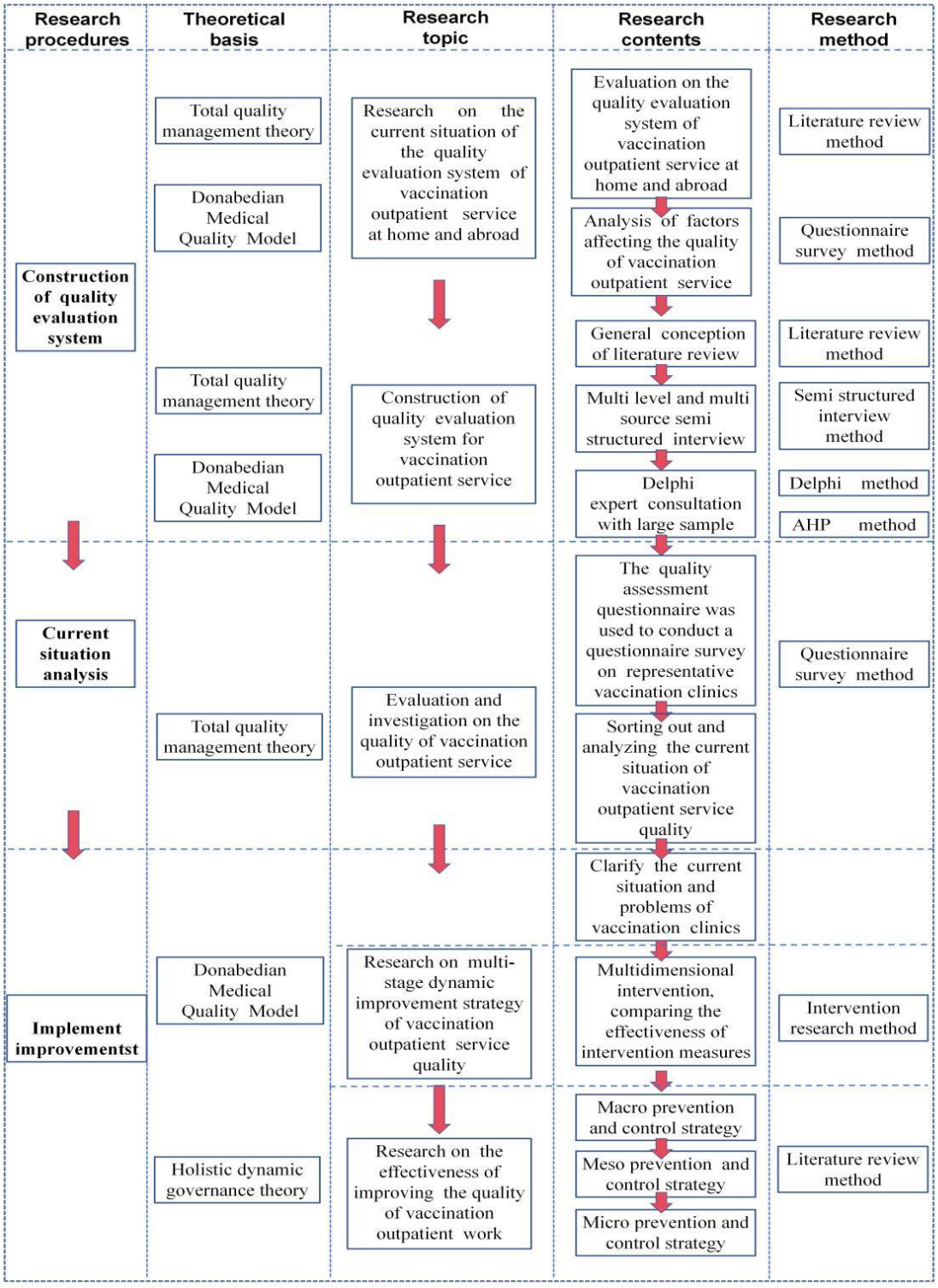


Figure 1.1 Research roadmap

1.5 Research Approach

This study systematically addresses the quality monitoring management system of vaccination outpatient clinics through a sequential examination of five key components. It begins with a

comprehensive review of the current research on quality monitoring management systems both within China and internationally, analyzing the merits and demerits of China's current system. The study then delves into the theoretical underpinnings of the quality monitoring management system, drawing on total quality management theory, structural process outcome theory, and holistic dynamic governance theory to clarify its conceptual framework. Following this theoretical foundation, the research proceeds to an empirical phase, engaging in in-depth interviews with experts in preventive medicine, vaccination clinic staff, and the public to identify the core components of the quality monitoring and management system. Using expert consultation and the Delphi method, key elements are selected to construct the system and to formulate an evaluation questionnaire. The developed system is then applied to assess the quality of vaccination outpatient clinics across different regions and levels, revealing the current state and challenges in quality monitoring and management. Based on these assessments, an intervention is designed and its effectiveness is evaluated through a pre-and post-intervention comparison. The study concludes by offering specific strategies and measures to improve the quality monitoring and management in vaccination clinics, based on the comprehensive analysis provided throughout the research.

1.5.1 Overview of domestic and international research and theoretical foundations of quality monitoring management systems in vaccination clinics

This study initially provides a broad overview of the research landscape regarding the quality assessment systems of vaccination clinics globally and within China, scrutinizing the strengths and weaknesses of China's current framework. The focus is on the practical operational outcomes and potential issues encountered by each evaluation system. By actively incorporating the progressive experiences and practices from abroad, the study identifies the distinctions and similarities between domestic and international systems through comparative analysis. The aim is to learn from each other's successes to refine and enhance the quality monitoring and management system for China's vaccination outpatient services.

Subsequently, the research delves into an in-depth analysis of the essence, components, and structure of the quality monitoring management system in vaccination outpatient clinics, drawing on theories of total quality management, structural process outcomes, and holistic dynamic governance. This approach ensures a comprehensive and precise understanding of the internal logic and operational mechanisms of the quality monitoring management system in vaccination outpatient services. The study aims to clarify the pivotal elements within the quality monitoring management system and to elucidate the interrelationships and operational

dynamics among these elements.

1.5.2 Development of a comprehensive evaluation indicator framework and index system for the quality of vaccination clinic services in China

This study employs literature reviews, expert consultations, and empirical research to establish a robust set of evaluation indicators, ensuring a rigorous, standardized, and precise quality assessment process. Given that vaccination clinics must deliver not only efficient and standardized services but also prioritize safety and patient experience, the selected indicators cover all aspects of service quality, providing a foundation for thorough evaluation.

With these indicators, the study constructs an index system for assessing vaccination clinic services, following a “clear hierarchy and structure” to enable systematic evaluation. To ensure scientific validity, interviews were conducted with preventive medicine experts, frontline clinic staff, and the public. These consultations provided valuable insights into the essential elements of service quality and captured the needs and expectations of all stakeholders.

Finally, the Delphi method refined and optimized the indicators for quality monitoring and management in vaccination clinics. Multiple rounds of expert feedback established key elements and their weightings, forming a reliable quality monitoring and management system.

1.5.3 Assessment of the current state of quality monitoring and management in vaccination clinics in China

This study developed a comprehensive evaluation index system for the quality of services in China’s vaccination clinics and conducted a nationwide survey to assess the current quality evaluation system. The goal was to understand the actual service quality, identify issues, and provide guidance for improvement. The survey was conducted in three stages: pre-survey, survey, and post-survey, to ensure scientific rigor.

A pilot study in two Harbin clinics was conducted to identify potential problems and refine the initial questionnaire. The final questionnaire considered regional differences, clinic scale, and incorporated the latest research and best practices to ensure comprehensiveness. The full investigation was launched with close collaboration with relevant units, adhering to laws, regulations, and ethical norms, respecting respondent rights, and ensuring data confidentiality. The study analyzed quality scores across different dimensions and regions, identified significant differences in vaccination clinic quality.

1.5.4 Study on interventions to improve quality monitoring and management in vaccination clinics and enhance vaccination effectiveness

This study identified key areas and factors impeding quality improvement in vaccination clinics from previous assessments. Interventional research was conducted to enhance quality through refining regulations, improving staff training, streamlining processes, and innovating health education. The aim was to strengthen enforceability of management systems, innovate training methods, and boost vaccination staff's professional skills and service awareness.

Field research was used to optimize the vaccination service process, improve efficiency, and humanize service. Health education initiatives addressed public misconceptions about vaccinations to improve compliance. Selected clinics were divided into intervention and control groups, with quality data collected for comparison using statistical methods to assess the impact of interventions.

1.5.5 Policy recommendations for enhancing quality monitoring and management in Chinese vaccination clinics

Based on the findings from the preceding research, this study offers targeted recommendations and measures aimed at enhancing the service quality and safety of vaccination clinics. These recommendations include policy suggestions and conceptual frameworks for bolstering the quality of vaccination services in China. The areas of focus include:

(1) Strengthening policy support to provide a robust legislative and regulatory foundation.

(2) Improving facilities and equipment to ensure a high standard of service provision.

(3) Enhancing personnel training to elevate the competencies of vaccination staff.

(4) Fortifying the management of vaccine research, development, production, and distribution to maintain vaccine integrity and efficacy.

(5) Advancing information technology to streamline processes and improve data management.

(6) Enhancing social supervision to ensure transparency and public trust.

The study anticipates that with the collaborative efforts and support from the government and various sectors of society, a comprehensive and multi-tiered system can be established to safeguard the quality of vaccination services. This system is designed to achieve a holistic improvement in the quality of vaccination work, thereby ensuring the health and well-being of the population.

1.6 Research Structure

The dissertation is comprehensively structured across seven chapters, presenting a systematic exploration of vaccination clinic quality monitoring and management. The first chapter serves as an introduction, delineating the research background, significance, core questions, objectives, and innovative aspects, while outlining the technical route and research approach. The second chapter provides a thorough literature review, systematically examining domestic and international research on vaccination clinic quality monitoring, comparatively analyzing vaccination systems across different countries, and establishing a robust theoretical foundation and research framework. The third chapter focuses on research methodology, detailing the research design, object selection, tool development, data collection strategies, and statistical analysis approaches. The fourth chapter conducts qualitative research on vaccination clinic quality monitoring management elements through semi-structured interviews with CDC experts, clinic staff, and social stakeholders to preliminarily identify potential indicators. In the fifth chapter, the research constructs a vaccination clinic quality monitoring management system using the Delphi method, subsequently refining the initial indicator system through multiple rounds of expert consultation via Analytic Hierarchy Process (AHP) to establish a final evaluation framework with determined indicator weights. The sixth chapter presents an investigation and intervention study of vaccination clinic quality monitoring management in China. By applying the constructed evaluation system, the research conducts comprehensive on-site investigations across different regions and levels, analyzing quality status and regional variations. Based on these findings, targeted intervention measures are designed and implemented, with intervention effects rigorously evaluated through before-and-after comparisons. The seventh chapter synthesizes research conclusions and recommendations, summarizing key findings, proposing policy suggestions for system improvement, and discussing research limitations and future research directions. The eighth chapter provides a concise summary of the study's primary discoveries. The entire research design adheres to a logical progression of "problem identification - evaluation system construction - status analysis - intervention verification - policy recommendations", ensuring organic interconnectivity between chapters and forming a comprehensive, systematic research approach.

Chapter 2: Literature Review

2.1 Bibliometric analysis of domestic and foreign literature

A precise search was conducted in the China National Knowledge Infrastructure (CNKI) database using “immunization” and “quality monitoring management” as keywords within the scope of journals, yielding 319 Chinese researches. In the Web of Science Core Collection, specifically the Science Citation Index Expanded (SCI-Expanded) and Social Sciences Citation Index (SSCI) databases, a search using the query TS=(vaccination) AND TS = (Quality monitoring management) returned 730 English-language publications. This disparity suggests that research on immunization quality assessment in China remains relatively scarce. Internationally, studies on the quality assessment of vaccination clinics first appeared in 2012, while in China, such research can be traced back to 1988. To maintain consistency in the publication timeframe between domestic and international literature, this study focuses on bibliometric analysis of publications from 2012 to 2022.

2.1.1 Publication timeline and volume

In the field of immunization program research, both domestic and international literature on immunization quality assessment shows fluctuating trends in publication volume. Compared to international publications, domestic research demonstrates a higher growth momentum (Figure 2.1).

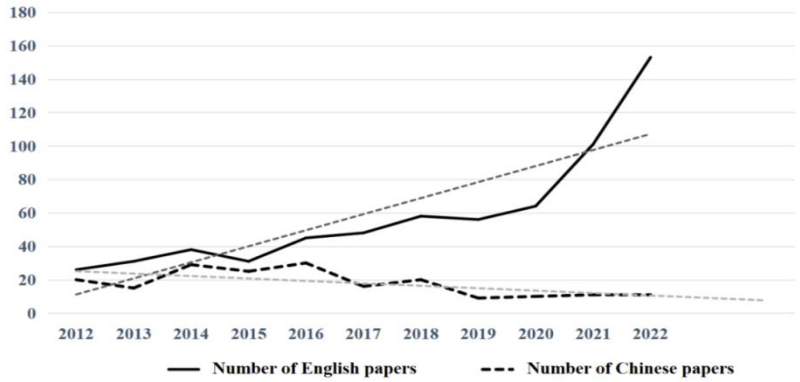


Figure 2.1 Publication volume of research on vaccination clinic quality assessment, domestic and international

2.1.2 Publication journals

As shown in Table 2.1, international research on immunization quality assessment is currently published across a wide range of journals, without a centralized system. Findings appear in international journals such as *Vaccine*, *Vaccines*, and *Cochrane Database of Systematic Reviews*. Domestic research is primarily published in specialized journals in the fields of immunology and preventive medicine, including *Chinese Journal of Vaccines and Immunization*, *Modern Preventive Medicine*, and *Chinese Journal of Planned Immunization*.

Table 2.1 Journal status of quality assessment of vaccination outpatient clinics published at home and abroad

	Journal name	Thesis account	Proportion
China	Chinese vaccine and immunity	47	14.73%
	Modern preventive medicine	13	4.08%
	Chinese journal of vaccines and immunization	13	4.08%
	Occupation and Health	12	3.76%
	Strait Journal of Preventive Medicine	9	2.82%
	Henan Journal of preventive Medicine	7	2.19%
	Journal of Medical Pest Control	7	2.19%
	Journal of Preventive Medicine Information	7	2.19%
	Chinese Primary Health Care	7	2.19%
	Other journals	197	61.76%
International	Vaccine	65	8.90%
	Vaccines	31	4.25%
	Cochrane Database of Systematic Reviews	21	2.88%
	PLOS One	19	2.60%
	BMJ Open	18	2.47%
	Human Vaccines & Immunotherapeutics	18	2.47%
	BMC Infectious Diseases	16	2.19%
	BMC Health Services Research	15	2.05%
	BMC Public Health	8	1.10%
	Pharmacoeconomics	8	1.10%
	Value in Health	8	1.10%
	Frontiers in Immunology	7	0.96%
	Frontiers in Public Health	7	0.96%
	International Journal of Environmental Research and Public Health	7	0.96%
	Preventive Medicine	7	0.96%
	Other journals	475	65.07%

Note: Other journals refer to those that have published a total of less than 7 researches related to the quality assessment of vaccination.

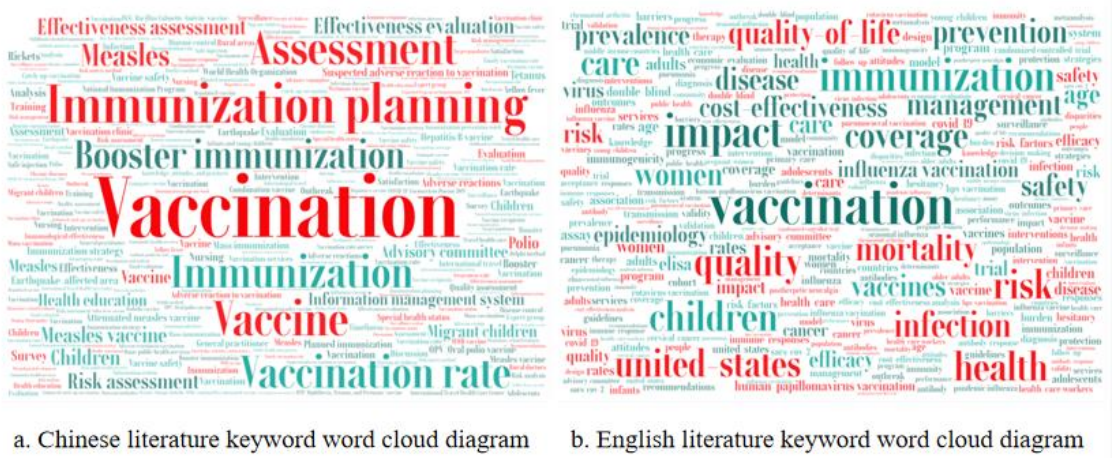
2.1.3 Research themes and content

To gain deeper insight into current and future focus areas in immunization quality assessment research, both domestically and internationally, this study conducted a statistical analysis of keywords from the retrieved literature (Table 2.2) and generated keyword cloud maps (Figure 2.2). In domestic research, key focus areas include “immunization,” “immunization planning,”

"vaccination," "vaccination rates," "enhanced immunization," and "effect evaluation." International research primarily focuses on keywords such as "vaccination" (Jonathan et al., 2016; Puliafito et al., 2020; Sak et al., 2015) "impact" "immunization"(Calo et al.; Clark et al., 2012; Eisenhauer et al., 2021) "quality" (Hoonakker et al., 2016; Oliver et al., 2019; Remschmidt et al., 2014; Sapir et al., 2016) "children" "health" (Adekola et al., 2012; Alhendyani et al., 2022; Luo et al., 2021; Okoli et al., 2021; Pham et al., 2016).

Table 2.2 High frequency Chinese and English keywords

English keyword	Frequency	Chinese keyword	Frequency
vaccination	90	Preventive vaccination	85
impact	58	Immunization Program	34
immunization	54	Vaccines	28
quality	46	Assessment	27
children	45	Immunization	24
health	43	Vaccination rate	24
risk	43	Strengthen immunity	23
united-states	39	Measles	14
coverage	37	Effect evaluation	14
care	36	Impact assessment	14
infection	34	Children	13
mortality	33	Risk assessment	13
prevention	30	Measles vaccine	13
quality-of-life	29	Mis	9
women	29	Health Education	9
management	27	Mobile children	9
disease	26	Advisory committee	9
vaccines	25	Suspected abnormal reaction to Vaccination	8
safety	25	Effect	8
cost-effectiveness	25	Evaluate	8
prevalence	25	Adverse reactions	8
influenza vaccination	24	Immune strategy	7
epidemiology	24	Earthquake stricken areas	7
efficacy	24	Measles attenuated live vaccine	7
human-papillomavirus vaccination	20	Vaccine safety	7



a. Chinese literature keyword word cloud diagram b. English literature keyword word cloud diagram

Figure 2.2 Keyword cloud map

The above research literature on vaccination quality assessment at home and abroad was sorted out. Cite Space software was used to cluster keywords and draw a clustering map with a timeline (Figure 2.3, Figure 2.4). The analysis results showed that domestic scholars attached great importance to vaccine safety when conducting research on vaccination quality assessment. Live attenuated polio vaccine and hepatitis B vaccine were the key objects of attention, and immunization planning was also one of the focuses of attention of domestic scholars. International scholars tend to focus more on topics such as "human papillomavirus," "vaccination hesitancy," "immune response," and "quality improvement."

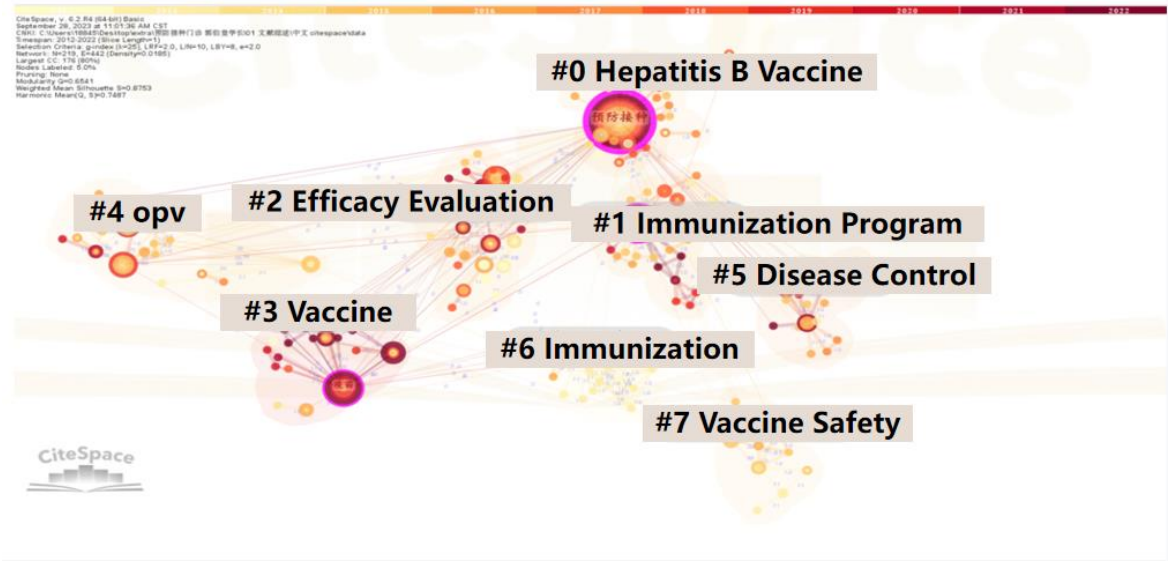


Figure 2.3 Keyword clustering diagram of the literature on quality assessment of domestic vaccination clinics

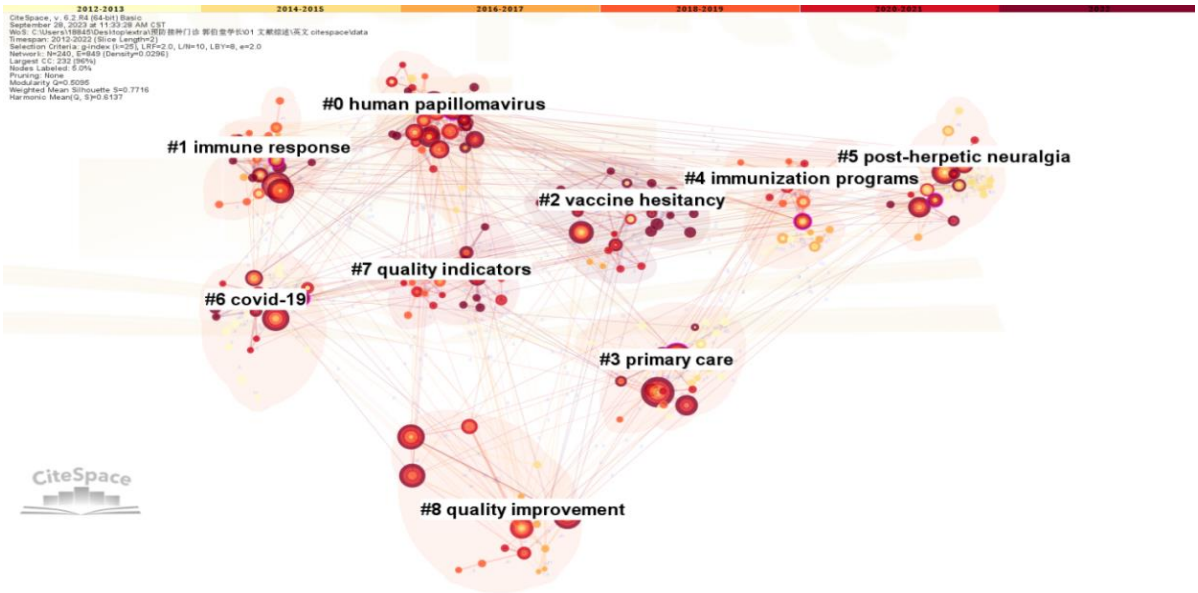


Figure 2.4 Keyword clustering diagram of literature on quality assessment of vaccination clinics abroad

In the process of deeply analyzing and organizing literature in the field of vaccination service capacity, as shown in Table 2.3, many studies have been conducted by Chinese scholars in recent years, highlighting their close concern for current realities. Through keyword searches of literature and in-depth reading, it has been found that these studies mainly revolve around the core theme of vaccination clinic resource allocation, covering key dimensions such as clinic space utilization, information technology infrastructure, scientific staffing, and cold chain system operation and maintenance. Many of these studies use cross-sectional research methods for specific regions or cities, striving to accurately depict the actual situation in this field. Lan (2011) delved into the influencing factors of vaccination services from dimensions such as supply and demand relationships and socio-economic factors. After rigorous argumentation, it was pointed out that improving service efficiency requires efforts in multiple aspects: consolidating the foundation of financial investment, strengthening the construction of personnel training systems, comprehensively enhancing service capabilities, simultaneously strengthening public health education and popularization work, and strictly ensuring the effective implementation of the vaccination certificate inspection system. Xie and Liu (2016) anchored their research perspective on all vaccination clinics in Xiamen City, focusing closely on the main line of resource allocation. They comprehensively considered elements such as the delineation of service areas, characteristics of the served population, staffing structure, clinic service flow, and the rationality of salary levels to conduct a detailed study on service capacity. Their conclusion clearly pointed out that increasing the number of clinics, expanding the staff establishment, and reasonably improving salary treatment are necessary measures to enhance service capacity. Zhang and Li (2018) adhering to a research approach similar to that of Xie Qun and others, based their study on the data resources of clinics across the city. They used fine comparisons and in-depth analysis to assess the capacity of vaccination services and subsequently proposed targeted optimization suggestions to reduce the service radius and moderately expand personnel allocation, aiming to enhance the precision and smoothness of the services. He et al. (2018) conducted a study covering all vaccination clinics within their jurisdiction. They focused on the rationality of personnel allocation architecture and provided a detailed description and analysis of the current situation, including the size of clinic areas, vaccination station facilities, medical refrigerator equipment, and the progress of digital clinic construction. Based on this, they called for increased investment in the basic construction of clinics, with particular emphasis on strengthening the long-term construction of personnel teams and solidifying the talent foundation to empower the sustainable development of clinics. Wang et al. (2020) focused on vaccination clinics across Henan Province, concentrating on two

major areas: the standardization of clinic setup and the scientific nature of personnel allocation. Adhering to the spirit of empirical research, they comprehensively employed diverse methods such as on-site inspections, data collection, and questionnaire interviews to deeply comb and analyze the current situation, uncover potential issues, and lay a solid data foundation for the formulation of subsequent optimization strategies, providing decision-making references. Xue et al. (2020) strictly aligned with the provincial standardized clinic construction standards, focusing on 173 clinics. They conducted a current status description and benchmarking assessment around key dimensions such as precise measurement of clinic area, quantified assessment of digital construction ratio, and verification of personnel allocation density. They accurately identified the shortcomings in the reserve of personnel teams and the weak links in infrastructure, clarifying subsequent improvement targets, and aiding in the steady progress towards standardized construction and high-quality enhancement of service capabilities.

Table 2.3 Research on the vaccination service capability of domestic scholars

Publishing year	Researcher	Related indicators
2011	Lan (2011)	Funding investment, personnel training, institutional construction, vaccination certificate verification, health education.
2015	Xie & Liu (2016).	Outpatient area, service population, staff configuration, vaccination frequency, salary level
2018	Zhang & Li (2018)	Service cycle, service radius, personnel composition
2020	Wang et al. (2020)	Staff configuration
2019	Xue al. (2020)	Outpatient area, staff configuration, cold chain facilities
2018	He et al. (2018)	Number of service population, staffing, outpatient area, number of vaccination stations, number of seats, number of refrigerators
2018	Yu et al. (2018)	Outpatient area, service radius, service cycle, staff configuration, information technology construction, number of refrigerators
2018	Shang (2018)	Human resources (staffing, technical level), equipment resources (outpatient area, functional areas, cold chain facilities, humanized facilities), management status (information management, work system implementation, filing rate), service quality (vaccination rate, service satisfaction)

From a global academic research perspective, there is currently a lack of systematic exploration aimed at improving the quality of vaccination services (Casey et al., 2016). On one hand, the field of vaccination services itself contains multiple special characteristics, such as the strict requirements for the cold chain storage and transportation of vaccines, and the complex impact of individual differences among the vaccinated population on the effectiveness of immunity. These are compounded by numerous practical challenges faced in conducting research, such as the difficulty of cross-departmental data collaboration and the high cost of long-term tracking and monitoring, which often result in fragmented research that is difficult to

integrate into a complete theoretical and practical system. On the other hand, existing research tends to focus on the details of the vaccination process, emphasizing operational standards and time control at the micro level of vaccine administration. However, there is a lack of effort in integrating multiple stages and elements to provide a panoramic view of the overall situation and in conducting systematic analysis of service quality from a macro structural perspective (Shen et al., 2014). However, with the innovation of public health concepts and the deepening of practices, vaccination services, as the cornerstone of building herd immunity, continue to rise in strategic importance (Omer et al., 2009). Therefore, adopting a multi-dimensional perspective to conduct a comprehensive review of this field and to construct a service quality evaluation system that meets practical needs has become a key issue that both academia and the practical field urgently need to address.

Tracing the development of global vaccination systems reveals a clear trajectory of evolution from scattered, ad-hoc interventions to systematic, routine services. Using cowpox vaccination to prevent smallpox marked a pioneering moment in the field of human immunization. At that time, vaccination primarily relied on individual physicians' empirical practices, lacking standardized procedures and quality control mechanisms. It was not until the early 20th century that, with the advancement of bacteriology and immunology, vaccination gradually transformed from an individual medical practice to a broader social public health initiative. Countries began to establish preliminary immunization intervention programs targeting specific infectious diseases, signaling a significant shift in approach to disease prevention. From an international perspective, in the process of vaccination service practice, China, like Japan and South Korea, exhibits a high degree of similarity in the dimension of financing models. These countries largely rely on a hybrid model dominated by public finance, supplemented by some social capital, which aligns with China's current national conditions and development needs (Tang et al., 2017). However, focusing on the dynamic curve of vaccination needs, with the awakening of public health awareness and the profound adjustment of population structure, the existing list of immunization program vaccines in China is gradually showing its limitations and is unable to fully cover diverse prevention needs. There is an urgent need to optimize the immunization strategy framework based on evidence-based medical evidence and epidemiological surveillance data, and to carefully select and introduce new types of vaccines (Zheng et al., 2010). In the management of vaccines and vaccination, professionalism is the guiding principle throughout the entire process, from the establishment of standardized procedures for vaccine procurement and storage to the formulation of detailed guidelines for vaccination operations, all strictly adhere to scientific standards and quality

control baselines. At the same time, the adverse reaction compensation mechanism has undergone iterative improvements and is steadily approaching international standards, demonstrating China's firm determination to protect public health rights and interests and to align with international advanced management concepts (Fei & Peng, 2017). At the current stage, China's vaccination service supply system exhibits distinct hierarchical characteristics. Community health service centers and township health clinics, as the main forces, bear the heavy responsibility of routine vaccination services. In contrast, general hospitals, which focus more on the diagnosis and treatment of complex diseases, and private clinics, which are constrained by operational costs and regulatory oversight, have a relatively limited degree of participation (Fang et al., 2017). In contrast, in European and American countries, pharmacies, leveraging their widespread distribution advantage, and pharmacists, with their professional pharmaceutical knowledge, have deeply integrated into the vaccination service chain, gradually becoming an emerging trend. This provides valuable insights for China to expand the subjects of service supply and promote innovation in service models (Goad et al., 2012). Focusing on the dimension of service accessibility, with the promulgation and implementation of the "Vaccine Administration Law," the moderate relaxation of the entry threshold for vaccination clinics aims to stimulate the participation of diverse medical entities and expand the service coverage network. However, there is still a gap between the current practice and the ideal vision, and the path to improving service accessibility remains a long and arduous task (Zheng et al., 2018).

International academia, focusing on research in vaccination services, although often anchored in three core areas: the assessment of resource allocation rationality, the quantification of service quality, and the exploration of vaccination rate improvement strategies, varies in emphasis and approach. Developed countries in Europe and America, leveraging their robust scientific research resources, meticulously delve into the subfields of outcome indicators to uncover deep-level associations. However, they are somewhat lacking in integrating research findings and constructing systematic theoretical frameworks. Particularly noteworthy is the increasing emphasis on empowering the professional roles of pharmacies and pharmacists, advocating for service delivery with a humanistic care philosophy to optimize the vaccination experience (Isenor et al., 2016). Low- and middle-income countries, constrained by limited resources, focus on the equity of resource distribution, the actual breadth of vaccine coverage, the analysis of factors constraining and driving vaccination rates, and the adaptability study of introducing new types of vaccines (Ozawa et al., 2019). Domestically, thanks to the solid advancement of long-term immunization programs, the vaccination rates for scheduled

immunization vaccines have remained at a high and stable level. However, academic research has largely focused on the layout of outpatient hardware facilities and the current state of service processes. There is still a significant gap in developing systematic evaluation tools for the quality monitoring and management capabilities of vaccination clinics, as well as in-depth analysis of the intrinsic logical relationship between standardized management and service capabilities (Wei et al., 2023). In recent years, especially in the wake of occasional vaccine incidents, there is an urgent need to strengthen and fill the gaps in the exploration of the fine-tuned and standardized management of vaccination service processes, as well as the mechanisms by which these processes affect overall service capabilities.

Globally, countries establish vaccination management systems tailored to their national conditions, which can be broadly categorized into three models: market-driven, national health service, and government-led, each with distinct characteristics. From a historical perspective, the development of vaccination systems demonstrates three notable features. First, there has been a conceptual shift from disease control to health promotion, moving beyond mere treatment to a more holistic approach of maintaining population health. Second, the service model has transformed from passive vaccination to active participation, emphasizing patient engagement and informed decision-making. Third, the function of vaccination has expanded from simple immunization to comprehensive health services, integrating broader healthcare objectives and preventive strategies. This evolutionary process provides critical insights for developing a modern vaccination clinic quality monitoring and management system, highlighting the importance of adaptive, patient-centered, and comprehensive approaches to public health interventions.

2.1.3.1 Vaccine and vaccination management

In developed countries represented by the United States, the United Kingdom, Australia, Canada, and Japan, their official online platforms carry and publish comprehensive and systematic vaccination guidelines. These guidelines systematically cover core points including standards for immunization schedules, precise standards for vaccination operations, precautions throughout the entire process before and after vaccination, and precise definitions of vaccination postures and sites (Australian Government Department of Health, 2023). Among them, the Centers for Disease Control and Prevention (CDC) in the United States has distinctively conducted specialized training in communication skills, focusing on emotional soothing before vaccination, meticulous care after vaccination, vaccination strategy guidance in disease scenarios, and detailed rules for vaccine catch-up, aiming to optimize the interaction

experience of vaccination services in all aspects. Australia and Canada adhere to a federal and local collaborative governance structure. While building a macro framework for vaccine and vaccination management at the federal level, each province/county and city tailors its own unique regulations based on regional characteristics, population structure, and differences in disease spectra to meet local needs. Australia particularly highlights the concept of diversity and inclusiveness by carefully tailoring three differentiated immunization schedules for different ethnic groups and creating efficient communication plans specifically for Indigenous peoples. Additionally, the Department of Health has meticulously compiled an immunization service toolkit for medical personnel and simultaneously published authoritative national guidelines on vaccine storage (World Health Organization [WHO], 2019). The United Kingdom relies on the "Green Book" Immunization Handbook to encapsulate the core principles of vaccine management, focusing on the scientific scheduling of vaccine stocks and precise control of the cold chain. The Department of Health and Social Care also demonstrates foresight by issuing national minimum standards and a core curriculum for immunization training of health care support workers, thereby solidifying the foundation of professional talent (Festenstein et al., 1988). Developed countries, leveraging advanced information technology and meticulous management thinking, have established a nearly perfect vaccination information management system, efficiently empowering the precise registration and convenient verification of children's vaccination records (Groom et al., 2015). Canada actively addresses public concerns by publishing strategy guidelines for dealing with vaccine hesitancy and offering effective communication suggestions. At the same time, it focuses on the pain management challenges of vaccinations for different age groups, innovating measures to reduce pain and significantly enhancing the overall experience of preventive vaccination services (Taddio et al., 2015). In terms of post-vaccination observation management, countries like Ireland and Australia leverage the professional services of pharmacies and pharmacists to implement a 15-minute post-vaccination observation standard. In contrast, China, based on its local pharmaceutical service ecosystem and considerations for adverse reaction compensation, has established a 30-minute observation mechanism, demonstrating a prudent and rigorous approach in institutional design (National Health Commission of the People's Republic of China (NHCPC), 2016).

In China, the "Vaccine Administration Law" serves as the cornerstone legislation for the vaccine sector, explicitly stipulating that the procurement and distribution of vaccines must follow the unified operation of the disease control center platform, strictly adhere to the full-process cold chain storage and transportation standards, and implement a refined inventory

management model of "daily clearance and monthly settlement" (National Medical Products Administration (NMPA), 2019). In China, the "Vaccine Administration Law" serves as the foundational regulation governing the vaccine sector. It explicitly stipulates that vaccine procurement and distribution must follow the unified operation of the disease control center platform, strictly adhere to the full-process cold chain storage and transportation standards, and implement a refined inventory management model of "daily clearance and monthly settlement". The "Prevention Vaccination Work Specification" collaborates with health authorities to periodically conduct management training and on-site supervision, comprehensively promoting the standardized service process of "three checks, seven verifications, and one confirmation" (NHCPC, 2021). Strengthening the quality control of vaccination services. In recent years, the implementation of the full-process traceability system and the vaccination certificate system has taken deep root, deeply regulating the vaccine production supply chain, and greatly facilitating the query, traceability, and scientific management of vaccination records (NMPA, 2019).

Foreign official websites serve as information hubs, targeting both medical and health professionals and the general public. They regularly publish vaccination information and promotional materials, which not only help professional groups update their cutting-edge knowledge but also empower the public to enhance their scientific understanding. Against the backdrop of the spread of vaccine hesitancy in Western societies, these websites act as pioneers in guiding public opinion correctly (Butler & Macdonald, 2015; Goldstein et al., 2015). The CDC in the United States, the Ministry of Solidarity and Health in France, and other agencies have keen insight into audience needs, providing customized immunization programs for different age groups, communication skills for doctors, and guidance on common questions from vaccine recipients. Japan and Australia leverage government integration efforts, launching comprehensive publicity campaigns through unified printing of posters, promotional materials, professional manuals for doctors, and guidebooks for parents. The United Kingdom and Japan focus on key moments, carefully crafting vaccination propaganda at the time of school enrollment for children, promoting specific vaccine catch-ups, and driving the rate of immunization coverage to climb (Public Health Agency of Canada (PHAC), 2017). In contrast, in China, after the implementation of the "Vaccine Administration Law," although there is active encouragement for social forces to engage in the scientific promotion of vaccines and vaccination, the current information disclosure is fragmented and limited. The main entities still rely on health departments or disease control departments to produce popular science materials. They use a dual-track approach of offline education and online new media to disseminate health

knowledge and enhance public awareness (NHS, 2019). Compared with the direct public disclosure model abroad, China's information dissemination faces challenges such as varying quality, the need for strengthened authoritative certification, and limited active dissemination due to the bottleneck of attention, and there is an urgent need to improve the efficiency of dissemination (CDC, 2022b).

In recent years, European countries have been mired in controversies over mandatory immunization policies, with a surge in public vaccine hesitancy, a continuous decline in measles vaccination rates, and a resurgence of measles outbreaks, forcing Western countries to reshape their strategic layout of immunization services (Bobo et al., 2022). U.S. schools follow state legal regulations to strictly check the vaccination and exemption status of children. State and local immunization programs accurately measure the vaccination coverage rate of children on an annual basis (CDC, 2022a). Some states impose mandatory vaccination strategies, resulting in a significant increase in vaccination rates (Ministry of Health, Labour and Welfare [MHLW], 2014). The French Ministry of Solidarity and Health expanded the list of mandatory vaccinations in 2018, paving the way for hospital pediatric wards to vaccinate children aged 5 to 11 (Health, 2018). Germany, facing the dilemma of declining vaccination rates, has set new immunization targets and strengthened the support of the health system (PHAC, 2019). The UK innovates a family-based immunization model, targeting the group of children who have not been vaccinated with the measles, mumps, and rubella vaccine in a timely manner, and strives to increase the vaccination rate (NHS, 2023). Japan's Ministry of Health, Labor and Welfare has introduced a series of immunization regulations to solidify the foundation of vaccination service standards, focusing on the trust crisis surrounding HPV vaccines. They have initiated long-term research to tackle this issue, striving to restore vaccination rates, and strictly define the responsibilities and rights of promotional announcements in accordance with the Immunization Law, standardizing the implementation details of immunization (MHLW, 2013).

In response to the immunization coverage gap in low- and middle-income countries, international organizations such as WHO and the United Nations Children's Fund (UNICEF) have joined hands to implement the RED (Reaching Every District) strategy. This initiative targets the optimization and upgrading of the immune system, aiming to boost immunization coverage (WHO, 2017). International aid organizations, adhering to their mission of knowledge transformation, call for attention to deep-rooted factors that constrain the increase in vaccination rates, such as religious beliefs and women's rights to autonomy. Given the low enrollment and attendance rates in the African region, school-based immunization programs face obstacles. Instead, they rely on clinic platforms and employ innovative methods such as

text messages and call reminders to drive the implementation and establishment of preventive vaccination efforts (Dustin et al., 2017).

China has experienced shocks from vaccine incidents, leading to a loss of public confidence. Subsequently, through dual impetus of legislative regulation and strengthened supervision, reforms in the batch release system and deep cultivation in the field of health science popularization, the foundation of public trust has been steadily reshaped (Zheng et al., 2018). In the practice of immunization planning, a mandatory vaccination-led model is implemented, with some provinces and cities innovatively introducing non-immunization planning vaccine school entry verification mechanisms, or offering free mandatory vaccinations for special groups (such as varicella and influenza vaccines), with multi-dimensional measures working together to boost vaccination rates steadily.

Comparative analysis reveals that while vaccination systems across countries exhibit significant differences, they also demonstrate common developmental trends. First, there is a growing diversification of service providers, moving beyond traditional healthcare institutions to include a broader range of stakeholders. Second, the degree of information management has substantially increased, with digital technologies and data systems playing an increasingly critical role in vaccination services. Third, quality evaluation systems have become progressively more sophisticated and refined, incorporating multiple dimensions and nuanced assessment metrics. This international comparative perspective offers crucial insights for constructing China's vaccination clinic quality monitoring and management system. Particularly in areas such as social resource integration, service process optimization, and precise quality control, China can draw upon advanced international experiences while adapting them to the country's specific national conditions. The ultimate goal is to develop a vaccination quality management model that is both globally informed and distinctively Chinese in its approach and implementation.

2.1.3.2 Incentive and service evaluation mechanisms

In the context of international healthcare service structures and operational mechanisms, many developed countries have established and implemented competitive health insurance systems. The aim is to leverage the intrinsic dynamics of market competition to fully activate the subjective initiative and self-discipline of service providers (Blumenthal et al., 2014). Under this paradigm, recipients of vaccination services are granted the right to choose their service providers independently, while providers follow established contractual agreements or standardized service documentation to claim corresponding fees from the government. The

amount of fee settlement is closely and positively correlated with the volume of actual services provided, thereby forming a strong incentive for improving service quality and efficiency (Neumann et al., 2008). Taking the United States' Health Maintenance Organizations (HMOs) as an example, they practice a prepaid system design, where the scale of insurance participation is positively linked to the amount of prepaid funds, meaning the more participants, the larger the amount of prepaid funds received. After achieving cost savings through efficient cost control strategies, the surplus funds can be reasonably allocated for cost compensation in the field of immunization services (Zuvekas & Cohen, 2016), thereby laying a solid economic foundation for the advancement of immunization service quality. The Australian government, in order to encourage doctors to actively engage in the provision of preventive vaccination services, has meticulously introduced a compensation project plan, offering financial incentives for high-quality service performance, such as detailed reporting of children's vaccination completion (Australia Government Department of Health, 2023), using economic rewards to leverage the improvement of service supply efficiency. In contrast, the management structure of domestic vaccination services mainly relies on assessment and management mechanisms to drive the advancement of service quality and efficiency, which is relatively thin and weak in the design and implementation of incentive mechanisms. The assessment dimensions closely align with the national basic public health service standard specifications and local characteristic vaccination service rules, and efforts are made to strengthen the comprehensive service capacity of outpatient clinics and optimize service quality by building and periodically assessing star-rated and digital outpatient clinics (Wang, 2022). Existing incentive measures are mainly reflected in the performance assessment dimensions of higher authorities and medical institutions. The higher-level performance assessment focuses on core indicators such as the rate of newborn record establishment and vaccination coverage, focusing on the control of macro public health service effectiveness; the internal performance assessment of the institution covers the execution of attendance regulations and the assessment of non-immunization planning vaccination volumes, with the latter being closely related to service charging matters, thus receiving much attention in internal assessment practices (Hu et al., 2014).

In the international academic research domain, focusing on the quality monitoring and refined management of vaccination (Table 2.4), there is a lack of comprehensive and systematic studies. Most research is cross-sectional, focusing on vaccination coverage rates as the key outcome, examining both the structural framework and service content of vaccination clinics (Omer et al., 2009). In response to global vaccine hesitancy and low immunization coverage in impoverished areas, researchers in developed countries are prioritizing studies on preventing

vaccination rate declines and improving immunization service delivery (Larson et al., 2014; Olive et al., 2018). The research encompasses: (1) Adjusting national immunization strategies and strengthening oversight to broaden immunization coverage through increased funding, mandatory immunization, school entry checks, improved child information systems, and policy incentives (Olive et al., 2018; Seither et al., 2019). (2) Assessing the potential of pharmacies and private clinics to enhance the convenience, professionalism, and satisfaction of immunization services, aiming to leverage diverse entities and reshape the service ecosystem (Burson et al., 2016). (3) Optimizing service processes with reminders, online interventions, health education, and effective communication to improve service flow and experience (Cataldi et al., 2020; Jacobson Vann et al., 2018). (4) Enhancing service convenience by improving accessibility, such as reducing geographic barriers, shortening service times, and adding humanized facilities (Restivo et al., 2015).

Table 2.4 Research by foreign scholars on vaccination quality monitoring and management in developed countries

Research content	Main conclusions	Researcher
Vaccination intervention	The patient reminder and recall system in primary healthcare institutions may effectively increase the proportion of target populations receiving immunization.	Jacobson Vann et al. (2018)
	Comprehensive intervention measures, such as improving the convenience of vaccine access, implementing appointment reminders, strengthening education, and conducting targeted health communication, can effectively address the issue of unequal immunization coverage among marginalized groups.	Machado et al. (2021)
Immunization policy supervision	The health system can adopt various rewards and sanctions, targeted measures and outreach services for vulnerable groups, as well as expanding vaccination funding and eliminating administrative barriers to improve vaccine coverage.	Rigby et al., (2020), Rechel et al. (2019)
	Routine commands and reminders/recalls, provider communication strategies, centralized reminders/recalls (using state immunization information systems), network-based interventions, enrollment vaccination checks, and other vaccination reminder services can effectively improve immunization coverage.	Cataldi et al. (2020)
Optimize immunization services	The research focuses on the organization, structure, and management of immunization services, including improving service accessibility, optimizing service cycles, improving convenience facilities (such as setting up parking lots and accessible areas), allocating staff reasonably, and enhancing information technology levels. These measures aim to improve the coverage of vaccination by enhancing the accessibility of services.	Restivo et al. (2019)
	Suggest measures such as extending outpatient service hours and expanding service coverage to improve vaccination rates.	Evans et al. (2016),
	The use of SMS reminders, access to immunization websites, online portals for patient self-management, and automatic computer reminders can effectively improve the coverage of	Odone et al. (2015)

vaccination.

In the realm of public health research for low- and middle-income countries, key topics converge on WHO's assessments of immunization service capacity and the effectiveness of immunization programs(Table 2.5), aiming to uncover the deep-seated barriers to low immunization coverage and to identify feasible intervention strategies (WHO, 2013). During WHO's Global Vaccine Action Plan (GVAP) reviews, it is highlighted that these countries face urgent and critical missions, such as expanding immunization coverage, addressing immunization inequality, and eradicating vaccine-preventable diseases, while also confronting challenges like vaccine safety, public hesitancy, community mobilization, and financial sustainability (Hinman & Mckinlay, 2015). Systematic research tends to focus on several core dimensions: (1) The complex relationship between vaccine coverage and political factors, which can influence coverage through resource allocation and policy coherence (Figueiredo et al., 2016). (2) The interplay between socio-economic status and immunization service capacity, affecting both material foundations like vaccine supply and the public's immunization awareness (Arsenault et al., 2017). (3) The impact of education levels on immunization service outcomes, with higher education potentially fostering positive attitudes towards vaccines (Wiysonge et al., 2012). (4) The role of regional stability in immunization service delivery, with instability often disrupting immunization programs (Grundy & Biggs, 2018). (5) The connection between maternal and child health services and immunization service capacity, with inadequate services potentially leading to immunization gaps (Clara et al., 2016).

Table 2.5 International scholars' research on immunization quality monitoring and management in low and middle-income countries

Research content	Main conclusions	Researcher
Efficiency of immunization services	Improving the timeliness of vaccination is crucial for increasing the completion rate of immunization programs, which can not only expand the positive impact of vaccination programs on the health outcomes of children in sub-Saharan Africa, but also enhance the depth and breadth of their impact.	Janusz et al. (2021)
Immunization service cost	The cost of immunization services may be affected by various factors, including the operational status of medical institutions, the ability to provide external outreach services, the work pressure of management, the training and professional level of staff, the geographical location of vaccination sites, the number of days served per week, and the length of time required to complete the entire vaccination plan.	Menzies et al. (2017)
Fairness of vaccination	The key to improving vaccination coverage and reducing inequality is to increase people's access to high-quality, affordable, and easily accepted vaccination services.	Bobo et al. (2022)
Factors hindering immune coverage	The determining factors that affect the vaccination rate include three aspects: the preparation of service facilities, the vaccination process, and socio-economic factors such as children and	Phillips et al. (2017)

	mothers.	
	The vaccination rate is affected by various obstacles, including lack of immunization knowledge among parents or caregivers, economic poverty, distance from vaccination sites, insufficient support from partners, and lack of trust in vaccines; In addition, factors such as insufficient vaccination sites, specific lifestyles, immigration backgrounds, occupational restrictions, forgetting to get vaccinated, inconvenient vaccination times, and language barriers can also affect vaccination rates. Challenges at the health system level, such as human resource shortages, cold chain maintenance, and insufficient vaccine supply, also pose obstacles to improving vaccination rates.	Bangura et al. (2020)
	Providing comprehensive immunization and health education to parents and community members, combined with redesigned vaccination reminder cards, family reward programs, regular immunization reminders, home visit services, and strategies that combine vaccination with other health services, can effectively improve children's immunization coverage.	Oyo-Ita et al. (2023)
Intervention measures	Strengthen immunization services through baseline quality assessment and implementation of on-site technical support, training, and supervision. Key indicators include vaccine coverage and completion rates, while process improvement involves human resources, service provision, logistics, document management, coordination and cooperation, and monitoring and evaluation. The intervention significantly improved these indicators.	Manyazewal et al. (2018)
Immunization Program Review	The review pointed out that vaccine shortages and insufficient funding have led to the cancellation of external outreach services, as well as obstacles in monitoring visits and cold chain maintenance. It has been found that some countries are facing a shortage of human resources and insufficient use of vaccine inventory management tools. It is recommended that countries strengthen human resource training and improve logistics and information systems.	Shibeshi et al. (2020)
Personnel skill training	According to the training needs survey, there is a strong demand for training in new vaccine knowledge, immunization safety, cold chain and vaccine management, communication skills, and problem-solving. Meanwhile, immunization monitoring, data quality, sustainable financing, adverse event monitoring, and community mobilization are considered high priority areas for training. It is recommended that plan managers regularly evaluate employee training needs and adjust training strategies and content accordingly.	Mutabaruka et al. (2010), Masresha et al. (2021)

2.2 Core Concepts

2.2.1 Vaccination

Vaccination has both broad and narrow definitions. In a broad sense, it refers to the process of artificially cultivating and processing antigens or antibodies, administering them to the human body through appropriate routes to acquire immunity against specific infectious diseases,

thereby enhancing individual or group immunity and significantly reducing the incidence of targeted infectious diseases (WHO, 2023a; CDC, 2021). In a narrow sense, vaccination refers specifically to vaccine administration, introducing vaccines into specific individuals to prevent disease and produce antibodies for specific immunity (Greenwood, 2014).

2.2.2 Vaccination clinics

Vaccination clinics are specialized medical facilities providing comprehensive, safe, and efficient vaccine administration services to the public (Diseases, 2020). These clinics are staffed with professional medical personnel and equipped with advanced equipment to ensure optimal protection for each recipient (WHO, 2023b). They not only provide vaccination services but also offer immunization counseling to help patients understand the importance and safety of vaccines (Ventola, 2016). Additionally, vaccination clinics are responsible for administering vaccines within their jurisdiction as part of immunization programs, while also providing non-program vaccines to local residents (Li et al., 2003). For example, vaccines such as polio, DPT, influenza, shingles, and pneumonia can be consulted about and scheduled for administration here (Shen et al., 2014). Vaccination clinics can be categorized into: urban medical institutions, community health service centers, county-level and above disease control institutions, and township health centers implementing centralized immunization (Zheng et al., 2010).

2.2.3 Quality monitoring and management of vaccination clinics

Quality monitoring and management of vaccination clinics refers to the use of scientific and systematic methods to measure and evaluate various aspects of vaccination clinics, including structure, process, and outcomes. The goal is to continuously identify and resolve service quality issues, improve immunization work quality, and ultimately promote public health (Williams et al., 2015).

The World Health Organization (WHO) emphasizes that effective immunization quality management should cover various aspects including vaccine affordability, accessibility, and delivery appropriateness. It stresses the importance of conducting comprehensive quality monitoring and continuous improvement throughout the vaccine procurement, distribution, storage, and administration processes (WHO, 2015b). The U.S. Advisory Committee on Immunization Practices (ACIP) proposes that core elements of vaccination clinic quality management include ensuring vaccine supply, standardizing administration procedures, monitoring adverse reactions, strengthening information management, and providing high-

quality services. This requires collaboration among vaccination units, disease control departments, community organizations, and the public.

Chinese scholars have also conducted extensive research on vaccination clinic quality monitoring and management. Chen et al. (2024) suggest that quality monitoring should focus on developing assessment indicators for professional services, personnel capabilities, hardware facilities, process standardization, and safety management, establishing a regular quality assessment and feedback mechanism. Wu et al. (2024) propose that vaccination clinic quality management should adhere to a "people-oriented" concept, emphasizing humane service while maintaining standardized management to effectively improve public willingness and compliance with vaccination. Qiao et al. (2024) emphasize the importance of fully utilizing information technology in vaccination clinic quality monitoring to improve the quality of monitoring data and analysis utilization, providing support for scientific decision-making.

2.2.4 Factors affecting quality monitoring and management of vaccination clinics

As a key component of public health services, the quality of vaccination clinics has profound implications for public health and safety. When assessing the service quality of vaccination clinics, several critical factors should be considered, including staffing, facilities and equipment, service processes, vaccine management, patient compliance, and level of informatization. These factors collectively determine the service level of vaccination clinics and are crucial for maintaining and enhancing public health security.

2.2.4.1 Staffing and professional competence

Vaccination work must be carried out by medical personnel with professional knowledge and skills to ensure accuracy and effectiveness (Paterson et al., 2016). These personnel need to understand vaccine characteristics and vaccination procedures, and possess good communication skills and patience (Kaufman et al., 2019). The work involves vaccine storage, transportation, and administration, with each step requiring strict adherence to regulations (Kumru et al., 2014). Additionally, medical staff need to closely monitor the condition of vaccine recipients and promptly identify and address any abnormal situations (McNeil et al., 2013). Society should strengthen publicity and education to improve public awareness, trust, and confidence, thereby increasing vaccination rates (Nowak et al., 2015). Only with high standards of staffing, professional quality, and social recognition can the accuracy and effectiveness of vaccination work be ensured, better safeguarding public health.

2.2.4.2 Facilities, equipment, and environment

Facilities, equipment, and environmental construction are crucial factors affecting the quality monitoring and management of vaccination clinics. These elements are not only the cornerstone of efficient vaccination work but also key to ensuring the safety and effectiveness of vaccine administration (Guichard et al., 2010). To provide high-quality vaccination services, clinics need to adhere to high standards and be equipped with comprehensive facilities, such as comfortable waiting rooms, clean and orderly registration areas, and advanced cold chain equipment (Ophori et al., 2014). These facilities and equipment play a vital role in ensuring vaccine efficacy and smooth vaccination processes (Ashok et al., 2016). A high-quality vaccination environment not only enhances the patient experience but also helps shape the professional image of the vaccination clinic, gaining widespread social recognition and trust (Brown & Oluwatosin, 2012). Therefore, to create such an environment, vaccination clinics need to continuously invest in funds and resources, upgrade hardware facilities, and focus on cleanliness and hygiene, thereby providing a safe and comfortable vaccination environment for the public (Cooke et al., 2010).

2.2.4.3 Service process standardization and accuracy

In the service system of vaccination clinics, the standardization and accuracy of processes undoubtedly occupy a central position (Luman et al., 2007). As an important task in the medical field, vaccination work requires that every step of the service process be carefully designed and strictly standardized to achieve accurate vaccination processes (Cutts et al., 2016). This standardization and accuracy not only affect the success of vaccination work but also directly relate to the health and safety of each vaccine recipient (Dolan et al., 2019). Therefore, when formulating the service process for vaccination clinics, a rigorous, steady, and rational attitude must be maintained. Each operational step needs to be clearly defined, avoiding any form of ambiguity or misunderstanding (Hagan & Phethlu, 2016). When designing the service process, full consideration should be given to the connection between various links, ensuring accurate execution from recipient registration to post-vaccination observation (Stacey et al., 2014).

2.2.4.4 Vaccine management

Vaccine management is another crucial aspect affecting the quality monitoring and management of vaccination clinics. Strict management measures need to be implemented for the storage, transportation, and use of vaccines. Any minor oversight in these aspects can directly affect the safety and efficacy of vaccines, posing serious threats to the health of the vaccinated population.

In the vaccine storage phase, temperature control is paramount. Vaccination clinics need to be equipped with professional refrigeration equipment and set up reasonable temperature monitoring systems to ensure vaccines are stored within an appropriate temperature range (Murhekar et al., 2013). Any temperature fluctuations outside this range may negatively impact vaccine efficacy (Yakum et al., 2015). During vaccine transportation, a series of safeguard measures must be adopted. Transport personnel need to undergo professional training and be capable of dealing with various adverse weather conditions and road situations to ensure vaccines maintain a stable state during transportation (Matthias et al., 2007). Any form of severe vibration or temperature fluctuation may pose a threat to vaccine safety (Ren et al., 2009). Furthermore, when administering vaccines, doctors must perform detailed verification work. This includes checking key information such as the vaccine's production date, expiration date, and batch number to ensure that the administered vaccine is safe and effective (Olivia et al., 2017). At the same time, vaccination personnel need to master correct vaccination techniques and methods to minimize the occurrence of adverse reactions (Panda et al., 2011).

2.2.4.5 Patient compliance

Patient compliance during the vaccination process significantly influences the quality monitoring and management of clinics (Ventola, 2016). Specifically, the degree to which patients adhere to vaccination precautions and regulations directly relates to the safety and effectiveness of vaccination work (Frew et al., 2016). For example, understanding contraindications and strictly following post-vaccination precautions are important steps in ensuring vaccination effectiveness (Dempsey et al., 2018). Patient compliance is also reflected in adherence to doctors' professional advice. Doctors provide personalized vaccination recommendations based on individual differences such as age, physical condition, and medical history (Arnaud et al., 2018). Active patient cooperation and following doctors' guidance not only help improve vaccination effectiveness but also effectively reduce the probability of adverse reactions (Kaufman et al., 2019). Therefore, patient compliance during the vaccination process is an important criterion for measuring the service quality of clinics. To improve service quality, vaccination clinics should emphasize health education for patients, enhance patient awareness and trust. Meanwhile, strengthening communication and interaction with patients can improve patient satisfaction and loyalty (Ford et al., 2016).

2.2.4.6 Level of informatization

With the continuous development of information technology, informatization plays an increasingly important role in vaccination work. By strengthening information construction and

implementing informatized management and electronic registration, the efficiency and quality of vaccination work can be greatly improved (Varela et al., 2023). For example, using information systems can conveniently manage patient information, vaccine inventory, and vaccination records, reducing errors and omissions in manual operations.

Overall, vaccination clinic quality monitoring and management is evolving towards digitalization, precision, humanization, and integration. These emerging research focuses not only expand the dimensions and boundaries of traditional quality monitoring but also provide a theoretical foundation for constructing a more inclusive, adaptive, and forward-looking quality monitoring system. Future research must closely track advancements in these cutting-edge domains, actively integrating innovative concepts and methodologies into the development of vaccination clinic quality monitoring management systems. The ultimate objective is to drive vaccination services towards increasingly sophisticated and comprehensive quality levels, ensuring that emerging research paradigms translate into tangible improvements in healthcare delivery.

2.2.5 Evaluation of quality monitoring and management in vaccination clinics

The evaluation of quality monitoring and management in vaccination clinics is a comprehensive assessment of the work quality of these clinics, including aspects such as facilities and equipment, staffing, vaccine management, vaccination services, and information management. The purpose of the evaluation is to identify problems and shortcomings in the work of vaccination clinics, propose improvement suggestions, and thereby enhance work quality and ensure vaccination safety and effectiveness. Evaluation methods include on-site investigations, questionnaire surveys, and interviews. Evaluation indicators can be formulated according to actual situations but should comprehensively reflect the work quality of vaccination clinics. The evaluation results can provide valuable references for decision-makers and feedback and suggestions for vaccination clinics, promoting continuous improvement and enhancement of work quality. During the evaluation process, attention needs to be paid to issues such as the authenticity and reliability of data, the rationality and objectivity of evaluation methods, to ensure the accuracy and validity of evaluation results. The evaluation results can provide feedback and suggestions for vaccination clinics, promoting their continuous improvement and enhancement of work quality, and providing better vaccination services for the public.

2.3 Theoretical Foundation

2.3.1 Total quality management theory

Total Quality Management (TQM) encompasses comprehensive quality management, full-process management, all-employee participation, and comprehensive management methods (Cao, 2006). It was first proposed by American quality management expert Feigenbaum in his book “Total Quality Control” and was initially applied in business management practices. In the 1990s, it was introduced to the medical field by the United States (Zhang et al., 2017) and has been widely applied in medical management (Lu et al., 2021). The core ideas of Total Quality Management theory include: (1) Customer-centric approach. TQM consistently focuses on customer needs and expectations, using customer satisfaction as a key indicator for evaluating organizational performance (Satish et al., 2008). By continuously understanding customer needs and feedback, organizations can improve their products and services and enhance customer satisfaction. (2) Total employee involvement. TQM emphasizes the participation of all employees in quality management, believing that every employee is responsible for quality. Through training, motivation, and empowerment, employees can actively participate in quality improvement activities, raising the overall quality level of the organization (Psychogios, 2007). (3) Process management. TQM focuses on managing the processes for realizing products and services. By defining, measuring, analyzing, and improving processes, organizations can ensure process stability and controllability, thereby enhancing the quality of products and services (Iwu et al., 2019). (4) Continuous improvement. TQM views quality improvement as an ongoing process. By regularly assessing the organization’s quality performance, identifying improvement opportunities, and taking corresponding measures, organizations can continuously enhance quality levels to meet ever-changing customer needs (Martínez Fuentes et al., 2000). (5) Fact-based decision-making. TQM emphasizes decision-making based on data and information. By collecting and analyzing relevant data, organizations can better understand the performance of products and services, as well as customer needs and expectations, leading to more scientific and effective decision-making (Talib et al., 2010).

The Total Quality Management theory is applicable to the study of quality monitoring and management evaluation systems for vaccination clinics, mainly reflected in the following five aspects: (1) Comprehensiveness. TQM theory emphasizes comprehensive quality management, focusing not only on product quality but also on the overall quality management of processes,

services, and systems (Mosadeghrad, 2013). In evaluating the work quality of vaccination clinics, TQM theory can be applied to the entire vaccination process, including vaccine management, vaccination services, and safety aspects, ensuring the comprehensiveness and completeness of the evaluation. (2) Prevention-oriented approach. TQM theory emphasizes the principle of prevention, strengthening process control and preventive measures to reduce the occurrence of defects and problems (Shortell et al., 1995). In evaluating the work quality of vaccination clinics, the preventive control principle of TQM theory can be adopted to establish risk assessment and monitoring mechanisms for vaccination, timely identifying and resolving potential issues to improve the safety and reliability of vaccinations. (3) Continuous improvement. TQM theory pursues the goal of continuous improvement and constant optimization (Shortell et al., 1995). In evaluating the work quality of vaccination clinics, the continuous improvement principle of TQM theory can be applied to continuously optimize and refine the evaluation system and methods based on assessment results and feedback information, improving the accuracy and effectiveness of the evaluation. (4) Customer-centric approach. TQM theory focuses on customer needs and satisfaction. In evaluating the work quality of vaccination clinics, patient satisfaction can be used as an important evaluation indicator. By investigating and analyzing patient needs and feedback, service quality can be continuously improved to meet patient requirements (Dipankar et al., 2006). (5) Data analysis and improvement. TQM theory emphasizes the importance of data analysis and improvement. In evaluating the work quality of vaccination clinics, TQM theory's data analysis methods can be employed to statistically analyze evaluation results, identify existing problems and shortcomings, and propose improvement suggestions and measures to promote continuous improvement and enhancement of work quality in vaccination clinics. In summary, Total Quality Management theory is applicable to the study of quality monitoring and management evaluation in vaccination clinics and can provide theoretical support and guidance for establishing an evaluation system. By applying TQM theory, the effectiveness of evaluating work quality in vaccination clinics can be improved, promoting the enhancement of vaccination service quality and safety, strengthening employee quality awareness and sense of responsibility, facilitating continuous improvement and innovation, and increasing customer satisfaction.

2.3.2 Structure-process-outcome theory

The Structure-Process-Outcome (SPO) theory (Satish et al., 2008) is a theoretical framework in organizational and management research used to describe and analyze various aspects of an organization and their relationships. This theory divides an organization into three main parts:

structure, process, and outcome, each with its unique elements and interrelationships (Donabedian, 2010). Structure refers to the internal setup and arrangements of an organization, including its goals, strategies, resources, organizational structure, and power relationships. It reflects the static characteristics of an organization and serves as its foundation and support. Process refers to the internal activities and workflows of an organization, including decision-making, coordination, communication, and leadership. These processes involve interactions and cooperation among employees, as well as the allocation and utilization of resources. Process is the bridge connecting structure and outcome; through effective process management, organizational goals can be achieved (Gardner et al., 2010). Outcome refers to the results and performance achieved by an organization, including product quality, service effectiveness, and customer satisfaction. Outcome is the final product of organizational activities and reflects the overall performance and achievements of the organization (Rademakers et al., 2011).

The Structure-Process-Outcome theory is applicable to the study of quality monitoring and management evaluation systems for vaccination clinics, mainly manifested in the following aspects: (1) Structure dimension evaluation: The structure dimension mainly focuses on the facilities, equipment, and personnel allocation of vaccination clinics. By evaluating the structural dimension of clinics, we can understand their basic facilities and resource allocation, providing a foundation for subsequent process and outcome evaluations (Vukovic et al., 2018); (2) Process dimension evaluation: The process dimension mainly focuses on the actual work processes and operational norms of vaccination clinics. By evaluating aspects such as vaccination procedures, service quality, and operational standards, we can understand the actual situation of clinics in implementing vaccination processes and determine whether they comply with relevant standards and requirements; (3) Outcome dimension evaluation: The outcome dimension mainly focuses on the work effects and benefits of vaccination clinics. By evaluating indicators such as vaccination rates, timely vaccination rates, vaccine management quality, vaccination service satisfaction, vaccination safety, and incidence of infectious diseases, we can understand the work effects and benefits of clinics, providing a basis for improvement and refinement (Purbey et al., 2007); (4) Causal relationship analysis: The Structure-Process-Outcome theory also emphasizes the analysis of causal relationships. In evaluating the work quality of vaccination clinics, we can analyze the causal relationships among structure, process, and outcome to identify factors and mechanisms affecting work quality, providing guidance for formulating targeted improvement measures (Mwamba et al., 2017); and (5) Continuous improvement: The Structure-Process-Outcome theory focuses on the principle of continuous improvement. In evaluating the work quality of vaccination clinics, this theory can be applied

to continuously optimize and refine the evaluation system and methods based on assessment results and feedback information, improving the accuracy and effectiveness of the evaluation and promoting continuous improvement and enhancement of work quality in vaccination clinics (Wahab et al., 2016). In conclusion, the Structure-Process-Outcome theory is applicable to the study of quality monitoring and management evaluation systems for vaccination clinics and can provide theoretical support and guidance for establishing an evaluation system. By comprehensively evaluating the structural, process, and outcome dimensions of clinics, we can fully understand their actual work quality, identify existing problems and shortcomings, propose targeted improvement suggestions and measures, and promote continuous improvement and enhancement of work quality in vaccination clinics.

2.3.3 Holistic dynamic governance theory

Holistic Dynamic Governance Theory is a new type of public management theory that emphasizes the holistic and dynamic nature of various elements within the public sector. It posits that different departments and levels are not isolated but interconnected and mutually influential. Additionally, this theory emphasizes the interactive relationship between the public sector and the external environment, suggesting that public sectors need to continuously adapt to changes in the external environment through dynamic adjustments and management (Psychogios, 2007).

The Holistic Dynamic Governance Theory is applicable to the study of quality monitoring and management evaluation systems for vaccination clinics. Firstly, this theory is guided by holistic thinking, comprehensively considering multiple factors such as internal and external environments, resources, processes, and personnel within an organization, aiming to achieve optimal overall effects (Osborne et al., 2016). In evaluating the work quality of vaccination clinics, we should apply holistic thinking to comprehensively assess various aspects including facilities, equipment, personnel, processes, vaccine management, service quality, and safety, ensuring the comprehensiveness and completeness of the evaluation. Secondly, the Holistic Dynamic Governance Theory emphasizes the importance of dynamic adjustment and optimization (Keast & Mandell, 2014). In quality monitoring and management evaluation of vaccination clinics, we need to continuously optimize and adjust the evaluation system and methods based on changes in the internal and external environment of the clinics and feedback information, improving the accuracy and effectiveness of the evaluation. Moreover, this dynamic adjustment helps clinics identify and address potential problems and challenges in a timely manner. Furthermore, this theory values the participation and collaboration of multiple

stakeholders. In quality monitoring and management evaluation of vaccination clinics, we should actively encourage the participation of relevant stakeholders and multiple entities, including government departments, experts, parents, and community residents (Klijn, 2006). Through the joint participation and collaboration of multiple stakeholders, we can gain a more comprehensive understanding of the work quality situation in clinics and propose more targeted improvement suggestions and measures to promote continuous enhancement of work quality in clinics. Additionally, the Holistic Dynamic Governance Theory pursues synergistic effects, aiming to maximize overall benefits through optimizing resource allocation and coordinating actions and cooperation among different entities (Emerson et al., 2011). In evaluating the work quality of vaccination clinics, we should leverage synergistic effects, integrating resources and strengths from various aspects to improve the effectiveness and quality of the evaluation, further promoting continuous improvement and enhancement of work quality in vaccination clinics. Lastly, the Holistic Dynamic Governance Theory focuses on innovation and improvement of governance mechanisms. In quality monitoring and management evaluation of vaccination clinics, we should continuously innovate evaluation mechanisms and methods, and continuously improve the evaluation system to enhance the accuracy and effectiveness of the evaluation (Gash, 2008). At the same time, innovation in governance mechanisms also helps vaccination clinics cope with complex and changing internal and external environments, enhancing their ability to address challenges and solve problems. In conclusion, the Holistic Dynamic Governance Theory is applicable to the study of quality monitoring and management evaluation systems for vaccination clinics and can provide theoretical support and guidance for establishing an evaluation system. By applying principles such as holistic thinking, dynamic adjustment, multi-stakeholder participation, synergistic effects, and governance mechanism innovation, we can improve the effectiveness of quality monitoring and management evaluation in vaccination clinics, promoting continuous improvement and enhancement of work quality.

2.4 Theoretical Framework

In this study, we have integrated the Total Quality Management (TQM) theory, the Structure-Process-Outcome (SPO) theory, and the Holistic Governance theory to construct a theoretical framework for the quality monitoring and management of vaccination outpatient services, as shown in Figure 2.5.

The theoretical framework demonstrates the integrated application of three major theories in this study. Firstly, Total Quality Management (TQM) emphasizes a customer-centric

approach, full participation, and continuous improvement, enhancing service quality by strengthening outpatient internal management processes and staff involvement. Secondly, the Structure-Process-Outcome (SPO) theory evaluates aspects such as the facilities and equipment of vaccination clinics, process management, and the final vaccination outcomes, ensuring the safety and effectiveness of vaccination work through systematic process management. Lastly, the Holistic Governance theory emphasizes collaborative governance across multiple departments and levels, ensuring that vaccination clinics can adapt to complex external demands and policy adjustments in a changing environment, promoting continuous system improvement. This theoretical framework provides a systematic analytical perspective for this study, helping us to comprehensively understand the key factors affecting the quality of vaccination clinics from different dimensions, and providing theoretical support for the development of scientific and effective management strategies.

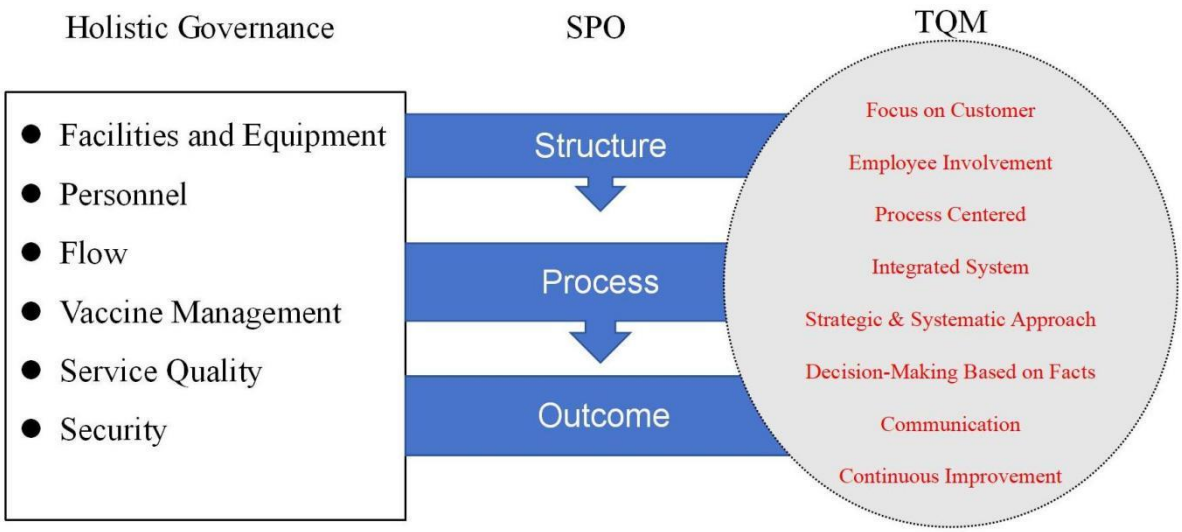


Figure 2.5 Theoretical framework

2.5 Summary of the chapter

Domestic research on quality monitoring, management, and evaluation of immunization clinics primarily focuses on quality assessment, management strategies, and performance evaluation. These studies predominantly employ qualitative research methods, utilizing on-site investigations and interviews to understand the current work situation and existing problems in immunization clinics, followed by proposing corresponding management strategies and improvement measures. Additionally, some studies have begun to attempt establishing evaluation indicator systems for quality monitoring and management of immunization clinics.

However, these indicator systems are not yet fully developed and lack empirical research. International research on quality monitoring, management, and evaluation of immunization clinics is relatively more mature. Countries such as the United States, United Kingdom, and Canada have established comprehensive evaluation systems for quality monitoring and management of immunization clinics, conducting regular assessments and monitoring. These evaluation systems often employ a combination of qualitative and quantitative research methods, using various means such as on-site investigations, questionnaire surveys, and statistical analysis to comprehensively understand the work quality and existing problems in immunization clinics, providing a scientific basis for improvement. Furthermore, international research emphasizes continuous refinement and optimization of evaluation indicator systems to enhance the accuracy and reliability of assessments.

In summary, there are notable differences between domestic and international research on quality monitoring, management, and evaluation systems for immunization clinics. Domestic research is relatively preliminary, lacking comprehensive evaluation indicator systems and empirical studies. In contrast, international research is more mature and systematic, emphasizing the scientific nature of evaluation methods and support from empirical data. Therefore, in future research, it is essential to draw upon international research experiences and methods to continuously improve the domestic work quality evaluation system for immunization clinics, enhance the accuracy and reliability of assessments, and provide a scientific basis for work improvement.

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Chapter 3: Research Method

3.1 Study design

This research aimed to establish a systematic inquiry into the development and efficacy enhancement of a quality monitoring and management evaluation framework for vaccination clinics in China, utilizing diverse methodologies including literature review, expert consultation, cross-sectional surveys, and intervention studies.

Initially, we will conduct a comprehensive literature review and perform a metrological visualization analysis to synthesize the current state of domestic and international practices and research on the quality management of preventive vaccination clinics. Drawing from established assessment models and experiences, we will draft an initial framework for evaluating the quality monitoring and management of China's preventive vaccination clinics. Subsequently, the Delphi technique will be employed to solicit feedback from public health, pediatric healthcare, and vaccination experts, refining the indicator system for comprehensiveness, scientific validity, and practicality, thereby creating a multi-dimensional, tiered assessment system.

In the second phase, the developed assessment tool will be deployed to gauge the current state of quality monitoring and management among Chinese preventive vaccination clinics through a cross-sectional survey. Utilizing a multi-stage sampling approach, we will select representative clinics at the provincial, city, county, and township levels for the survey. We will gather extensive data on each clinic's operational status, management practices, and service delivery through questionnaires, site visits, customer satisfaction surveys, and data audits. Descriptive statistics will be applied to analyze the current quality status.

The third phase involves crafting a targeted quality improvement intervention program that addresses the critical issues and deficiencies uncovered by the initial assessment. This program will encompass regulatory enhancements, staff training, service process optimization, and health education innovation. A comparative group design will select 10 intervention clinics and 10 control clinics to collect pre- and post-intervention data, including staff and client surveys, overall clinic quality assessment scores, and scores across various dimensions. Statistical analyses, such as two-sample t-tests and multivariate ANOVA, will be conducted to measure

the comparative improvements in quality and to evaluate the intervention's impact.

By following a structured research trajectory of "assessing the current state – identifying issues – analyzing causes – devising solutions – implementing – evaluating outcomes", the goal is to develop a scientifically robust and actionable quality monitoring and management evaluation system for preventive vaccination services. This system will pave the way for a scalable and replicable model for continuous quality enhancement, serving as a reference for various regions. It will also aim to enhance the overall quality of vaccination clinic services and pediatric health. Furthermore, by mining the extensive data from the CDC and health department quality assessments, this study will offer empirical insights and inform policy-making and the strategic allocation of public health resources.

3.2 Research method

3.2.1 Literature review approach

Employing the literature review approach, we systematically gather, organize, analyze, and interpret existing literature to explore the research domain of quality monitoring and management assessment in preventive vaccination clinics (Li et al., 2021). This method is pivotal for understanding the current research landscape, theoretical underpinnings, and methodologies, thereby offering theoretical support and reference for the establishment of China's quality monitoring and management assessment system for preventive vaccination clinics. We have conducted a thorough literature search on academic platforms such as China Knowledge, WanFang, PubMed, Google Scholar, and Web of Science, focusing on terms related to the quality assessment system of preventive vaccination clinics. By econometrically analyzing the literature, we have constructed a scientific knowledge map based on publication counts and key terms to synthesize a comprehensive view of the quality assessment system. Furthermore, by reviewing the policies, systems, and measures for quality assessment in clinics globally, we aim to deepen our understanding of the quality work's connotation and extension, along with related theories such as total quality management and the structure-process-outcome framework, to provide a robust theoretical basis for the development of the subsequent assessment index system.

3.2.2 Semi-structured interview technique

The semi-structured interview has gained popularity as a data collection technique due to its adaptability and flexibility (Melissa et al., 2019; Santiago et al., 2020). It allows for both individual and collective interviews, with the flexibility to adjust the level of structure based on the study's objectives and research questions. This method facilitates a dynamic interaction between the interviewer and interviewee, allowing for follow-up questions in response to the interviewee's input, while also accommodating the interviewee's unique perspectives and expressions (Yang et al., 2021). For this study, we engaged in in-depth interviews with key stakeholders, including preventive medicine specialists, CDC professionals, frontline workers, and community members, to gain a comprehensive understanding of the vaccination clinic's operational process and the critical factors influencing it. These interviews aim to identify and synthesize the pivotal components of the vaccination clinic's quality monitoring and management assessment system, thereby establishing a foundation for pinpointing effective intervention points and improvement strategies.

3.2.3 Delphi technique

The Delphi method, originating from the RAND Corporation in 1946, is a cyclic anonymous questionnaire technique used to gather expert opinions on specific issues and form a consensus for prediction or decision-making (Ferreira & Santos, 2016; Feng, 2006). In the field of vaccination clinic quality assessment, it aids in reaching a unified predictive conclusion (Sandford & Hsu, 2007). The Delphi process is as follows:

(1) Assemble an expert panel based on the research topic's required expertise, typically not exceeding 20 members.

(2) Present forecast questions and requirements to the panel, along with all relevant background materials, and collect their written responses.

(3) Experts independently provide forecasts based on the materials provided, explaining their reasoning.

(4) Collect and synthesize the forecasts anonymously, then feedback to the experts for further input.

(5) Repeat the process of opinion concentration, feedback, and re-concentration until a consensus is reached.

For this study, we have chosen experts and scholars with extensive experience in preventive medicine and disease control to participate in multiple rounds of Delphi consultations. These

consultations focus on the interventions and measures identified at various stages of the behavioral events from the semi-structured interviews. The aim is to screen for key elements that will inform the development of the questionnaire for the subsequent quality assessment system of vaccination clinics, as well as to prepare for the enhancement measures.

3.2.4 Expert consultation approach

The expert consultation approach is a research technique that involves soliciting the insights and guidance of professionals within the field of study. Engaging with experts allows researchers to acquire profound experience and knowledge, thereby refining the research design, research method, and analytical processes. This, in turn, bolsters the study's quality and reliability (Bogner et al., 2009). In this study, the expert consultation approach was primarily utilized to establish the assessment criteria. By interacting with experts, we aimed to delve into the nuances and scope of vaccination clinic quality, as well as the critical factors and metrics essential for the evaluation process. This comprehensive understanding is instrumental in crafting a scientifically sound and rational set of assessment indicators.

3.2.5 Survey questionnaire method

To assess the current state of quality monitoring and management in China's preventive vaccination clinics, a questionnaire survey was conducted from selecting 50 clinics in Guangdong, Heilongjiang, Henan, and Shaanxi provinces. This survey aimed to evaluate the national quality monitoring and management assessment system. The self-administered questionnaire was crafted after reviewing relevant Chinese policies, regulations, and through consultations with health sector authorities, covering the essential elements of quality monitoring and management assessment for Chinese vaccination clinics, divided into pre-, during-, and post-survey phases. A pilot survey in Harbin City preceded the main survey, and its findings were used to refine the initial questionnaire. The final version was then rolled out for the formal nationwide survey.

3.2.6 Intervention strategy

The intervention strategy, within the scope of evaluating quality monitoring and management in vaccination clinics, is a structured approach designed to enhance the clinics' capabilities in these areas through targeted strategies and actions (Bryce et al., 2004; Rowe et al., 2005). Tailored to address unique scenarios and requirements, the intervention strategy typically

encompasses the following stages:

(1) Problem Identification: Initially, the research issue must be pinpointed and dissected to comprehend the essence of the problem, its underlying causes, and the extent of its influence.

(2) Plan Formulation: Drawing on the problem analysis, an intervention plan is crafted, outlining clear objectives, strategies, a timeline, and resource allocation.

(3) Intervention Execution: Interventions are carried out as per the plan, potentially involving training and education, technical support and resource provision, and the refinement of processes and systems.

(4) Monitoring and Assessment: The intervention's impact is continuously monitored and assessed through data collection and analysis, and regular progress reviews.

(5) Refinement and Optimization: The intervention plan is adjusted and enhanced in light of monitoring and assessment feedback to ensure its effectiveness and longevity.

In this study, employing the intervention strategy facilitates a thorough examination of the vaccination clinic's quality monitoring and management, enabling the identification of issues and the proposal of targeted improvements, thereby fostering ongoing refinement and quality enhancement in vaccination services. In practical application, the intervention's execution must consider various factors, including the clinic's specific context, resource availability, personnel capabilities, and the broader environmental context.

3.2.7 Statistical Analysis

The statistical analysis method involves the examination and interpretation of data utilizing mathematical and statistical techniques. In this research, it is primarily employed to gather and evaluate data pertaining to the preventive vaccination clinic's operational quality. The aim is to uncover service-related issues within China's preventive vaccination clinics, to dissect the interplay between these issues, and to devise strategies for enhancing the clinics' service quality grounded in these findings. SPSS 26.0 software was utilized for statistical summarization, Analysis of Variance (ANOVA). Categorical data were presented as frequencies or proportions (%), while differences among sample groups were assessed using t-tests or independent *F*-tests. The chi-square (χ^2) test was applied to examine variations in rates or proportions between groups. Statistical significance was determined at the $P < 0.05$ threshold.

3.3 Summary of the chapter

This chapter provides a detailed introduction to the design and methodology of the research, ensuring the scientific and systematic nature of the study. Firstly, literature review was conducted to comb through the theories and practices related to the quality management of vaccination clinics, laying a solid theoretical foundation for subsequent research. Secondly, a variety of data collection methods were employed, including semi-structured interviews, the Delphi method, expert consultation, and questionnaire surveys, ensuring that the research could obtain rich qualitative and quantitative data from multiple dimensions. At the same time, the application of intervention methods provided a basis for practical verification of the research, and statistical analysis methods helped to scientifically analyze and interpret the collected data. Through the integrated use of these methods, this study can comprehensively and deeply explore the construction and application effects of the quality monitoring management system in vaccination clinics, providing strong support and assurance for further research.

Chapter 4: Composition of Quality Monitoring and Management Elements in Vaccination Clinics

Preventive vaccination constitutes a vital component of the public health service system, crucial for the control and eradication of diseases preventable through vaccination, thereby safeguarding public health (Orenstein & Ahmed, 2017). As the variety of vaccines expands and immunization strategies are refined, delivering safe, potent, and prompt preventive vaccination services is imperative for attaining the objective of universal immunization coverage (Gurnani et al., 2018). The preventive vaccination clinics, as specialized entities responsible for administering these vaccinations, have a direct impact on the effectiveness of immunization programs due to their service quality (Shen et al., 2014).

Domestic and international research has demonstrated that the determinants of preventive vaccination clinic quality are complex and multilayered, encompassing staffing and training, infrastructure, medical supplies, equipment, vaccine storage and management, vaccination protocols, adverse event surveillance, health education, IT systems, and regulatory compliance (Phillips et al., 2017; Zaffran et al., 2013). In many countries, a systematic approach to the quality monitoring and continual enhancement of these clinics is now a fundamental part of their vaccination strategies. China, in recent years, has emphasized the quality management of preventive vaccination clinics, with the Health Commission issuing detailed regulations and standards such as the “Code for the Construction and Management of Preventive Vaccination Clinics” and the “Regulations on the Circulation of Vaccines and Administration of Preventive Vaccination”, which provide clear guidelines for clinic infrastructure, staffing, and regulatory adherence(State Council of the People's Republic of China, 2005). Nonetheless, the quality monitoring and management system for vaccination clinics in China is still in need of refinement; the assessment metrics require more scientific validation and practical application, and the measures for improving quality need to be more specifically targeted. There is an urgent need to enhance research and explore practical solutions to these challenges (Wu et al., 2012).

Conducting qualitative research on the elements of quality monitoring and management in vaccination clinics is of great significance for systematically understanding the essence of quality, identifying key factors that affect it, and establishing a scientific and standardized assessment indicator system. Creswell et al. (2006) point out that qualitative research can help

to gain a deeper understanding of complex social phenomena and to tap into the subjective feelings and experiential appeals of individuals. Semi-structured interviews, as a common method of qualitative research, are topic-focused, flexible and open, and conducive to in-depth exploration and other characteristics (Given, 2008). Foreign scholars are more likely to use semi-structured interviews to examine the factors influencing the quality management of vaccination clinics. For example, Haidari et al. (2015) identified eight major factors affecting the quality of preventive vaccination, including human resources, infrastructure, equipment management, supervision and management, information system, service delivery, by interviewing stakeholders in 18 developing countries. Iwu et al. (2019) interviewed frontline vaccination workers in South Africa and other countries and found that staff training, monitoring and evaluation, and health education were the main influences on vaccination performance. These studies provide useful lessons for this study. Given that exploratory studies on the factors influencing the quality of vaccination clinics in China are still insufficient, it is necessary to carry out in-depth and systematic qualitative interviews to explore the key elements of quality monitoring and management from different perspectives, such as managers, medical staff, and service users.

In this research, semi-structured interviews were conducted with stakeholders such as health department managers, CDC personnel at various levels, medical staff from preventive vaccination clinics, and the public, focusing on the questions, ‘What do you think are the main factors affecting the quality of preventive vaccination clinic services?’ and ‘How should we strengthen the quality management of vaccination clinics?’ These interviews aimed to deeply understand the subjective feelings and experiences of various subjects regarding the quality of preventive vaccination clinics and the factors influencing it. Based on this understanding, we summarized and refined the key elements of quality monitoring and management. The study’s outcomes are anticipated to elucidate the internal mechanisms of vaccination clinic quality, establish a foundation for a demand-oriented, multi-dimensional assessment index system, and offer substantial theoretical and practical importance for enhancing vaccination quality management, improving immunization planning performance, and advancing national health development.

4.1 Objectives and methods

4.1.1 Study participants

This research utilizes purposive sampling to select study participants, comprising managers from health departments, medical staff from CDCs and vaccination clinics at various levels, and members of the public who utilize preventive vaccination services. The selected participants are representative and possess substantial work experience. The inclusion criteria are as follows: (1) Managers from CDCs and health departments: Section-level or higher managerial staff in charge of overseeing preventive vaccination within their jurisdiction, with at least 3 years of experience in managing preventive vaccinations; (2) Preventive vaccination clinic medical staff: Licensed physicians or nurses with at least 3 years of experience in preventive vaccination work; and (3) Members of the general public: Individuals who have received vaccination services at the selected clinics, with children aged between 0 to 6 months, or individuals aged 60 or above. Exclusion criteria include: (1) Those unwilling to participate or unable to fully articulate their opinions; and (2) Parents of children with contraindications to vaccination. Ultimately, 35 interview reports were gathered, encompassing CDC and health department administrators, medical staff, and public members.

4.1.2 Research method

Data collection for this study was achieved through semi-structured, in-depth personal interviews, which allowed for a balance between standardization and flexibility in the questioning process. A researcher with extensive experience in conducting interviews carried out these sessions, following a predefined interview protocol to ensure consistency across all interviews. This protocol served as a guide, enabling the researcher to ask a series of core questions while also adapting the conversation to the unique insights and responses provided by each participant.

The interviews were designed to delve into the complexities of quality monitoring and management within vaccination clinics, focusing on the critical factors that impact service quality and exploring the strategic approaches to quality management. These discussions were aimed at uncovering the nuances of day-to-day operations, challenges faced, and the innovative solutions implemented by the participants (Annex A). The interviews were tailored to each participant's role and experience, ensuring that a wide range of perspectives were captured.

Each interview lasted between 30 to 60 minutes, providing ample time for in-depth

exploration of the topics at hand. The interviews were meticulously documented, with audio recordings made to capture the full range of responses and written notes taken to supplement the recordings. This dual-method approach ensured that no detail was overlooked and that the data could be accurately transcribed and analyzed later.

The data collection phase of the study was conducted over a two-month period, from November to December 2023, to accommodate the busy schedules of the participants. Interviews were held at the participants' workplaces or at other mutually convenient locations, as agreed upon with each participant. This flexibility in scheduling and location helped to facilitate a high response rate and contributed to the overall success of the data collection process. The careful planning and execution of the interviews played a crucial role in gathering rich, qualitative data that would inform the study's findings and recommendations.

4.1.3 Analysis techniques

For data analysis, Nvivo 12, a qualitative data analysis software, was utilized. Initially, the interview audio recordings were transcribed in full to create a textual record. Subsequently, a thematic framework analysis was applied to identify and synthesize the principal themes and sub-themes related to Quality in Disease Management (QDM). This involved multiple readings of the transcripts, followed by the application of open coding to break down the data, axial coding to identify relationships between codes, and selective coding to focus on core themes. Ultimately, the thematic content was distilled and consolidated into the study's findings. The analysis was an ongoing process throughout the research, with regular consultations among the research team to maintain uniformity in coding practices and thematic classification.

4.1.4 Interview guide

In order to gain an in-depth understanding of the key factors affecting the quality of services in vaccination clinics, this study designed a detailed interview outline aimed at guiding the interview process and ensuring that researchers can comprehensively collect interviewees' views and suggestions on the quality management of vaccination clinics. Through these questions, researchers can delve into the influencing factors from multiple aspects such as management, services, and personnel, and provide a solid foundation for subsequent data analysis.

During the process of designing the interview outline, researchers followed these steps:

(1) Determine the interview objectives: First, clarify the specific objectives of the interview

to ensure that the questions can effectively collect the required information. The core objective of the interview is to gain an in-depth understanding of the current state of service quality management in vaccination clinics and its influencing factors, in order to provide a basis for subsequent improvement measures.

(2) Select interviewees: Based on the research needs, select representative experts to participate in the interview. The interviewees include health administrators, vaccination clinic staff, and relevant stakeholders of vaccination services to ensure the comprehensiveness and diversity of the information.

(3) Design questions: Around the research objectives, a series of open-ended questions were designed, covering key aspects of service quality, including management, personnel, materials, and services. The design of the questions aims to guide the interviewees to freely express their opinions and delve into their views and suggestions on service quality.

(4) Pilot interview and revision: Before the formal interview, researchers conducted a pilot interview to test the rationality and clarity of the questions, and revised and improved the content of the outline based on feedback, ensuring that the formal interview could proceed smoothly.

(5) Formal interview: Conduct the formal interview according to the revised outline to ensure the effective collection of data. During the interview process, researchers engage in in-depth communication with the interviewees to obtain their detailed opinions and suggestions on the quality management of vaccination clinic services.

Below is the final interview outline:

(1) In your opinion, what components should the quality of services at a preventive vaccination clinic encompass?

(2) What do you consider to be the primary factors influencing the service quality of preventive vaccination clinics? Feel free to discuss your perspectives regarding personnel, resources, management, services, target groups.

(3) Given the current circumstances, what actions do you believe should be implemented to enhance the quality monitoring and management of preventive vaccination clinics?

(4) Do you have any valuable recommendations for refining the quality assessment index system of preventive vaccination clinics?

(5) What do you perceive as the main activities conducted at preventive vaccination clinics? (Please prioritize the following list) A. Parental education sessions B. Vaccine scheduling C. Informed consent notifications D. Safe vaccination practices E. Management of school-age population within the jurisdiction F. Digitalization G. Vaccine storage and distribution H. Other

(Please specify)

(6) Are there any additional elements you would propose to further improve the service quality of the vaccination clinic?

4.1.5 Quality assurance

This research was conducted with strict adherence to the principle of informed consent, with all participants providing their signed consent forms, indicating their voluntary participation. Confidentiality was strictly upheld during interviews, and personal information was anonymized through coding to protect participant identities. The interview protocol was refined based on a preliminary pilot survey to enhance the quality of the interviews. Interviewers received standardized training to ensure objectivity and neutrality in conducting interviews. The study protocol was reviewed and approved by the hospital's Medical Ethics Committee, ensuring the research met ethical standards and guidelines for the protection of human subjects.

4.1.6 Software and tools

For the collation and coding analysis of data, Nvivo 12, a qualitative data analysis software, was utilized. Microsoft Office Word 2019 served as the platform for transcribing interview data. Audio recordings of the interviews were captured using a Sony ICD-UX560F digital voice recorder.

4.2 Results

4.2.1 Demographics of participants

To ensure the material was comprehensive and up-to-date, theoretical sampling was employed to select interviewees based on the evolving theoretical framework of the study. Recognizing that qualitative research demands participants with a solid understanding and familiarity with the subject matter, we targeted a group of interviewees who were both representative and experienced: managers from CDCs and health departments at various levels, vaccination clinic medical staff, and individuals receiving preventive vaccination services. The demographic details of the participants are presented in Annex B.

4.2.2 Interview data coding

4.2.2.1 Open coding

Open coding involves the initial breakdown of raw data into discrete units and the identification of key concepts related to the study's main theme. It is the foundational phase of data analysis. Initially, an open approach was taken to label the material meticulously, examining each line and sentence. Subsequently, based on the textual content, relevant categories were established in Nvivo 12 for coding. Ambiguities were resolved through discussions with the project team to achieve consensus, ensuring thorough exploration of the material. To minimize errors and bias, the interviewees' original expressions and textual content were prioritized as the primary source for concept extraction. Concurrently, considering the study's focus, irrelevant content was excluded after a thorough review and analysis of the transcripts. The selected 30 interview transcripts were then coded. For clearer coding, the materials were initially analyzed using Nvivo 12's word frequency query function to generate a word cloud, as illustrated in Figure 4.1.

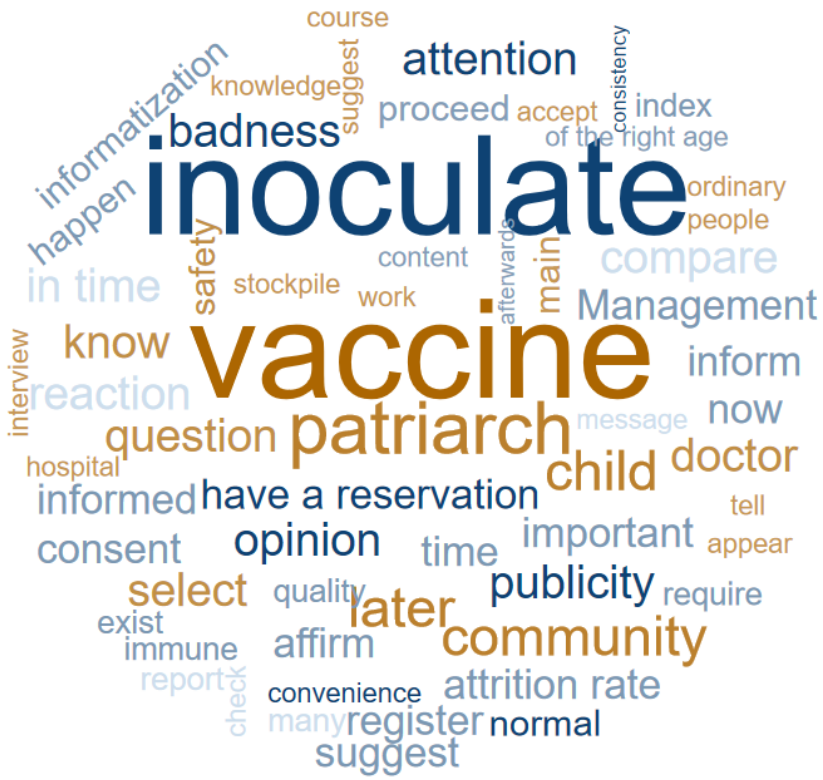

Figure 4.1 Nvivo 12 words cloud analysis of raw data

Upon importing the organized interview data into Nvivo 12, the initial task is to establish nodes. A new free node is created on the software's homepage and appropriately named. Each node signifies a preliminary category that encompasses the textual information from the

interview data, also known as the original code. Nodes are typically categorized as either free nodes or tree nodes; content that cannot be definitively classified is provisionally labeled as a free node. During the open coding phase, the researcher has the option to perform browse coding, quick coding, or automatic coding. Browse coding involves the researcher reviewing the original material and coding the relevant sections to the designated nodes, simultaneously creating free nodes informed by the study's content. Quick coding allows for the swift generation of nodes from keywords in the primary source material, followed by the application of selective coding to the chosen content. Automatic coding refers to the process where the researcher applies codes across the entire primary source material based on pre-labeled paragraphs. In this study, a combination of browse coding and quick coding is selected to develop the original code. A sample of the free nodes is provided in Annex C.

As we gathered data, we conducted separate interviews with 35 individuals from the health sector management, medical staff, and the general public to secure the interview transcripts. Concurrently, to ensure the logical coherence and clarity of our research narrative, to further refine the concepts and categories, and to visually trace the original information back to its corresponding concepts, we assigned sequential numbers to the data coding statements.

Initially, 30 out of the 35 sets of textual data were randomly selected for open coding, with the remaining 5 reserved for the theory saturation test. To streamline statistical analysis, the author conducted a tiered classification and coding system for the interview participants and their responses: the first tier indicates the order of the interviewees, denoted by 'O' for 'Object', for instance, 'O1' for the first interviewee; the second tier categorizes the interviewees, denoted by 'C' for 'Category', such as 'C1' for experts, 'C2' for frontline staff, 'C3' for the public, and 'C4' for pediatricians. The third tier corresponds to the sequence of questions in the interview outline, denoted by 'Q' for 'Question', for example, 'Q1' for the first question. An example code like 'O1-C1-Q1' would refer to an expert's (first in the expert category) response to the first question. Following the coding of the interviews, a total of 83 coding sequences were identified, yielding 83 distinct concepts through comparison and analysis. These concepts were then consolidated by merging those with overlapping meanings, leading to the development of open coding categories. An example of this open coding for 17 textual transcripts is presented in table 4.1.

Table 4.1 Illustrative examples of open coding for textual data

Excerpts from Interview Transcripts	Open Coding	
	Concepts	Categorization
O4-C1-Q3: After vaccination with some vaccines, there might be issues, and it's important to use parent education sessions to disseminate pertinent knowledge. O4-C3-Q4: For social welfare, we are tasked with conducting lectures, which is a yearly mission we have to fulfill. O1-C6-Q4: Each time individuals come for vaccination; they should be provided with a one-time education on the relevant knowledge. O2-C10-Q4: Given that many people currently do not understand the effects of vaccines, do you think there are channels that could increase awareness among all age groups, including children and the elderly? When referring to the elderly, I mean that the entire population should be well-informed through effective propaganda.	a1. Parent Education Classes a2. Community Lectures a3. Knowledge Popularization a4. Efficacy Promotion	A1. Social Education
O2-C4-Q3: We have been focusing on enhancing the health literacy among the populace. O2-C7-Q1: I believe scheduling vaccinations is crucial to ensure children receive their immunizations promptly and consistently, preventing any lapses in the vaccination program.	a5. Health Literacy Assessment for Residents within the Jurisdiction a6. Proactive Appointment Scheduling	A2. Public Health Literacy in the Jurisdiction
O3-C1-Q2: The transportation is very convenient; in any case, making an appointment is also very convenient. O3-C1-Q2: There happens to be a considerable amount of traffic nearby, but since we have a car, we can drive over directly; it's not far, and it's very convenient. O3-C2-Q2: It's about a 15-minute drive away, which isn't particularly close.	a7. Traffic Convenience a8. Driving Duration a9. Transportation Distance	A3. Accessibility of Transportation
O3-C6-Q5: The reception area includes both clinical and preventive medicine doctors. O3-C6-Q6: There should be a designated observation room, not located in the hallway. O3-C4-Q5: For instance, the decor should be more child-friendly, with a clean and bright space. O3-C7-Q6: Our room should be more spacious, brighter, and it would be ideal to have more toys available.	a10. Reception Room a11. Observation Room a12. Lighting Brightness a13. Types of Toys a14. Pre-Examination Triage Room	A4. Outpatient Comfort
O2-C8-Q1: Additionally, I believe more emphasis should be placed on pre-vaccination screening and triage. O1-C5-Q2: Firstly, we must maintain rigor and integrity in our work to ensure the quality of vaccinations is upheld throughout the vaccination process. O1-C7-Q1: I believe that our CDC's procedures for vaccine storage and distribution are currently very	a15. Rigorous Concept a16. Work Procedures a17. Efficient Execution a18. Work Flexibility a19. Process Division of Labor	A5. Work Philosophy

Excerpts from Interview Transcripts	Open Coding	
	Concepts	Categorization
stringent. O2-C4-Q4: The aim is to save time and enhance efficiency; whether we adhere strictly to the guidelines or can adapt flexibly, I hope to see increased training in this area. O2-C7-Q2: We will initiate the normal process, ensuring a rational division of labor. O1-C4-Q6: Attention should be given to the communication between nurses during the reception process and parents or the vaccinees. O1-C1-Q3: Beyond our expertise, we also require the collaboration of other units and multiple departments to better serve the children and parents in our community. O2-C1-Q1: This includes a small classroom for parents to comprehend the importance of vaccines, enabling them to cooperate with us in ensuring timely vaccinations. O2-C1-Q1: We implement flow control and monitor disease registration data for certain individuals within our preventive vaccination program. O1-C2-Q4: Ultimately, it depends on the professional knowledge of our staff to determine which vaccines should or should not be administered. O1-C6-Q3: For those who do not understand, we require the media or some of our staff to patiently and meticulously explain to them. O1-C8-Q4: Mild side effects such as a low-grade fever, headache, and fatigue, or rashes, should not be a cause for alarm as they are quite common. O3-C3-Q5: We inquire about their discomfort, understand the nature and extent of their discomfort, and provide timely guidance accordingly. O2-C5-Q1: It involves informing them about their previous vaccinations and providing prior advice on safe vaccination practices. O4-C1-Q1: Understanding which vaccinations are administered, the number of doses required, or the frequency of administration constitutes having this fundamental information. O1-C2-Q4: Parents are fully informed at the time of vaccination. O1-C1-Q2: The information must be consistent, that is, it should be truthful. O1-C1-Q4: I instruct them to keep track of the children they are responsible for and to call and text them promptly. O3-C3-Q5: Initially, we have a parent-baby group that communicates feedback to the vaccinating nurse, who then contacts the child's mother to follow up. O2-C7-Q1: We also utilize a pre-cognitive notification letter, which is signed and machine-	a20. Communication Platform a21. Multi-Department Coordination a22. Parental Cooperation a23. Problem-Solving Personnel a24. Speed of Issue Diagnosis a25. Consultation and Problem Resolution a26. Frequency of Issues Occurring a27. Timeliness of Issue Guidance a28. Advance Notification a29. Comprehensive Disclosure a30. Adequate Communication a31. Essential Information Sharing a32. Telephone Notification a33. Parent Group Feedback a34. Pre-informed Consent Form a35. Scheduled Notification	A6. Problem-Solving Capability A7. Notification and Feedback Competence

Excerpts from Interview Transcripts	Open Coding	
	Concepts	Categorization
verified each visit. O1-C6-Q1: Then, two months in advance, we mention the schedule once and ensure to provide prior notification. O3-C3-Q5: Initially, we establish a parent-infant group that conveys feedback to the vaccinating nurse, who subsequently contacts the child's mother for follow-up. O2-C7-Q1: We also implement a pre-awareness notification letter that requires a signature and is machine-verified with each visit. O1-C6-Q1: Subsequently, two months in advance, we remind about the schedule once and ensure to provide advance notice.	a36. Educational Background a37. Years of Work Experience a38. Research and Development Status	A8. Personnel Competency
O2-C8-Q4: There should be an enhancement in continuing education, not just confined to our community health physicians delivering lectures to parents.	a39. Continuing Education Situation	A9. Continuing Education
O2-C9-Q1: Safe vaccination is paramount because it involves injecting into a child; I consider this the primary and most critical aspect. O1-C9-Q3: For instance, many individuals are uninformed about vaccine pricing, such as the distinctions between different cost categories like bivalent or trivalent vaccines. O4-C1-Q1: Nowadays, there is a multitude of vaccine types, including attenuated, inactivated, and synthetic vaccines, with an especially wide variety available. O4-C4-Q2: Different vaccines have different regulations, and registering the batch number is also of significant importance. O2-C1-Q1: We will also be informed about the vaccine's manufacturer and batch number, as well as the source of the vaccine, meaning the origin of the vaccine being procured. O2-C9-Q4: For example, we might be aware of how something was so costly before, such as our recent influenza outbreak.	a40. Vaccine Safety a41. Vaccine Name a42. Type of Vaccine a43. Vaccine Batch Number a44. Source of Vaccine a45. Price of Vaccine a46. Vaccine Selection	A10. Vaccine Category Management
O1-C3-Q3: For instance, once he comprehends the reasons, he can only accept the decision, understanding why a Class II vaccine was chosen over a Class I vaccine. O1-C4-Q1: Regarding vaccine storage and distribution, distribution as an activity doesn't exist; however, storage is in place, including a backup room and cold storage facilities. O1-C6-Q1: Secondly, there is the matter of vaccine storage and distribution—our vaccines are essentially sourced from the district CDC. O2-C1-Q1: For instance, we keep records of vaccine inventory movements, cold chain transportation, and operations to ensure the vaccine's safety.	a47. Vaccine Storage a48. Vaccine Distribution a49. Inventory Accounts a50. Operation Records a51. Cold Chain Maintenance a52. Temperature Records	A11. Vaccine Storage Management

Excerpts from Interview Transcripts	Open Coding	
	Concepts	Categorization
O2-C7-Q1: We maintain a cold chain temperature log to monitor the temperature, which is recorded twice daily. O2-C8-Q1: Our cold chain warehouses have specific requirements for the storage temperature, duration, and shelf life of vaccines. O2-C9-Q1: Since vaccines have temperature requirements, they need to be stored within a range of 2 to 8 degrees Celsius. O1-C2-Q4: The nation has set regulations, and everything is in accordance with these regulations. O2-C1-Q1: Initially, we conduct some pre-screening assessments, such as checking if the child has a cold or fever and needs to take medication, as well as other related issues. O2-C3-Q1: Post-vaccination, it is required that a child be observed for half an hour before they can leave. O2-C4-Q2: Regarding the check-up requirements, there are scheduled free health assessments at ages 3, 6, 8 months, one year, two years, two and a half years, and three years old.	a53. Standardized Operation a54. Preliminary Screening a55. Observation and Waiting a56. Physical Examination and Diagnosis	A12. Vaccine Administration Management
O2-C7-Q4: Our unit has established a range of management systems, including the biological products management system. O2-C7-Q4: Additionally, we have the cold storage management system and the vaccine transportation system, among others. O3-C9-Q4: post-vaccination, it is necessary to refrain from consuming spicy and irritating foods.	a57. Bioproducts Management System a58. Cold Storage Management System a59. Vaccine Transportation System	A13. Vaccine System Management
O2-C1-Q1: Following the pre-screening, we inform individuals about the vaccine's precautions and potential adverse reactions. O2-C3-Q2: We aim to ensure that individuals remain for observation for at least 30 minutes, and we are committed to improving our services wherever possible.	a60. Dietary Restrictions a61. Adverse Reactions a62. Relief Measures	A14. Adverse Reaction Management
O2-C6-Q2: In vaccine quality management, key nursing job indicators, I believe the consistency of basic information on the vaccination card with the administered vaccines is the most critical point. O2-C7-Q3: Key performance indicators include the completeness and timeliness of reports, the rate of adverse effects from vaccines, the dropout rate, as well as quality metrics such as validation and reliability coefficients. O2-C7-Q3: We focus on the completeness of the report, which is something we aim to finalize on the day we administer the vaccines, ensuring that the reports are definitely communicated to the parents in a timely manner. O2-C8-Q2: Timeliness of reporting is imperative; if we are not prompt, some infants may miss their	a63. Quality Management a64. Quality Index a65. Report Completeness a66. Reporting Timeliness Rate a67. Vaccine Dropout Rate a68. Attrition Rate a69. Verification Index a70. Reliability Coefficient	A15. Vaccine Reporting Information Management

Excerpts from Interview Transcripts	Open Coding	
	Concepts	Categorization
vaccinations. O2-C8-Q2: The third aspect is the vaccine dropout rate; we monitor for dropouts specifically to minimize them. O1-C2-Q2: The fourth is the vaccine attrition rate, which is also quite significant, especially when considering the overall dropouts for vaccines that require multiple doses. O4-C4-Q3: Particularly, we have to scrutinize the verification after many kindergartens, as kindergartens in Shenzhen have very stringent requirements. O3-C1-Q2: Sometimes, we cannot avoid reliable and irresistible factors, so I consider this to be acceptable. O3-C1-Q3: Physicians provide a scheduled appointment time, and the timing for the final dose has already been noted and pre-booked in the log. O3-C3-Q6: It is suggested that a larger stock of vaccines be maintained, with communities submitting more plans, as there is a high demand from the public, and they may not be able to obtain it when desired. O3-C10-Q1: One should educate oneself online and then refer to the vaccination record book. O1-C4-Q1: The subsequent step is to streamline the vaccine appointment process, ensuring the last mile of service and enhancing convenience. O1-C4-Q2: The accuracy of the appointment is relatively important and should be placed in the high-priority column. O2-C7-Q4: Initially, we inquire about the age of the individual to be vaccinated and provide an overview of their physical condition. O4-C1-Q1: It is essential to determine if there are any prevalent special diseases within his family, including any infectious or genetic metabolic disorders. O2-C10-Q1: These considerations relate to aspects of drug allergies, and it is also necessary to verify the batch number and check all related aspects, including the expiration date. O1-C4-Q2: If not properly informed or if they choose not to stay, it could be very dangerous if they later exhibit an allergic reaction. O1-C4-Q1: The sixth aspect pertains to the management of school-age children within the jurisdiction. O4-C4-Q4: There are distinct regulations for different vaccines, and it is also crucial to register the batch number. O1-C3-Q1: Therefore, with safe vaccination, it is important to carry out leak checks and defect inspections. O3-C2-Q2: However, vaccination clinics are still	a71. Time Appointment a72. Difficulty of Appointment a73. Channels for Appointment a74. Convenience of Appointment a75. Accuracy of Appointment	A16. Internet Medical Capability
	a76. Understanding of Physical Conditions a77. Knowledge of Genetic Diseases a78. Awareness of Medication Intake a79. Allergy History Information a80. Management of Eligible Children in the Jurisdiction a81. Children's Vaccination Registration a82. Identification and Supplement of Gaps a83. Area Allocation	A17. Resident Health Record Management Competence

Excerpts from Interview Transcripts	Open Coding	
	Concepts	Categorization
district-based, with some distance between them.		

4.2.2.2 Axial coding and main categories

In line with the study's themes, we performed a comparative analysis on the 17 categories derived from open coding. Adopting a "finding the axis of rotation" approach, we delved into the interconnections and synthesized related categories to refine and define the primary categories. This process culminated in the development and summarization of four overarching categories: professional service management, dedicated staff business management, social service management, and information management.

(1) Emergence of the professional service management category: Professional management is a crucial aspect of public health, encompassing critical components such as vaccine variety management, storage management, administration management, system management, adverse reaction management, and reporting information management. Each of these components demands specialized expertise and meticulous oversight to guarantee the safety and efficacy of vaccine administration.

1) Vaccine variety management entails a meticulous assessment of vaccine safety and efficacy, encompassing the management of details such as vaccine names, types, batch numbers, sources, selection criteria, and pricing. 2) Vaccine storage management is centered on maintaining optimal storage conditions and distribution processes, ensuring that every stage of the vaccine journey—from manufacturer to vaccination site—is conducted under rigorous cold chain conditions. 3) Vaccine vaccination management primarily involves standard operating procedures, initial pre-vaccination assessments, physical examinations of vaccinees, and subsequent diagnosis. 4) Vaccine system management encompasses the biological product management system, cold storage management system, and vaccine transportation system, which are pivotal in ensuring compliance with national regulations and standards at every stage, from production to vaccination. 5) Adverse reaction management pertains to the monitoring and handling of potential adverse reactions post-vaccination, including dietary restrictions, documentation of adverse events, and the provision of appropriate mitigation measures. 6) Vaccine reporting information management deals with the recording, compilation, and reporting of vaccination data, including oversight of key metrics such as quality indicators, reporting completeness, timeliness, vaccine leakage rates, damage rates, and verification indices along with reliability coefficients.

(2) The establishment of the main category for professional staff business management:

The competency of vaccinators is grounded in a profound understanding and practical skill set within the medical and health domain. This necessitates that the vaccination team possess not only a high level of professional expertise but also a meticulous and rigorous work ethic coupled with efficient execution. This encompasses work philosophy, problem-solving capabilities, notification and feedback skills, interpersonal abilities, and ongoing education.

1) The work concept encompasses more than just a surface-level professional demeanor; it includes a precise understanding of vaccine knowledge, adept application of vaccination techniques, strict adherence to vaccine cold chain storage and management protocols, and the capacity to make informed decisions across various vaccination scenarios. 2) Problem-solving ability necessitates that vaccinators can swiftly and accurately pinpoint potential issues during vaccination, such as adverse reactions to vaccines, evaluating and managing contraindications, and ensuring the continuity of vaccination activities despite vaccine supply challenges. 3) In terms of notification and feedback capabilities, vaccinators must possess strong communication skills, able to convey essential information to recipients clearly and accurately, including the vaccine's effects, potential side effects, post-vaccination precautions, and be capable of effectively listening to and addressing the questions and concerns of those being vaccinated. 4) Personnel capacity refers to the personal attributes of vaccinators, which include their scientific research capabilities, clinical experience, and proactive engagement in continuing education. 5) The rapid evolution of medicine and technology has heightened the expectations placed on vaccinators, making continuing education a critical priority. Regular involvement in professional training, academic conferences, and clinical research has thus become an essential component of their career development.

(3) The formation of the main category of social service management: Social education, the quality of public health within the jurisdiction, transportation accessibility, and outpatient comfort forms the backbone of developing social service capabilities. These elements not only directly impact the public's experience with vaccination services but also significantly contribute to enhancing overall public health and attaining public health objectives.

1) First and foremost, the crux of the social mission lies in enhancing public awareness and understanding of health issues through systematic education and outreach initiatives. 2) The health quality assessment of residents within the jurisdiction serves as another pivotal measure of social service capability. This encompasses regular health evaluations of the population and data analysis to gauge the status and trends of proactive vaccination appointments. 3) Ensuring transport accessibility is vital for facilitating seamless public access to vaccination services. This involves assessing the clinic's location accessibility and the travel time and distance by

car or public transit. 4) Enhancing outpatient comfort not only elevates the patient's medical experience but also significantly reduces the rate of vaccination refusals stemming from nerves, anxiety, and other emotional factors. Specific measures include the thoughtful design of pre-screening triage areas, emergency rooms, and observation spaces, ensuring proper lighting and temperature controls, as well as providing play areas and toys for children.

(4) The formation of the main category of information management: Information technology capability integrates internet medical capabilities and resident file management capabilities, creating a system that comprehensively enhances the quality and efficiency of medical services.

1) Within this system, Internet medical capability is primarily aimed at enhancing the interaction between patients and healthcare services, while resident file management capability concentrates on the consolidation and stewardship of backend data. 2) Resident file management capability is more closely tied to the governance and application of medical information, including detailed documentation and monitoring of critical data such as residents' health status, genetic background, medication use, and allergy history. Additionally, it encompasses the registration of school-age children in the jurisdiction, recording of children's vaccination status, and identification of gaps with appropriate resource allocation based on actual conditions to ensure equitable access to medical services and preventative measures for all residents. At this juncture, the categorization of all groups is complete, yielding a total of 4 main categories, and the axial coding is concluded. Table 4.2 delineates the main categories, subcategories, and their logical interconnections:

Table 4.2 Main categories, spindle coding, and logical relationships

Main Category	Corresponding Category	Logical Relationship
Social Services Management	Social Education	The more effective the social education within the research area, the better the social service capability.
	Public Health Literacy	The higher the public health literacy within the research area, the better the social service capability.
	Accessibility	The more convenient the transportation within the research area, the better the social service capability.
	Clinic Comfort	The more comfortable the clinics within the research area, the better the social service capability.
Professional Staff Business Management	Work Philosophy	The better the work philosophy within the research area, the better the professional staff's business capability.
	Problem-Solving Ability	The better the problem-solving ability within the research area, the better the professional staff's

		business capability.
	Notification and Feedback Ability	The better the notification and feedback ability within the research area, the better the professional staff's business capability.
	Personnel Capability	The better the personnel capability within the research area, the better the professional staff's business capability.
	Continuing Education	The higher the level of continuing education within the research area, the better the professional staff's business capability.
Professional Services Management	Vaccine Category Management	The better the vaccine category management within the research area, the better the professional capability.
	Vaccine Storage Management	The better the vaccine storage management within the research area, the better the professional capability.
	Vaccination Management	The better the vaccination management within the research area, the better the professional capability.
	Vaccine System Management	The better the vaccine system management within the research area, the better the professional capability.
	Adverse Reaction Management	The better the adverse reaction management within the research area, the better the professional capability.
	Vaccine Reporting Information Management	The better the vaccine reporting information management within the research area, the better the professional capability.
Information Management	Internet Medical Capability	The higher the internet medical capability within the research area, the better the information management capability.
	Resident Record Management Capability	The higher the resident record management capability within the research area, the better the information management capability.

4.2.2.3 Thematic coding

Thematic coding is a more conceptual and theoretical approach compared to axial coding. Its primary goal is to delve deeper into the connections between the main categories and subcategories, as established by axial coding. This method aims to distill the central categories that encapsulate all other categories comprehensively, and to narrate and elucidate the interconnections among these core categories, the main categories, and the subcategories through a narrative thread. The core category must possess a high level of generalization and abstraction, consolidating all categories under a unified theoretical umbrella and establishing a groundwork for theoretical model development. Our analysis has pinpointed the core category as the 'Vaccination Clinic Quality Monitoring and Management Assessment System Model'. The narrative constructed around this core category can be structured around social service management, professional staff business management, professional service management, and

information technology management, which collectively form the framework of the vaccination clinic quality monitoring and management assessment system. The detailed relationships are depicted in Table 4.3.

Table 4.3 Typical structural relationships of the main categories

Typical Structural Relationships	Essence of the Relationship Structure
Social Service Management → Vaccination Clinic Quality Monitoring and Management Assessment System Model Elements	Social service management refers to the way a society (including government, healthcare systems, and communities at various levels) provides and manages social services. It can enhance the work quality of vaccination clinics through education about vaccines, optimization of the environment, and many other aspects. Therefore, the capability of social services is an element of the Vaccination Clinic Quality Monitoring and Management Assessment System Model.
Professional Staff Business Management → Vaccination Clinic Quality Monitoring and Management Assessment System Model Elements	Professional staff business management directly affects the efficiency, safety, and public satisfaction of vaccination. Therefore, professional staff business management is an element of the Vaccination Clinic Quality Monitoring and Management Assessment System Model.
Professional Service Management → Vaccination Clinic Quality Monitoring and Management Assessment System Model Elements	Professional service management refers to the content demonstrated by vaccination personnel in the multi-level management of vaccines, such as storage, administration, and management of adverse reactions. Therefore, professional service management is an element of the Vaccination Clinic Quality Monitoring and Management Assessment System Model.
Information Management → Vaccination Clinic Quality Monitoring and Management Assessment System Model Elements	The information system helps clinic institutions achieve real-time monitoring and statistical analysis of patient vaccination status, vaccine inventory, and other data, including information sharing and collaboration among various units. Therefore, information management is an element of the Vaccination Clinic Quality Monitoring and Management Assessment System Model.
Information Management → Professional Staff Business Management	Through the management of resident records, real-time monitoring and tracking of residents' vaccination status can be achieved, thereby timely notifying residents of the need for vaccination. Therefore, information management has an impact on professional staff business management.
Information Management → Professional Service Management	The internet medical platform can integrate vaccination information data from various related institutions and departments to establish a unified vaccine information database. Through the application of internet medical technology, centralized management of vaccine reporting information can be realized. Therefore, information management has an impact on professional service management.
Social Service Management → Professional Staff Business Management	Through social education, it is also possible to timely understand residents' attitudes and needs towards vaccination, collect their feedback, opinions, and problems, and thus adjust the educational strategy and improve service quality in a timely manner. It also facilitates better notification and feedback; therefore social service management has an impact on professional staff business management.

4.2.3 Development of the theoretical framework

4.2.3.1 Building the theoretical framework

The progression through 'open coding - axial coding - selective coding' levels essentially capture the essence of the theoretical prototype. The development of a theoretical framework is a process that builds upon this coding structure, focusing on the core categories identified (the central theory), and creating a three-dimensional network that reflects the inherent connections between these core categories, the main categories, and the subcategories.

Drawing from the research findings, we have adopted the core category 'Vaccination Clinic Quality Assessment System' as the focal point for the theoretical framework's development. By referencing the typical relationship structure of the main categories, we have delineated the interconnections among the core category, main categories, and subcategories. This has culminated in the completion of the Vaccination Clinic Quality Assessment System model (Figure 4.2).

Figure 4.2 Vaccination clinic quality monitoring and management assessment system model

The Vaccination Clinic Quality Monitoring and Management Assessment System Model delineates four key elements along with their respective components, which include Social Service Management, Full-Time Staff Operational Management, Professional Service Management, and Information Technology Management. It also defines the classifications and interrelationships of each element.

4.2.3.2 Theoretical saturation analysis

To ascertain theoretical saturation, we conducted a thorough analysis and refinement of the five preserved textual data extraction methods. The findings indicate that the categories within the theoretical model are exhaustively developed. No additional categories beyond the four primary categories—Social Service Management, Full-Time Staff Business Management, Professional Service Management, and Information Technology Management—and their respective subcategories were identified, and no new category relationships were uncovered. Consequently, it can be affirmed that the aforementioned model for the Vaccination Clinic Quality Monitoring and Management Assessment System has satisfied the theoretical saturation test and is considered conceptually robust.

4.2.3.3 Reliability and validity analysis

In identifying and analyzing the elements, two individuals were involved in the coding process. Using Nvivo12 software and the same dataset, both coders independently performed open coding on the existing information. They then engaged in discussions to refine the analysis results and collaboratively completed the axial and selective coding, ensuring the credibility of the study's findings. The original information selected for analysis was comprehensive, capturing the subject matter clearly and accurately from various sources, which contributed to the high credibility of the textual data. The texts all provided a clear and precise understanding of the theme, ensuring source diversity and reflecting the essential content of the research object at different levels. Comparative analyses were used to enhance the research's validity by examining the variations and transformations within the subject matter.

4.3 Discussion

This study leveraged the robust coding capabilities of Nvivo12 to establish a three-tier coding system for the literature review, organizing each coding node in a hierarchical structure. The initial coding, or tertiary nodes, was conducted by meticulously reading the literature and is positioned at the base of the hierarchy; secondary nodes represent broader categorizations

derived from the tertiary nodes and are situated in the middle layer of the structure. The primary nodes are overarching generalizations derived from a comprehensive analysis of all primary sources and an examination of the determinants affecting the quality of work, specifically the framework for evaluating the quality within the preventive vaccination clinic context.

The four main categories distilled through the selective coding process facilitated by Nvivo12—social services management, full-time staff business management, professional services management, and information technology management—constitute the components of the quality monitoring and management assessment system for the preventive vaccination clinic. These categories are represented as the first-level nodes in the literature coding. Figure 4.3 illustrated the number of coded reference points as a percentage of the total reference points, indicating that a higher number of reference points correlates with a greater influence on the preventive vaccination clinic and a more significant role in the quality monitoring and management system.

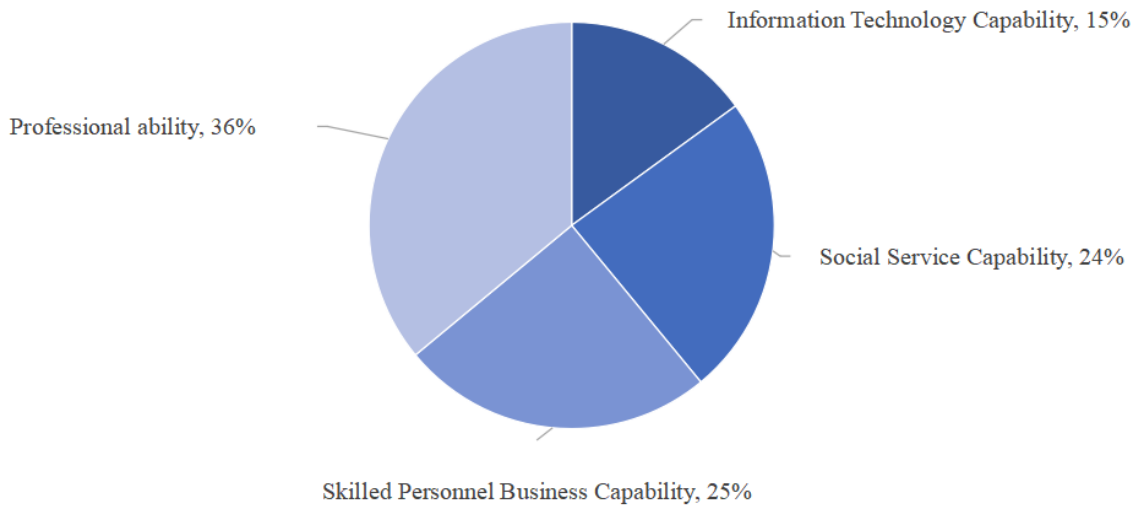

Figure 4.3 Percentage of reference points for first-level node coding

The percentage of reference points for the first-level nodes indicates that the professional service management category within the quality monitoring and management assessment system for preventive vaccination clinics has the highest number of coded nodes. Social service management and full-time staff business management follow in frequency, while the information technology management category has a comparatively lower number of reference points. This suggests that professional service management is a predominant factor in the assessment system.

The hierarchical structure created by the three-tier coding system means that the reference point count for a first-level node is contingent upon the collective sum of its subordinate nodes

and its own. A thorough examination of the quality monitoring and management assessment system for preventive vaccination outpatient clinics should extend beyond a macroscopic view. Delving into the microscopic factors within each macro factor with meticulous detail is more beneficial for gaining a comprehensive understanding of the components that constitute the assessment system for quality monitoring and management in preventive vaccination clinics.

4.3.1 Professional service management

Professional service management is central to the quality monitoring and management of preventive vaccination clinics, covering the entire vaccination service process and being directly connected to the safety, effectiveness, and accessibility of vaccines. The quality of vaccine professional services greatly impacts public confidence and acceptance of preventive vaccinations. Standardized vaccine storage, vaccination practices, and monitoring of adverse reactions are crucial for ensuring the quality of preventive vaccinations. Hence, integrating professional service management into the quality assessment system of vaccination clinics is essential for accurately reflecting the level of vaccination services.

Based on qualitative interview data, this study used Nvivo12 software to extract the main category of professional service management, which mainly includes six subcategories: vaccine variety management, vaccine storage management, vaccination management, vaccine system management, adverse reaction management, and vaccine reporting information management. This aligns with the key elements in the vaccine quality management framework proposed by (Sridhar et al., 2014), where standardized vaccine management encompasses variety selection, storage and transportation, vaccination services, and full monitoring. The professional service management assessment dimensions constructed in this study are systematic and logical.

Vaccine variety management pertains to the standardized management of vaccine types, specifications, dosage forms, batch numbers, in the immunization program to ensure compliance with national quality standards. The WHO (2015a) indicates that procuring WHO pre-certified vaccines is a vital means of safeguarding vaccine quality. Vaccine storage management involves taking effective measures to maintain vaccines at appropriate temperatures during transport, storage, and vaccination to prevent vaccine failure (Hu et al., 2020). Kumru et al. (2014) showed that temperature fluctuations in the vaccine cold chain are the main cause of vaccine quality loss. A senior nurse remarked, *'The potency of vaccines is very much dependent on the storage temperature, and even one disruption in the cold chain may affect the quality of the vaccine and pose a safety risk'*.

Vaccination management refers to the standardized and procedural management of vaccine

dissolution and administration to ensure vaccine quality at the final stage of vaccination. A study of pediatric clinics in the United States found that 63% of vaccine administration errors occurred at the point of vaccination. Interviewed medical professionals acknowledged their susceptibility to operational errors due to the high intensity and risk of vaccination. Vaccine system management involves establishing robust rules and regulations to clarify the management requirements and operating procedures for each link in the vaccine supply chain, from procurement to disposal (State Council of the People's Republic of China, 2016). The 2017 Code for the Management of Vaccine Storage and Transportation provides clear requirements for vaccine warehousing, the cold chain, and emergency response plans. Managers generally believe that systems must be used as tools for closed-loop, rigid management and regularly assess the implementation of the system.

Adverse reaction management involves the timely detection and proper handling of vaccination adverse reaction events to alleviate public concerns and maintain the reputation of immunization programs (McNeil et al., 2013). China has established a comprehensive AEFI monitoring network, but there are still shortcomings in detection, reporting, and causation determination (Wang et al., 2024). Vaccine reporting information management refers to the timely, accurate, and complete reporting of vaccination status to support immunization strategy assessment and decision-making (Zhou, 2023). Standardizing vaccine registration and enhancing the use of information systems and electronic health records were the consensus among interviewees. One participant stated, ‘More information, less running for healthcare. Only with more data can the analyses be accurate and the decisions reliable’.

4.3.2 Operational management of specialized staff

Specialized personnel are the direct providers and managers of vaccination services, and their operational competence and performance directly affect the quality of vaccination and public satisfaction (Ames et al., 2017). Studies have indicated that the communication skills, professional knowledge, and attitudes of vaccination personnel significantly influence parents’ willingness to vaccinate their children. Vaccination practitioners play a pivotal role in improving vaccination rates, and it is essential to enhance their training to boost their knowledge, skills, and sense of responsibility. Thus, integrating the operational management of full-time staff into the quality assessment system of preventive vaccination clinics is highly valuable for ensuring the specialized level of vaccination services.

Based on the qualitative interview data, the study used Nvivo12 software to extract the

main category of business management of specialized staff, which consists of five sub-categories: work philosophy, problem-solving ability, communication and feedback ability, professional competence, and continuing education. This is largely consistent with the key elements of the core competency framework for immunization planners proposed by (Groom et al., 2015). The WHO's Global Vaccine Action Plan (GVAP) also emphasizes the importance of building the competencies of immunization planners and developing leaders in the field of vaccination. It can be seen that the business management assessment dimensions of specialized personnel constructed in this study are systematic and scientific.

Work philosophy refers to the cognitive attitude of vaccination personnel towards vaccine safety and effectiveness, as well as professionalism such as service consciousness and responsibility. During the interviews, both managers and frontline healthcare professionals said that only by establishing the work philosophy of 'people-oriented, prevention-oriented and safety-first' can we ensure that all aspects of vaccination are rigorous, standardized, and conscientious.

Problem-solving ability refers to the capacity of vaccination personnel to act swiftly, make decisive decisions, and respond effectively when confronted with emergencies and complex issues. Adverse vaccine reactions, parental complaints, and public opinion crises are significant challenges in the field of preventive vaccinations. Responding to vaccine inquiries and managing adverse events are identified as the primary difficulties faced by personnel in preventive vaccination work. It has been observed that proficiency in handling adverse reactions, effective communication with parents, and conflict resolution are fundamental skills necessary for those involved in preventive vaccinations.

Communication and feedback ability refers to the willingness and level of information exchange and feedback between preventive vaccination personnel and service recipients, colleagues, and supervisors. Willis et al.'s (2016) study showed that good communication is the cornerstone of gaining public trust in immunization. Professional competence encompasses the professional knowledge, operational skills, and clinical experience necessary for vaccination personnel to carry out their duties effectively. The absence of vaccine expertise is recognized as a significant obstacle for healthcare professionals in recommending vaccinations. Continuing education is the ongoing process of enhancing the professional competence of vaccinators by updating their knowledge and skills through various methods. It has been suggested that a comprehensive training system for preventive vaccination personnel should be established, including a range of educational programs, annual theoretical training, skills competitions, and incorporating training into performance assessments.

4.3.3 Social services management

Social service management is an integral part of vaccination clinic services and is directly related to vaccination accessibility and public acceptance (Thomson et al., 2015). The WHO's Global Vaccine Action Plan (GVAP) clearly articulates the need to strengthen community mobilization to improve vaccine accessibility and foster an environment that supports the increase of vaccination rates (WHO, 2012). China's Vaccine Management Law also emphasizes the importance of governments at all levels enhancing vaccination publicity and education to elevate public awareness of the significance of monoprophylaxis. The role of social services management in bolstering vaccination rates and achieving immunization goals is therefore substantial.

The study, grounded in qualitative interview data, employed Nvivo12 software to extract the main category of social service management, which is composed of four subcategories: social promotion, public health quality in the district, transport accessibility, and outpatient comfort. This framework is in line with the 'environmental factors' dimension from the model of factors influencing vaccine acceptance proposed by Larson et al (2015) also identified the convenience of the vaccination site and the friendliness of the service as important factors influencing the willingness to vaccinate. Thus, the assessment of social service management, when considering social mission, public quality, accessibility, and comfort, holds significant value for a comprehensive evaluation of the quality of vaccination clinic services.

Social mission is a crucial instrument for raising public awareness of monoprophylaxis and the willingness to vaccinate (Oyolu, 2023). Nyhan et al. (2014) showed that targeted communication and mission initiatives help correct public misperceptions about vaccines and enhance their willingness to vaccinate. Several interviewees highlighted the need to fully utilize new media platforms to innovate the content and form of education and promotion, aiming to improve public understanding and trust in vaccine knowledge. The quality of public health in the jurisdiction has a direct impact on awareness and acceptance of the importance of monoprophylaxis. Larson (2013) pointed out that doctor-patient communication is a key factor affecting trust in vaccines. Interviewed community doctors reported that individuals with lower health literacy, such as the elderly and rural residents, are less likely to comply with standardized vaccinations.

Transport accessibility is an essential factor affecting vaccination accessibility (Rainey et al., 2011). Administrators indicated that the location of preventive vaccination clinics should be rationally planned to ensure easy neighborhood access, facilitating timely vaccination of

residents. A comfortable and friendly vaccination clinic environment can enhance the public's experience and satisfaction (Zhang et al., 2024). Interviewed nurses suggested that the vaccination and waiting areas should be well-organized to reduce congestion; service flow should be optimized, with green channels opened and waiting times minimized; and a warm, clean, and orderly waiting environment should be established, complemented by suitable recreational facilities. They noted, 'When the clinic environment is comfortable, parents are in a good mood, children are emotionally stable, and the vaccination will go more smoothly.' The study by Cataldi et al. (2020) also showed that the comfort of the clinic environment was positively correlated with children's vaccination rates.

4.3.4 Information-based management

Information management is key in modern healthcare, improving vaccination service efficiency, quality, and equity. This study uses qualitative interviews and Nvivo12 to identify information management as a primary category, with sub-categories of digital healthcare proficiency and patient record management. Digital healthcare, using internet technology for services like online consultations and appointments, was highlighted as crucial for reducing clinic crowding and ensuring timely reminders (Gabarron et al., 2020). Patient records, documenting personal vaccination and health status, are fundamental for vaccination information management and can support public health policy-making (Jacob et al., 2020). Anonymized records can also aid in disease surveillance and epidemiological studies.

4.4 Summary of the chapter

This chapter's qualitative study of interviews with 35 vaccination clinic managers, using Nvivo12, found that social services, specialized staff operations, professional services, and information technology management are key to quality monitoring. These elements encompass vital areas including vaccination outreach, staff training, technical standards, and informational support, among other critical junctures. This framework lays the groundwork for developing a comprehensive, scientific, and practical index system for assessing the quality of vaccination clinics. In the future, further qualitative research such as Delphi method should be conducted on this basis to refine the evaluation indicators of each dimension and improve the evaluation standards.

Chapter 5: Construction of the Quality Monitoring and Management Assessment Index System for Vaccination Clinics

Quality monitoring management is a crucial strategy for ensuring the safety, efficacy, and standardization of vaccination services, playing a significant role in enhancing vaccination rates and protecting public health. A scientifically sound and comprehensive quality assessment indicator system is fundamental and essential for quality monitoring and management (Inaya et al., 2015). In the preceding chapter, we utilized qualitative research methodologies, including semi-structured interviews and analysis with Nvivo12 software, to identify the key components of vaccination clinic quality monitoring and management. This included four main categories: social service management, specialized staff operational management, professional service management, and information technology management. Establishing this framework sets the stage for the development of a holistic and practical quality assessment indicator system.

The Delphi method, an iterative, anonymous expert consultation technique that refines expert consensus through continuous feedback, has been extensively applied in the health care sector for indicator selection (Hasson et al., 2000; Helmer, 1963). The Analytic Hierarchy Process (AHP) is a decision-making tool that integrates quantitative and qualitative analysis, determining indicator weights through pairwise comparisons and consistency checks to ensure a more scientific and rational assessment (Ferreira et al., 2014; Remschmidt et al., 2014). Both the Delphi method and AHP have been successfully employed in various domains, including disease management (Shen et al., 2018), care quality (Milad et al., 2016), and hospital performance assessment (Büyüközkan et al., 2011).

This chapter aims to refine and optimize the quality assessment indicators for preventive vaccination clinics, establish the weights for each indicator, and construct a scientific, systematic, and operational quality monitoring and management assessment indicator system. This will be achieved by integrating the Delphi method with hierarchical analysis, based on prior research. Specifically, the chapter will undertake the following tasks: convene an interdisciplinary panel of experts to perform two rounds of Delphi consultations to screen candidate indicators, resulting in a formal indicator pool; develop a hierarchical model using AHP, calculate indicator weights through pairwise comparison matrices, and conduct consistency checks; synthesize consultation outcomes with weight analysis to select core

assessment indicators spanning social services, personnel management, professional services, and information technology; and ultimately, construct a scientific, systematic, and operational quality monitoring and management assessment indicator system for vaccination clinics. The study anticipates offering theoretical guidance and operational standards for the quality management practices of preventive vaccination clinics, further enhancing the standardization and refinement of vaccination services, and contributing to the high-quality progression of preventive vaccination initiatives.

5.1 Research subjects and approaches

5.1.1 Selection of participants

In this study, a purposeful method was applied to selectively identify and recruit specialists from the domains of healthcare, epidemiology, and health administration, with an emphasis on those who have specific knowledge in outpatient vaccination management. The inclusion criteria for participants were specifically defined as: (1) holding an associate senior or higher professional title; (2) possessing at least a decade of experience in vaccination, disease prevention, health administration, or similar areas; (3) demonstrable expertise in understanding vaccination outpatient management procedures and protocols; and (4) an expressed willingness to participate in the research.

5.1.2 Research methods

5.1.2.1 Delphi method

The Delphi method was chosen for this study due to its structured communication technique that allows for the collection of opinions from a group of experts through a series of questionnaires. This method is particularly useful when attempting to achieve consensus among a panel of experts on a complex issue, such as the quality assessment of vaccination clinics. The Delphi method is advantageous because it allows for anonymity, which can reduce the impact of dominant personalities on the group's responses, and it enables the collection of geographically dispersed experts' opinions. The specific steps involved in the Delphi method for this research are as follows:

(1) Expert Selection: A Delphi advisory panel was formed by selecting 22 interdisciplinary experts who are familiar with vaccination clinic management. The selection was made using a purposive sampling method, taking into account their field of specialization, title, and seniority.

The literature suggests that the optimal number of experts in a Delphi panel ranges from 15 to 50 (Keeney & Al, 2001; Sandford & Hsu, 2007). The chosen 22 experts in this study met the necessary requirements for representativeness and operability.

(2) Consultation Questionnaire Design: The initial set of indicators was developed based on a literature review and pre-interview data, covering social services, personnel management, professional services, and information technology management. A 5-point Likert scale was used to rate the importance of each indicator, with 1 being very unimportant and 5 being very important. Additionally, open-ended questions were included to collect opinions (Hasson et al., 2000).

(3) Assessment Indicators: The trend of concentration of experts' opinions and the degree of coordination were assessed using the following indicators, as referenced in existing studies (Diamond et al., 2014; Okoli & Pawlowski, 2004):

①Arithmetic Mean

Reflects the overall rating of experts, calculated as: bar = $(X_1+X_2+...+X_n)/n$, where X_i is the rating of the i-th expert and n is the number of experts.

②Coefficient of Variation (CV)

Reflects the degree of dispersion of expert ratings, with the formula: CV=S/bar, where s is the standard deviation and bar{x} is the arithmetic mean. A smaller CV indicates more concentrated expert ratings.

③Expert Positive Coefficient (Cr)

Reflects the degree of expert participation in the assessment, calculated as: Cr=N/M, where N is the actual number of questionnaires recovered and M is the total number of questionnaires distributed. A higher Cr indicates higher expert participation.

The criteria for indicator inclusion to form the formal assessment indicator pool were based on the literature (Boulkedid et al., 2011; Trevelyan & Robinson, 2015) and included a mean value of at least 4.0, a coefficient of variation of no more than 0.2, and an expert positive coefficient of at least 0.7.

5.1.2.2 Analytic hierarchy process (AHP) method

The Analytic Hierarchy Process (AHP) was employed in this study to prioritize the assessment indicators identified through the Delphi method. AHP is a structured technique for organizing and analyzing complex decisions. It is particularly useful when dealing with decisions that involve both tangible and intangible criteria. The method breaks down a decision into a hierarchy of more easily comprehensible sub-decisions, each of which can be analyzed

independently. The specific steps involved in the AHP method for this research are as follows:

(1) Hierarchical Model Construction: Utilizing the assessment indicators identified through the Delphi method, an AHP model was developed for evaluating the quality of preventive vaccination clinics. This model was structured according to the logical hierarchy of 'goal level – criterion level – indicator level' (Pecchia et al., 2010). The goal level represents the overarching objective of the clinic's quality assessment; the criterion level is composed of four primary indicators: social services, personnel management, professional services, and information management; the indicator level comprises the secondary and tertiary indicators under each criterion.

(2) AHP Matrix Questionnaire Design: Following the hierarchical model, Satty's (2008) 1-9 scale method was employed to create a pairwise comparison matrix questionnaire. Fifteen experts, who were notably engaged in the Delphi process, were invited to assess the relative importance of indicators at the criterion and indicator levels through pairwise comparisons. The 1-9 scale is interpreted as follows: 1 indicates equal importance, 3 suggests a slight advantage, 5 a moderate advantage, 7 a strong advantage, and 9 an absolute advantage; the intermediate values of 2, 4, 6, and 8 represent the midpoints between the adjacent scale numbers (Saaty, 1994).

(3) Data Input and Computation: The responses from the pairwise comparison matrix questionnaire was input into the Super Decisions software. The maximum eigenvalue and corresponding eigenvector were determined using the eigenvalue method to calculate the weight vectors for the criterion-level indicators. Subsequently, the weight vectors for the indicator level, along with their combined weights, were calculated to determine the relative significance of each indicator.

(4) Consistency Check: The consistency index (CI) and consistency ratio (CR) are applied to evaluate the consistency of the judgment matrix and the logical coherence of the expert assessments (Saaty, 1987). The CI is calculated as $(\lambda_{max}-n)/(n-1)$ is the largest eigenvalue of the judgment matrix, and λ_{max} is the order of the matrix. The CR is calculated as CR=CI/RI, with RI being the random consistency index obtained from a reference table. A judgment matrix is deemed to have adequate consistency if $CR<0.1$; otherwise, it requires re-evaluation by experts (Goepel, 2013).

(5) Indicator Prioritization and Outcome Analysis: The indicators' combined weights were ranked, and those with a cumulative weight of 80% were identified as key assessment indicators, guided by expert opinions and literature (Boelhouwer et al., 2013; Remschmidt et al., 2014). The results of the AHP and Delphi method were integrated to systematically analyze the

selected indicators' significance and weight, leading to the development of an indicator framework for assessing the quality of preventive vaccination clinics. A comprehensive research report was then compiled.

5.1.3 Ensuring research quality

To ensure the credibility and dependability of the research outcomes, a series of quality assurance measures were meticulously implemented:

(1) Expert Selection: The selection of experts for the Delphi process was conducted with great care, adhering to stringent inclusion and exclusion criteria. This meticulous process ensured that the assembled panel of experts was not only diverse and representative of various perspectives but also authoritative in their respective fields.

(2) Questionnaire Development: The development of the questionnaire was a meticulous process that involved a thorough literature review and insights gleaned from qualitative interviews. This approach guaranteed that the content was both exhaustive and accurate. After a preliminary survey, the questionnaire underwent further refinement to enhance its validity and ensure it effectively captured the nuances of the subject matter (Annex D).

(3) Data Collection: To ensure the timeliness and completeness of data collection, both the Delphi and hierarchical analysis surveys were administered via electronic questionnaires. This method facilitated a swift and efficient data gathering process. To further bolster the response rate, experts were proactively contacted via phone and SMS, encouraging their prompt participation and contribution to the research.

(4) Research Execution: Throughout the research process, strict adherence to the procedural guidelines of the Delphi and hierarchical analysis methods was maintained. Emphasis was placed on robust process management and quality oversight to ensure the integrity of the research. Feedback received from each round of the Delphi process was promptly synthesized, allowing for dynamic adjustments to the research protocol as needed, thus maintaining the adaptability and responsiveness of the study.

(5) Data Analysis: The data analysis phase was conducted using appropriate statistical methodologies, with a strict adherence to the established thresholds for assessment indicator criteria. This ensured that the analysis was not only methodologically sound but also aligned with the research objectives and questions at hand.

(6) Ethical Compliance: The research protocol was submitted for ethical review and successfully obtained approval from the hospital's ethics committee. All experts provided their informed consent prior to participation, and the survey process was designed to maintain the

anonymity and confidentiality of the responses. These measures were taken to uphold the highest ethical standards of the research, ensuring the protection of participants' rights and the integrity of the research process.

5.1.4 Data analysis techniques

The statistical analysis of the data in this study was conducted using SPSS 25.0 and Excel 2019 software, employing a variety of primary methods to ensure a thorough and accurate interpretation of the findings:

(1) Descriptive Statistics: To establish a clear understanding of the demographic and professional characteristics of the expert participants, descriptive statistics were utilized. Frequency distributions and percentage calculations were applied to outline the general profile of the experts, providing insights into their backgrounds and qualifications. For the Delphi scores, measures of central tendency and dispersion, specifically the mean and standard deviation, were employed to summarize the responses and provide a quantitative overview of the expert opinions.

(2) Delphi Method Indices Calculation: Key indices such as the mean, coefficient of variation, and expert positive coefficient were calculated to assess the level of consensus and the degree of alignment among the expert opinions. These indices are critical in the Delphi method as they help determine the convergence of opinions across multiple rounds of the process. Criteria for selecting these indices were established based on their ability to accurately reflect the collective view of the panel.

(3) Hierarchical Analysis Method Data Computation: The pairwise comparison matrix scores provided by the experts were inputted into the Super Decisions software, a tool designed to handle complex decision-making processes. The eigenvalue method was employed to calculate the judgment matrix, weight vector, and consistency indices, which are essential for understanding the relative importance of the criteria and alternatives. A consistency check was performed to ensure that the judgments made by the experts were logically consistent and reliable.

(4) Statistical Charting: To effectively communicate the complex hierarchical structure and the weight distribution of each indicator system, various types of statistical charts were created. Tree diagrams, bar charts, radar charts, and other graphical representations were generated using SPSS, Excel, and other specialized software. These visual tools are invaluable in providing a clear and intuitive understanding of the data, making it easier for researchers and stakeholders to interpret the results.

(5) Statistical Testing: To assess the trend of expert opinions over the course of the Delphi method, ANOVA or the Friedman test was performed on the scores of each round. This statistical testing allows for the identification of any significant changes in opinion trends, which can be crucial in understanding the dynamics of the consensus-building process (Pecchia et al., 2010). Additionally, the consistency ratio test was conducted on the judgment matrix of the hierarchical analysis method to evaluate the logical consistency of the expert judgments (Saaty, 2008). The significance level for these tests was set at $\alpha = 0.05$, providing a standard threshold for determining statistical significance and ensuring the robustness of the research findings

5.2 Results

5.2.1 Demographics and expertise of participants

A total of 22 questionnaires were issued from expert consultation, and 20 questionnaires were recovered. The average age of the experts was 43.05 years old, with 6 males and 14 females. The proportion of those holding associate senior titles or higher was 100%, and the average number of years of experience was 18.80. Professional background included nursing, clinical medicine, public health, preventive medicine, and immunization planning. The role encompassed professional and technical staff in immunization planning and clinical medicine within national, provincial, and municipal disease control centers (refer to Annex E for the experts' basic information). The response rate for the first round was 80.00%.

The Expert Authority Index (C) was calculated as the arithmetic mean of the Indicator Familiarity (Ca) (for details, see Annex F) and the Basis of Expert Judgment (Cs) (for details, see Annex G). This index assessed the extent of the experts' domain knowledge and the reliability and utility of the expert consultation outcomes. A result was considered more credible if it meets or exceeds the critical value of $C \geq 0.7$ (for details, see Annex H). In the current Expert Consultation Method, the Expert Authority Coefficient for both rounds exceeded 0.90, indicating a high level of expertise and authority among the participants.

5.2.2 First round of expert Delphi results

The importance of each indicator was rated on the Likert 5-point scale, where 1 point represents "extremely unimportant" and 5 points represent "extremely important." The specific scoring criteria can be found in Annex I.

The average importance score for the primary indicators exceeded 3.5, and the coefficient of variation (CV) was below 25%, leading to their inclusion in the final indicator framework with subsequent weight determination. Kendall's coefficient, calculated using SPSS 24.0, was 0.481, indicating satisfactory expert consensus as it passed the consistency test (P<0.05), as detailed in Table 5.1.

Table 5.1 Degree of concentration of expert opinion in the first round - primary indicators

No.	Primary Indicator	Mean	Standard Deviation	Coefficient of Variation (CV)
A1	Professional Service Management	4.800	0.340	0.071
A2	Full-time Staff Business Management	4.750	0.303	0.064
A3	Full-time Staff Business Management	4.825	0.568	0.118
A4	Information Management	4.600	0.576	0.125

For the secondary indicators, the mean importance score exceeded 3.5, with a coefficient of variation (CV) below 25%; similarly, the mean sensitivity score was above 3.5, with a CV under 25%, with the exception of the indicator 'B7 Staff Capacity'; the mean accessibility score also surpassed 3.5, with a CV below 25%, except for the indicator 'B15 Comfort in Outpatient Clinics'. Aside from the indicator 'B15 Outpatient Comfort', all scored maintain a mean above 3.5 and a CV below 25%. Consequently, the indicators 'B7 Staff Capacity' and 'B15 Outpatient Comfort' were omitted, while the remaining secondary indicators were incorporated into the final indicator system for weight determination. The Kendall coefficients for the dimensions of importance, sensitivity, and accessibility were 0.484, 0.470, and 0.459, respectively, all of which successfully passed the consistency test (P<0.05), indicating a high level of expert coordination. Refer to Table 5.2 for details.

Table 5.2 Degree of concentration of expert opinion in the first round - secondary indicators

Primary Indicator	No.	Secondary Indicator	Importance			Sensitivity			Accessibility		
			Mean	Standard Deviation	Coefficient of Variation (CV)	Mean	Standard Deviation	Coefficient of Variation (CV)	Mean	Standard Deviation	Coefficient of Variation (CV)
A1 Professional Service Management	B1	Vaccination Management	4.875	0.319	0.066	4.650	0.709	0.152	4.650	0.630	0.136
	B2	Vaccine Storage Management	4.850	0.328	0.068	4.750	0.526	0.111	4.750	0.414	0.087
	B3	Vaccine Category Management	4.700	0.657	0.140	4.625	0.646	0.140	4.625	0.582	0.126
	B4	Vaccine System Management	4.675	0.613	0.131	4.725	0.499	0.106	4.650	0.540	0.116
	B5	Adverse Reaction Management	4.800	0.523	0.109	4.675	0.568	0.122	4.750	0.526	0.111
	B6	Vaccine Reporting Information Management	4.825	0.406	0.084	4.625	0.793	0.171	4.575	0.766	0.167
A2 Full-time Staff Business Management	B7	Staff Capacity	4.625	0.723	0.156	4.200	1.056	0.252	4.525	0.850	0.188
	B8	Continuing Education	4.650	0.540	0.116	4.575	0.545	0.119	4.625	0.666	0.144
	B9	Work Philosophy	4.825	0.373	0.077	4.525	0.803	0.177	4.475	0.786	0.176
	B10	Problem-Solving Ability	4.800	0.410	0.085	4.700	0.410	0.087	4.625	0.425	0.092
	B11	Notification and Feedback Ability	4.725	0.617	0.131	4.575	0.634	0.139	4.550	0.686	0.151
A3 Social Service Management	B12	Social Education	4.475	0.866	0.193	4.400	0.968	0.220	4.325	0.863	0.199
	B13	Public Health Literacy	4.400	0.641	0.146	4.400	0.641	0.146	4.400	0.598	0.136
	B14	Accessibility of Transportation	4.450	0.826	0.186	4.425	0.730	0.165	4.350	0.829	0.191

	B15	Outpatient Comfort	4.525	0.734	0.162	4.250	0.803	0.189	3.825	0.990	0.259
A4 Information Management	B16	Internet Medical Capability	4.675	0.568	0.122	4.325	0.816	0.189	4.300	0.715	0.166
	B17	Record Management Capability	4.725	0.617	0.131	4.500	0.778	0.173	4.400	0.852	0.194

Among the tertiary indicators, the importance, sensitivity, and availability scored for all but the indicators ‘C31 Percentage of Undergraduate Education’ and ‘C33 Engagement in Scientific Research’ were greater than 3.5, with a coefficient of variation (CV) below 25%, aligning with the scores of the secondary indicators. Consequently, the indicators ‘C31 Percentage of Undergraduate Education’, ‘C33 Engagement in Scientific Research’, and the secondary indicators ‘B7 Staff Capacity’ and ‘B15 Comfort in Outpatient Clinics’ were excluded. The remaining tertiary indicators were included in the final indicator system, with weights being determined. The Kendall coefficients for the three dimensions—importance, sensitivity, and availability—were 0.446, 0.404, and 0.415, respectively, all of which passed the consistency test ($P<0.05$), indicating good expert coordination. For details, refer to Annex J.

Following the first round of expert consultation, the indicators were evaluated based on their importance, sensitivity, and availability. Those not meeting the set criteria were removed, resulting in a final indicator system comprising 4 primary indicators, 15 secondary indicators, and 61 tertiary indicators (as shown in Table 5.3). The weights for these indicators were ascertained through a second round of expert consultation.

Table 5.3 Immunization clinic work quality assessment indicator system

Primary Indicator	No.	Secondary Indicator	No.	Tertiary Indicator
A1 Professional Service Management	B1	Vaccination Management	C1	Physical Examination and Diagnosis
			C2	Preliminary Pre-screening
			C3	Standardized Operation
			C4	Observation and waiting
	B2	Vaccine Storage Management	C5	Vaccine Storage
			C6	Vaccine Distribution
			C7	Inventory Accounting
			C8	Operation Records
			C9	Cold Chain Maintenance
			C10	Temperature Recording
	B3	Vaccine Category Management	C11	Prominent Vaccine Naming
			C12	Complete Range of Vaccines
			C13	Accurate Vaccine Batch Numbers
			C14	Safe Vaccine Sourcing
			C15	Reasonable Vaccine Pricing
			C16	Diverse Vaccine Options
	B4	Vaccine System Management	C17	Biological Product Management System
			C18	Cold Storage Management System
			C19	Vaccine Transportation System
	B5	Adverse Reaction Management	C20	Adverse Reaction Notification
			C21	Guidance on Alleviation Methods
			C22	Adverse Reaction Recording
	B6	Vaccine Reporting Information Management	C23	Quality Management
			C24	Quality Index
			C25	Completeness of Reporting
			C26	Timeliness of Reporting
			C27	Omission Rate
			C28	Loss Rate
			C29	Verification Index
			C30	Reliability Coefficient
A2 Full-time Staff Business Management	B7	Continuing Education	C31	Frequency of Continuing Education
	B8	Work Philosophy	C32	Rigor in Work Style
			C33	Rationality of Work Procedures
			C34	Efficiency in Work Execution
	B9	Problem-Solving Capability	C35	Flexibility in Work Scheduling
			C36	Dedicated Problem Handling
			C37	Speed of Problem Judgment
			C38	Problem Consultation and Answering
			C39	Frequency of Problem Occurrence
			C40	Timeliness of Problem Guidance
	B10	Notification and Feedback Capability	C41	Advance Notification
			C42	Comprehensive Notification
			C43	Adequate Notification

A3 Social Service Management	B11	Social Education	C44	Substantive Notification
			C45	Pre-knowledge Notification Letter
			C46	Parent Workshop
			C47	Community Lecture
			C48	Knowledge Popularization
	B12	Public Health Literacy	C49	Efficacy Promotion
			C50	Resident Health Literacy
			C51	Proactive Appointment Scheduling
	B13	Accessibility of Transportation	C52	Traffic Convenience
			C53	Driving Duration
			C54	Travel Distance
	B14	Accessibility of Transportation	C55	Online Appointment Time
			C56	Difficulty of Online Appointment
			C57	Convenience of Online Appointment
			C58	Online Appointment Channels
A4 Information Management			C59	Accuracy Rate of Online Appointments
	B15	Record Management Capability	C60	Management Capability for Vulnerable Groups within the Jurisdiction
			C61	Management Capability for Eligible Children within the Jurisdiction

5.2.3 Second round of expert consultation: hierarchical analysis

5.2.3.1 Hierarchical modeling

Based on the issue to be addressed or the objective to be met, the underlying connections between the goal, the subject, and the relevant factors were analyzed. The decision-making goal, factors, and objects were then categorized into the objective layer, the criterion layer, and the factor layer, respectively. Subsequently, a hierarchy diagram was constructed to reflect these relationships.

5.2.3.2 Judgment matrix

Construction Experts perform pairwised comparisons of all indicators at the same level, using a predefined scale to determine the relative importance of each factor. These comparisons were quantified to form a judgment matrix, where a_{ij} represents the result of comparing the importance of element i with element j. The following table, provided by Saaty, outlined the nine levels of relative importance and their corresponding values. The matrix formed from these comparisons was known as the judgment matrix, which has certain properties: The method for scaling the judgment matrix element a_{ij} was detailed in Annex K.

5.2.3.3 Calculation of hierarchical single-order weight vectors

Utilize the sum-product method to determine the weight variables with the following steps:

Normalize each column vector of the judgment matrix;

$$\boldsymbol{a_{ij}} = \frac{\boldsymbol{a_{ij}}}{\sum_{\boldsymbol{i=1}}^{\boldsymbol{n}} \boldsymbol{a_{ij}}} \quad \text{(5.1)}$$

Sum the normalized results of the judgment matrix across row;

$$\boldsymbol{w_i} = \sum_{\boldsymbol{j=1}}^{\boldsymbol{n}} \bar{\boldsymbol{a}}_{\boldsymbol{ij}} \quad \text{(5.2)}$$

Normalize the summed results to derive the weight coefficients, denoted as w_i;

$$\boldsymbol{w_i} = \frac{\bar{\mathbf{w}}_{\boldsymbol{i}}}{\sum_{\boldsymbol{i=1}}^{\boldsymbol{n}} \bar{\mathbf{w}}_{\boldsymbol{i}}} \quad \text{(5.3)}$$

Compute the approximation of the largest eigenvalue, denoted as λ_{max}.

$$\boldsymbol{\lambda_{max}} = \frac{\mathbf{1}}{\mathbf{n}} \sum_{\mathbf{i=1}}^{\mathbf{n}} \frac{(\mathbf{Aw})_{\mathbf{i}}}{\mathbf{w_i}} \quad \text{(5.4)}$$

5.2.3.4 Consistency check

For each pairwise comparison matrix, determined the maximum eigenvalue along with its corresponding eigenvector and perform a consistency check. Specifically, calculated the Consistency Ratio (CR) for each level with respect to the preceding level, $\mathrm{CR} = \mathrm{CI}/\mathrm{RI}$, where $\mathrm{CI} = (\lambda_{\max} - \mathrm{n})/(\mathrm{n} - 1)$, n represents the number of indicators, $\lambda_{\max}$ is the maximum characteristic root of the judgment matrix, and RI was the Random Index for average random consistency, the values of which were provided in Table 5.4. This study employed R Studio 4.0.5 to conduct the consistency test, and a judgment matrix was considered to have passed the consistency test if the CR is less than 0.1. The outcomes displayed in Table 5.5 indicate that the CR values for all judgment matrices in this study are below 0.1, signifying that they have passed the consistency test. Should the consistency test not be passed, it would be necessary to revise the pairwise comparison matrix.

Table 5.4 Average random consistency index (RI) values

n	1	2	3	4	5	6	7	8
RI	0	0	0.52	0.89	1.12	1.26	1.36	1.41

The weights for the primary, secondary, and tertiary level indicators were ascertained through the hierarchical analysis method. Experts from pertinent fields were invited to assign scores reflecting the significance of each factor relative to its higher-level indicators. The individual ratings provided by each expert are then aggregated to compute the average value, which facilitates the derivation of the judgment matrix. For details on the judgment matrices, please refer to Annex L. Based on this, the weight table for the comprehensive quality evaluation system was derived as follows:

Table 5.5 Final indicator system and its weights

Primary Indicator	No.	Secondary Indicator	Weight 1	No.	Tertiary Indicator	Weight 2	Composite Weight
A1 Professional Service Management (0.394)	B1	Vaccination Management	0.177	C1	Physical Examination and Diagnosis	0.368	0.0257
				C2	Preliminary Pre-screening	0.163	0.0114
				C3	Standardized Operation	0.184	0.0128
				C4	Observation and waiting	0.285	0.0199
	B2	Vaccine Storage Management	0.245	C5	Vaccine Storage	0.146	0.0141
				C6	Vaccine Distribution	0.192	0.0185
				C7	Inventory Accounting	0.216	0.0208
				C8	Operation Records	0.092	0.0089
				C9	Cold Chain Maintenance	0.155	0.0150
				C10	Temperature Recording	0.200	0.0193
	B3	Vaccine Category Management	0.126	C11	Prominent Vaccine Naming	0.177	0.0088
				C12	Complete Range of Vaccines	0.245	0.0122
				C13	Accurate Vaccine Batch Numbers	0.126	0.0062
				C14	Safe Vaccine Sourcing	0.101	0.0050
				C15	Reasonable Vaccine Pricing	0.114	0.0056
				C16	Diverse Vaccine Options	0.238	0.0118
	B4	Vaccine System Management	0.101	C17	Biological Product Management System	0.443	0.0176
				C18	Cold Storage Management System	0.388	0.0154
				C19	Vaccine Transportation System	0.169	0.0067
	B5	Adverse Reaction Management	0.114	C20	Adverse Reaction Notification	0.411	0.0185
				C21	Guidance on Alleviation Methods	0.328	0.0147
				C22	Adverse Reaction Recording	0.261	0.0117
	B6	Vaccine Reporting Information Management	0.238	C23	Quality Management	0.126	0.0118
				C24	Quality Index	0.164	0.0154
				C25	Completeness of Reporting	0.089	0.0083
				C26	Timeliness of Reporting	0.095	0.0089
				C27	Omission Rate	0.117	0.0110
				C28	Loss Rate	0.192	0.0180
				C29	Verification Index	0.126	0.0118
				C30	Reliability Coefficient	0.092	0.0086
A2 Full-time Staff Business	B7	Continuing Education	0.285	C31	Frequency of Continuing Education	1.000	0.0681
	B8	Work Philosophy	0.184	C32	Rigor in Work Style	0.195	0.0086

Management (0.239)				C33	Rationality of Work Procedures	0.177	0.0078
				C34	Efficiency in Work Execution	0.195	0.0086
				C35	Flexibility in Work Scheduling	0.432	0.0190
				C36	Dedicated Problem Handling	0.220	0.0086
				C37	Speed of Problem Judgment	0.127	0.0050
	B9	Problem-Solving Capability	0.163	C38	Problem Consultation and Answering	0.132	0.0052
				C39	Frequency of Problem Occurrence	0.303	0.0118
				C40	Timeliness of Problem Guidance	0.218	0.0085
				C41	Advance Notification	0.169	0.0149
	B10	Notification and Feedback Capability	0.368	C42	Comprehensive Notification	0.263	0.0232
				C43	Adequate Notification	0.272	0.0239
				C44	Substantive Notification	0.112	0.0098
				C45	Pre-knowledge Notification Letter	0.184	0.0162
				C46	Parent Workshop	0.195	0.0111
	B11	Social Education	0.288	C47	Community Lecture	0.177	0.0100
				C48	Knowledge Popularization	0.195	0.0111
A3 Social Service Management (0.197)				C49	Efficacy Promotion	0.432	0.0245
	B12	Public Health Literacy	0.449	C50	Resident Health Literacy	0.500	0.0442
				C51	Proactive Appointment Scheduling	0.500	0.0442
				C52	Traffic Convenience	0.443	0.0230
	B13	Accessibility of Transportation	0.263	C53	Driving Duration	0.388	0.0201
				C54	Travel Distance	0.169	0.0088
				C55	Online Appointment Time	0.190	0.0160
				C56	Difficulty of Online Appointment	0.136	0.0115
	B14	Accessibility of Transportation	0.500	C57	Convenience of Online Appointment	0.165	0.0139
				C58	Online Appointment Channels	0.314	0.0266
A4 Information Management (0.169)				C59	Accuracy Rate of Online Appointments	0.195	0.0165
				C60	Management Capability for Vulnerable Groups within the Jurisdiction	0.500	0.0423
	B15	Record Management Capability	0.500	C61	Management Capability for Eligible Children within the Jurisdiction	0.500	0.0423

*The ultimate weights are determined by the multiplication of the weights of the primary indicators, secondary indicators, and tertiary indicators, also known as the composite weights.

5.3 Discussion

5.3.1 Significance of the evaluation system for preventive vaccination quality monitoring and management

The Analytic Hierarchy Process (AHP) was used to develop a quality assessment system for vaccination clinics, including indicators for professional service management, full-time staff operations, social service management, and information management. This system provides a comprehensive evaluation framework across vaccination process, staff, social services, and information management, capturing critical points in service quality (Deming, 2018). Indicator selection was rigorous, comprehensive, and operational, integrating qualitative and quantitative methods, and underwent expert consultation and piloting for clarity and logic. The Delphi method gathered expert insights across disciplines, leading to a consensus on a robust indicator system (Humphrey et al., 2017). AHP quantified qualitative issues to determine indicator weights, showing the highest weight for vaccination process management, followed by staff, social services, and information management. The system is practical, with indicators reflecting daily management aspects, aiding in direct application, standard comparison, gap identification, and practical issue resolution. By assigning weights to each index, the system enables quantitative assessment of service quality management, facilitating evaluations, detecting deficiencies, and improving service quality (Yin, 1994).

5.3.2 Analysis of the subjects of vaccination quality monitoring and management evaluation

5.3.2.1 Professional service management

In the quality monitoring and management evaluation index system for vaccination outpatient clinics developed in this study, professional service management carries the highest weight (0.394) among the first-level indicators, underscoring its pivotal role as the core component of quality management in vaccination clinics. Within this category, vaccine storage management (0.245) and vaccine reporting information management (0.238) are the two most weighted factors. Vaccines are highly sensitive biological products to temperature variations, and deviations from the prescribed temperature range can diminish their immunogenicity and efficacy (Matthias et al., 2007). Therefore, establishing an impeccable vaccine cold chain system and vigilant temperature monitoring and recording are fundamental to the quality

management efforts in vaccination clinics.

The comprehensive, accurate, and timely reporting of vaccination status is central to the information management of national immunization programs, which is crucial for understanding the vaccination status of target age groups, guiding vaccine usage and distribution, and assessing the effectiveness of immunization programs (Dolan et al., 2019). International organizations such as GAVI have emphasized that the quality of vaccination data is a critical factor influencing the performance of immunization programs, and enhancing the quality of data reporting should be a priority in the management of vaccination services (Bosch et al., 2010).

5.3.2.2 Operational management of specialized personnel

As a key component of the quality monitoring, management, and evaluation system for vaccination outpatient services, the professional management of full-time staff is dedicated to enhancing their professional caliber and service capabilities. Among the secondary indicators, notification and feedback capacity (0.368) holds the highest weight, signifying that effective communication with patients is a critical aspect of the quality of vaccination outpatient services. The significance of continuing education (0.285) and work philosophy (0.184) should not be overlooked. With vaccine types continually evolving and vaccination technology advancing, various forms of continuing education and on-the-job training are essential to keep full-time staff abreast of the latest knowledge and to bolster their professional competencies (Rowe et al., 2005). Moreover, a disciplined work ethic and standardized procedures are prerequisites for ensuring the quality and safety of vaccinations. Uskun et al. demonstrated that systematic immunization training for primary care providers can markedly improve their knowledge and vaccination rates (Uskun et al., 2008).

5.3.2.3 Social service management

Social service management is a pivotal element within the quality assessment framework for vaccination clinics, signifying the societal impact and outreach of vaccination services. Public health literacy, with the highest weight among secondary indicators at 0.449, underscores the critical role of enhancing community self-care consciousness and practices to bolster immunization programs. Extensive research has demonstrated a strong correlation between public health literacy and vaccination behaviors. Consequently, vaccination clinics ought to proactively engage in diverse health education initiatives to disseminate knowledge about vaccinations, heighten public recognition of the significance of immunization, and stimulate voluntary participation. Social education, weighted at 0.288, is a crucial avenue for elevating

public health literacy and encompasses four tertiary indicators: parent classes (0.195), community seminars (0.177), information dissemination (0.195), and vaccine efficacy communication (0.432). Notably, vaccine efficacy communication carries the greatest weight, suggesting that social education efforts should emphasize the profound preventative effects of vaccines against infectious diseases to foster an understanding of the imperative of immunization. Transport accessibility, albeit the least weighted at 0.263, is highly significant for encouraging vaccination uptake and enhancing immunization program coverage. Vaccination clinics should thus strategically establish fixed, mobile, and temporary vaccination sites in alignment with demographic size and service areas, offering clear directional guidance and travel advice to optimize public convenience.

5.3.2.4 Information management

Information management, albeit with a relatively low weight of 0.169, is a significant aspect of the quality monitoring and management evaluation system for vaccination clinics, especially in the era of rapidly advancing internet medical services and smart management. This component encompasses two key secondary indicators: internet medical capacity (0.500) and file management capacity (0.500), highlighting the potential of innovative information and communication technology to enhance the efficiency and management standards of vaccination clinics. Internet medical capacity, with an equal weight of 0.500, indicates the extent to which vaccination clinics leverage internet technology to offer online services. Among its five tertiary indicators, the most heavily weighted is online appointment channels (0.314), which suggests that there should be a focus on developing robust appointment scheduling systems to provide residents with convenient and efficient booking services. Online appointments can substantially reduce patient wait times and enhance patient satisfaction with the healthcare experience.

Additionally, file management capacity, also weighted at 0.500, is another critical area within information management. There is a need to expedite the development of electronic vaccination file systems to achieve digital and standardized management of vaccination data. Efforts should be directed towards refining the collection process of electronic file information to ensure that the data remains accurate, comprehensive, and dependable.

5.3.3 Evaluation of the effectiveness in quality monitoring and management of vaccination clinics

This study employed the Delphi consultation method, allowing experts to share views anonymously through questionnaires, preventing individual bias and ensuring scientific rigor.

The construction of the indicator system and expert selection were key. The study began by reviewing literature on vaccination clinic quality monitoring, both domestically and internationally, and then collaborated in a small team to create a preliminary indicator framework. During two consultation rounds, indicators were adjusted and refined based on selection criteria to ensure reliability.

Experts invited to participate had substantial experience in public health or vaccination-related research and practice, offering significant theoretical and practical knowledge. Both rounds achieved a 90.91% and 100% response rate, reflecting high engagement and valuable suggestions for refining indicators. The expert authority coefficient was 0.890, above the 0.7 threshold, denoting strong expertise. Coordination coefficient tests indicated increased consensus among experts over rounds, with all variation coefficients below 25%, suggesting high reliability. Thus, the quality monitoring and evaluation system developed is highly reliable and valid.

5.4 Summary of the chapter

This chapter has developed a quality monitoring and management assessment index system for vaccination clinics, which includes four primary indicators, 15 secondary indicators, and 61 tertiary indicators. The system has been constructed using the Delphi method and hierarchical analysis, and is founded on the principles of total quality management. The indicators cover professional service management, full-time staff business management, social service management, and information management. Although the system has been designed to be all-encompassing, it recognizes that it cannot account for every potential influencing factor and thus is intended to be modified and enhanced based on practical application. Additionally, given the varying management conditions of vaccination clinics in different regions, the indicators and their weights may need to be adjusted to ensure the system remains applicable and sensitive to local requirements.

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Chapter 6: Continuous Quality Improvement in Vaccination Clinic Services

Vaccination clinics are specialized facilities responsible for delivering preventive healthcare services, including vaccinations, monitoring and handling adverse reactions, and providing immunization education and consultation. They bear the crucial responsibility of ensuring that school-age children receive safe, effective, and timely vaccinations (Aaron S. Wallace & Dietz, 2012). Despite increasing health awareness and rights consciousness among residents, vaccination clinics still face numerous challenges related to injection safety, standardized management, staff training, and risk communication. Annually, China reports tens of thousands of adverse reaction cases from preventive vaccinations, and periodic public complaints and reports about preventive vaccinations can have significant negative social impacts (Wenzhou et al., 2016). Grassroots vaccination clinics also exhibit considerable variation and deficiencies in environment and facilities, workflow, staff capacity, service attitude, and information management (Hu et al., 2013). Enhancing the standardized management of vaccination clinics and improving service quality continuously is vital for vaccine safety and efficacy, boosting immunization rates, and protecting public health rights and interests. Quality improvement is an ongoing process that necessitates a scientific monitoring, evaluation, and feedback mechanism.

This chapter extends the development of the quality monitoring and management index system for vaccination clinics by selecting 50 clinics in four provinces and cities nationwide as the study subjects. It collects relevant quality management data through on-site research and questionnaire interviews, uses hierarchical analysis to determine indicator weights, and comprehensively assesses the current state of service quality management in vaccination clinics. It also analyzes quality shortcomings and root causes. Based on this, the chapter proposes continuous quality improvement strategies, including optimizing the service environment, standardizing vaccination procedures, enhancing staff training, improving public communication, and innovating management models. It selects certain clinics for interventions and evaluates the impact of these interventions. The chapter's goals are: (1) to systematically evaluate the service management status of vaccination clinics using the quality monitoring and analysis of the potential differences; (2) to explore effective strategies and pathways for

continuous quality improvement in vaccination clinics, creating a generalizable and replicable management model; (3) to confirm the feasibility and effectiveness of quality improvement measures through intervention studies, offering a holistic solution for enhancing standardized management of preventive vaccinations and fostering new clinic management models. This research aims to provide practical and theoretical support for strengthening standardized vaccination management and advancing public health improvements.

6.1 Objects and methods

6.1.1 Research object

This study used a multi-stage stratified random sampling method to ensure broad regional representation and scientificity. Firstly, 4 provinces and cities were randomly selected according to the economic development level and regional distribution characteristics of the eastern, central and western regions; secondly, 3 cities were randomly selected according to the municipal administrative units; finally, according to the total number of vaccination clinics that meet the inclusion criteria, and 50 clinics were finally included as the study objects.The criteria for inclusion were as follows: (1) Clinics must be at the county level or higher; (2) They must have been providing continuous vaccination services for a minimum of 2 years; (3) They should have served annually more than 80% of the total school-age children population in their area; (4) They must employ at least 3 full-time vaccinators; (5) They must voluntarily participate in the study and have signed an informed consent form. The exclusion criteria included: (1) Any significant vaccine safety incident within the preceding 12 months; (2) Concurrent engagement in other research or evaluations related to quality management; (3) Any direct conflict of interest with the research team members.

6.1.2 Application and scoring method of the quality monitoring and management indicator system

Building on prior research, the team identified 61 indicators from the dimensions of professional service management, full-time staff business management, social service management, and information technology management that capture the essential aspects of service quality management in preventive vaccination clinics. Utilizing the Delphi method, the team established the weight for each indicator and developed a standardized assessment protocol (for details, see Annex M). Each indicator was assigned a score ranging from 1 to 9,

with research team members independently evaluating based on field observations, information review, and personnel interviews. Discrepancies in scoring were resolved through discussion to reach consensus. The specific scoring method is as follows: total score = $i_1j_1+i_2j_2+...+i_{61}j_{61}$, i represents each index, and j represents the weight of each index. The four dimensions are summed by all indicator scores within this dimension. Additionally, a satisfaction survey was administered to a random sample of 20 service users from each clinic. The indicator scores were tallied, and when combined with their respective weights, they yielded a composite score, with higher scores indicating superior quality management (for details, see Annex N). The study protocol was approved by the hospital's Medical Ethics Committee and conducted in accordance with the Declaration of Helsinki; all participants provided informed consent (for details, see Annex O).

6.1.3 Intervention

Twenty preventive vaccination clinics in Heilongjiang Province were selected, with 10 designated as the intervention group and 10 as the control group. The intervention group implemented targeted improvements based on quality assessment results and identified issues in various areas:

(1) Professional Service Management: Clinic layouts were optimized to improve patient flow, with upgrades to disinfection and isolation facilities. Additional signage enriched the consultation experience, and protocols for vaccine storage, cold-chain transport, and safe administration were revised. Multi-point quality control was applied to ensure vaccine quality and safety. An adverse reaction monitoring and response plan was introduced, standardizing reporting and investigation to strengthen emergency response.

(2) Operational Management of Full-Time Personnel: Tailored training plans, including pre-service and continuing education, were developed to enhance operational skills. Activities like inoculation skills competitions and case reviews heightened risk awareness and standardized practices. Performance appraisal metrics were updated to include inoculation rates, knowledge retention, and satisfaction levels to boost motivation.

(3) Social Service Management: Health education methods were updated, utilizing multimedia and mobile apps to increase public awareness of vaccinations. The informed consent process was standardized to respect patient rights, with improved communication to address concerns. Complaint and feedback channels were streamlined, with a hotline and suggestion box to enhance service satisfaction.

(4) Information Management: Investments in vaccine electronic supervision and clinic

information systems were increased to ensure stability. Mobile apps were introduced for online booking, vaccination record access, and health education, facilitating public access to services. The data analysis capabilities of the information system were enhanced to regularly evaluate vaccination and adverse reaction data, supporting quality management.

The control group followed routine training measures. The intervention period lasted three months.

6.1.4 Evaluation of intervention outcomes

The indicators for assessing the impact of the intervention encompass the following aspects: (1) the overall score fluctuations of the outpatient quality monitoring and management indicator system, along with the score variations within each dimension, from pre-intervention to post-intervention; (2) shifts in key outcome indicators, including vaccination rates, adverse reaction rates, and the rates of service user complaints and satisfaction, comparing the periods before and after the intervention; feedback from collaborating vaccination providers regarding the efficacy of the training programs and the management initiatives implemented (for details, see Annex P).

6.1.5 Quality control

(1) A project management team, led by the principal expert, is established to develop a comprehensive work plan and to conduct training sessions that delineate the critical quality control points at each stage of the project; (2) Assessment team members utilize a standardized form for independent scoring, ensuring that at least two evaluators perform cross-evaluations within each clinic; (3) On-site surveys are conducted strictly according to the survey schedule, with any missing data promptly verified and completed to ensure data integrity; (4) Data entry is executed through a dual-entry system by two individuals, employing a logical screening process coupled with automatic verification to ensure accuracy; (5) Regular symposiums are convened throughout the study to review and synthesize experiences, allowing for dynamic adjustments to the implementation program as needed.

6.1.6 Statistical analysis methods

In this study, we used both EpiData 3.1 and SPSS 25.0 software for statistical analysis. For the measurement data, the mean $\pm$ standard deviation is presented, and the *t*-test or variance analysis are used according to the specific situation; the counting data are expressed by the

number of cases and the percentage, and the between-group difference analysis is used by chi-square test. Total quality assessment and scores of each dimension were compared by paired *t*-test. A two-sided test was used, using P <0.05 as the criterion to be statistically significant.

6.2 Results

6.2.1 Basic information of the research object

This research encompassed a total of 50 vaccination clinics. The distribution by geographical region was as follows: 24 clinics (48.0%) were located in the East region, 14 clinics (28.0%) in the Central region, and 12 clinics (24.0%) in the Western region. Among the clinics, 37 (74.0%) operated at the county level or higher, while 13 (26.0%) were situated within township health centers. The annual patient volume for these clinics varied, with a range of 12,000 to 35,000 visits, averaging 22,500 ±0.69 million. The staffing levels of full-time vaccinators also varied, with a minimum of 3 and a maximum of 6 per clinic, averaging 4.52 ±1.07. For further details, refer to Table 6.1.

Table 6.1 Basic information of 50 vaccination clinics

Variable	Number	Proportion (%)
Geographic Region		
East	24	48
Central	14	28
West	12	24
Urban-Rural Location		
Urban	37	74
Rural	13	26
Number of Full-Time Staff		
3	9	18
4	19	38
5	9	18
6	13	26
Annual Service Volume (in ten thousand)		
<1.5	9	18
1.5 to 3	31	62
>3	10	20

6.2.2 Current status of quality monitoring and management in vaccination clinics

The quality monitoring management score of 50 vaccination clinics was 6.12 ± 0.33. The scores of the four dimensions from high to low are 2.81 ± 0.15 points for professional service management, 1.30 ± 0.14 points for full-time personnel business management, 1.11 ± 0.16 points for social service management, and 0.91 ± 0.14 points for information management. The

scores of the remaining secondary indicators were shown in Table 6.2. At the same time, it was found that the outpatient department with a relatively high professional service management score (2.81 ± 0.15 points) of its full-time staff also scored a relatively high business management score (average 1.42±0.12 points, 0.12 points higher than the overall average). In the outpatient clinics with professional service management score in the top 25%, 92.3% were above the median in the business management of full-time staff, indicating that these two dimensions show a significant trend in the same direction. The data showed that the social service management score was higher than the average outpatient level (n=23), the average professional service management score was 2.95±0.13 points, which was higher than the social service management score of 2.69±0.16 points lower than the average outpatient level. At the same time, the average incidence of adverse reactions in these outpatient clinics was 1.21‰, lower than the overall average of 1.55‰, and the complaint rate was 7.82%, also lower than the overall average of 9.66%. In the information management score in the top 1/3 (n=17), the average vaccine reporting information management score was 0.73 ± 0.05, which was significantly higher than the 0.58±0.06 score in the last 1/3. Similarly, the average score of these outpatient clinics was 0.56±0.06, which was also higher than the 0.42±0.07 score for the lower level of information management..See Table 6.2 for more details.

Table 6.2 Quality monitoring and management scores of 50 vaccination clinics

Variable	Primary Indicator	Secondary Indicator	Score
Quality monitoring and management			6.12±0.33
	Professional service management		2.81±0.15
		Vaccination management	0.53±0.06
		Vaccine storage management	0.72±0.07
		Vaccine category management	0.37±0.04
		Vaccine system management	0.30±0.04
		Adverse reaction management	0.24±0.03
		Vaccine reporting information management	0.64±0.07
	Full-time staff business management		1.30±0.14
		Continuing education	0.36±0.11
		Work philosophy	0.24±0.05
		Problem-solving ability	0.22±0.04

	Notification and feedback capability	0.48±0.07
Social service management		1.11±0.16
	Social education	0.31±0.07
	Public health literacy	0.52±0.13
	Accessibility of transportation	0.28±0.08
Information management		0.91±0.14
	Internet medical capability	0.46±0.08
	Record management capability	0.45±0.12

Note:The score was evaluated using Satty 1-9, with a total score ranging from 1 to 9.

Table 6.3 illustrated the variance in quality monitoring and management scores across various characteristics of vaccination clinics. The data indicated a significant disparity in quality monitoring and management scores between urban and rural vaccination clinics ($P < 0.05$), whereas the differences across various economic regions were not statistically significant. Additionally, no significant variations were observed in quality monitoring and management scores among vaccination clinics with differing numbers of full-time staff or levels of annual service volume ($P > 0.05$).

Table 6.3 Quality monitoring and management scores of vaccination clinics with different characteristics

Variable		Number of clinics	Proportion (%)	Score	χ^2	P
Geographic Region						
	East	24	48.0	6.28±0.32	1.900	0.161
	Central	14	28.0	6.01±0.23		
	West	12	24.0	5.90±0.31		
Urban/Rural Location						
	Urban	37	74.0	6.20±0.34	10.747	0.002
	Rural	13	26.0	5.88±0.16		
Number of Full-Time Staff						
	3	9	18.0	5.99±0.05	2.551	0.067
	4	19	38.0	6.01±0.19		
	5	9	18.0	6.23±0.30		
	6	13	26.0	6.27±0.52		
Annual Service Volume (thousands)						
	＜1.5	9	18.0	6.27±0.33	0.718	0.493
	1.5~3	31	62.0	6.05±0.33		
	＞3	10	20.0	6.19±0.32		

The outcomes of vaccination services across the 50 preventive vaccination clinics were as follows: the complaint rate was 9.66% with a standard deviation of 6.11%; the vaccination rate was recorded at 87.24% with a standard deviation of 4.29%; the incidence rate of adverse reactions was 1.55 per ten thousand with a standard deviation of 0.89 per ten thousand; the public satisfaction score averaged at 7.68 with a standard deviation of 1.90; and the public

awareness score averaged at 1.98 with a standard deviation of 1.36.

6.2.3 Changes in the quality monitoring and management indicator scoring system before and after intervention

The total and dimensional scores of the quality monitoring and management indicator system for preventive vaccination clinics, as depicted in Table 6.4, demonstrate a shift following the intervention. The overall score of the system rose significantly from a pre-intervention mean of 6.25±0.36 to a post-intervention mean of 8.75±0.99, reflecting a substantial improvement (t = -10.604, $P < 0.05$).

Table 6.4 Comparison of total and dimensional scores of the quality monitoring and management indicator system before and after intervention (x±s, points)

Variable	Primary Indicator	Secondary Indicator	Before Intervention	After Intervention	t-value	P-value
Quality Monitoring and Management			6.25±0.36	8.75±0.99	-10.604	< 0.001
	Professional Service Management		2.84±0.15	4.60±0.74	-10.434	< 0.001
		Vaccination Management	0.55±0.06	0.59±0.04	-2.574	0.074
		Vaccine Storage Management	0.74±0.09	0.83±0.05	-3.984	0.002
		Vaccine Category Management	0.38±0.04	0.43±0.02	-5.351	0.012
		Vaccine System Management	0.31±0.05	0.34±0.03	-2.764	0.004
		Adverse Reaction Management	0.24±0.03	1.21±0.13	-31.918	< 0.001
		Vaccine Reporting Information Management	0.63±0.07	0.74±0.05	-6.289	0.276
	Full-time Staff Business Management		1.32±0.15	1.93±0.05	-17.275	< 0.001
		Continuing Education	0.38±0.10	0.51±0.10	-4.024	0.935
		Work Philosophy	0.23±0.06	0.37±0.10	-5.320	0.191
		Problem-Solving Ability	0.22±0.04	0.32±0.09	-4.732	0.013
		Notification and Feedback Capability	0.49±0.08	0.65±0.08	-6.440	0.520
	Social Service Management		1.14±0.19	1.42±0.12	-5.407	0.041

	Social Education	0.32±0.07	0.53±0.16	-5.172	0.018
	Public Health Literacy	0.43±0.09	0.63±0.15	-5.222	0.001
	Accessibility of Transportation	0.28±0.10	0.43±0.09	-4.880	0.640
Information Management		0.95±0.14	1.47±0.32	-6.811	＜ 0.001
	Internet Medical Capability	0.46±0.05	0.62±0.08	-7.083	0.183
	Record Management Capability	0.42±0.09	0.72±0.12	-9.272	0.034

6.2.4 Changes in vaccination rates, adverse reaction incidence, complaint rates, and service recipient satisfaction before and after intervention

Following the intervention, the vaccination rate among children at the 20 clinics surveyed saw an increase from 86.35% to 94.05%, marking a 7.7 percentage point improvement compared to pre-intervention levels. The incidence of adverse reactions experienced a notable decrease, dropping from 1.48 per ten thousand to 0.79 per ten thousand, a reduction of 0.69 per ten thousand from the initial rate. The complaint rate among service recipients was also significantly reduced, falling from 9.75% to 4.05%, which is a 5.7 percentage point decrease. Customer satisfaction scores rose from 7.2 to 8.3 points, an increase of 1.1 points. Additionally, the public awareness score in the district climbed from 1.75 to 3.45. The difference in the incidence of adverse reactions before and after the intervention was found to be statistically significant ($t = 3.324$, $P = 0.001$).

6.2.5 Feedback from full-time vaccinators on training and management initiatives

A survey was conducted among the 73 full-time vaccinators who took part in the training program. A significant majority, 85.0%, found the training content to be well-structured and relevant. An impressive 93.2% reported that the training was effective, while 86.2% felt that the knowledge and skills acquired were exceedingly beneficial in their day-to-day professional tasks. Furthermore, 89.0% of the participants felt that the intervention strategies were instrumental in streamlining the management practices within vaccination clinics. The same proportion, 89.0%, viewed the assessment mechanism as a positive tool for enhancing work motivation. Additionally, 87.6% reported that the performance evaluation had led to an increase in their service consciousness and competence. For more details, refer to Figure 6.1.

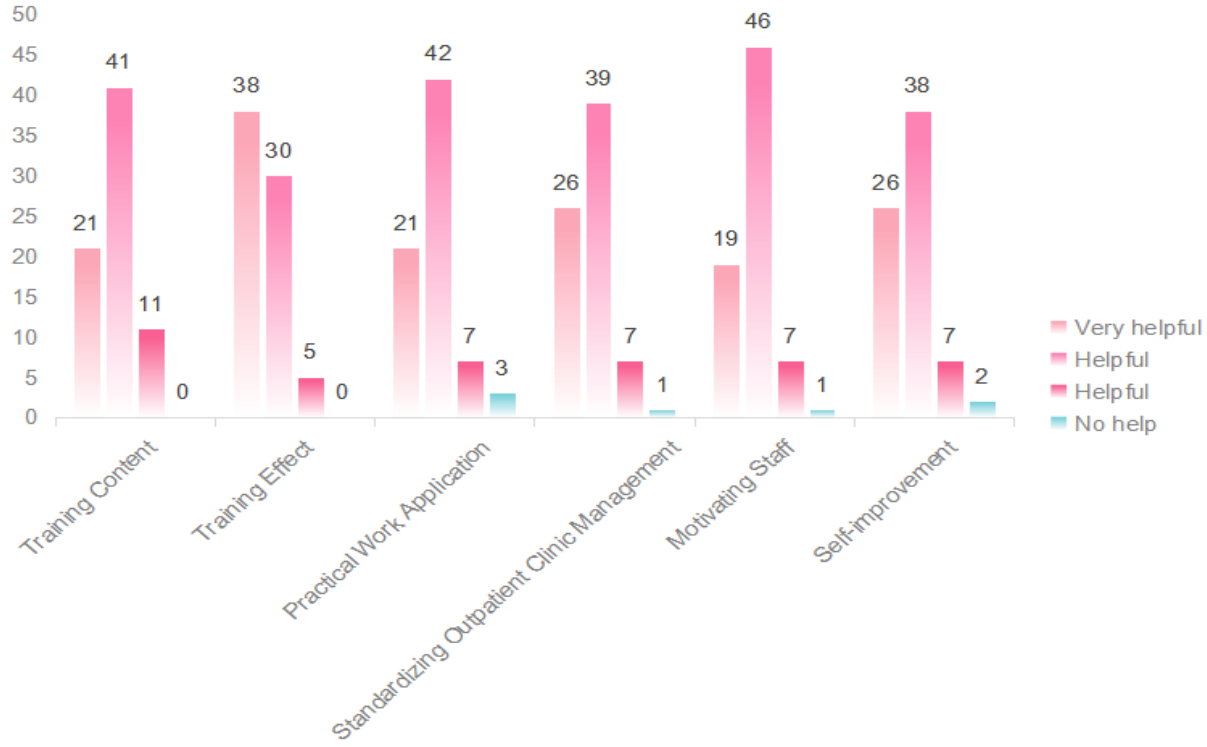

Figure 6.1 Feedback from full-time vaccinators on training and management measures

6.3 Discussion

6.3.1 The overall quality monitoring and management evaluation score for vaccination clinics was found to be low

As public health in China continues to evolve, vaccination services, a cornerstone of the primary healthcare system, bear the essential task of safeguarding public health and combating infectious diseases. However, the survey findings on the quality monitoring and management evaluation of vaccination clinics indicate that the overall scores are disappointing, signaling a need for improvement in the general quality of work.

Firstly, the professional caliber of some staff in vaccination clinics is inadequate, with a lack of comprehensive knowledge regarding vaccine types, vaccination protocols, and adverse reaction management, which could potentially lead to safety hazards in vaccine storage, transportation, and administration. This has, to some extent, impacted the standardization and efficacy of vaccination operations, as well as the effectiveness of immunizations and public confidence.

Secondly, with the rapid growth of digital healthcare in China, the establishment of digital vaccination clinics has become a focal point for health administrations and disease prevention

centers (Zhou et al., 2023). The data of this study revealed significant differences among the different dimensions of quality monitoring management of vaccination clinics, and their inherent links deserve in-depth exploration. The internal data of professional service management also showed obvious differentiation: vaccine storage management (0.72±0.07 points) and vaccine reporting information management (0.64±0.07 points) were prominent, while the adverse reaction management (0.24 ± 0.03 points) was significantly low. This unbalanced state indicates that the outpatient department is relatively skilled in routine and procedural vaccine management links, but the ability to deal with sudden and emergency adverse reactions is still insufficient. This is highly consistent with the data performance of full-time personnel business management, notification feedback ability (0.48 ± 0.07 points) is significantly higher than problem solving ability (0.22±0.04 points), reflecting the internal correlation between personnel ability structure and professional service quality. According to the data of urban-rural differences, the total score of urban vaccination outpatient service (6.20 ±0.34 points) was significantly higher than that of rural outpatient (5.88±0.16 points), and this overall difference was particularly prominent in the dimension of information management (Chen et al., 2021). The gap between urban and rural areas is not only a simple disparity in scores, but also reflects the systematic imbalance in resource allocation, talent reserve and technology application (Zhou et al., 2014). In particular, rural clinic in social service management dimension score is lower than cities, but its gap with professional service management score is bigger than urban clinic, rural areas vaccination work "professional social" tendency is more obvious, may lead to public participation and health literacy development lag (Li, 2021). Another interesting data phenomenon is that despite more than three times the difference (from <15000 to> 30000), not (6.27±0.33 vs.6.19 ± 0.32). This suggests that the quality of preventive vaccination clinics does not simply decrease with increasing workload and that there may be critical capacity and scale effects of quality assurance. The in-depth analysis shows that although the outpatient department with large service volume is at a disadvantage in per capita workload, it often has advantages in staffing structure, professional division of labor and cooperation, and information application, forming a specific quality compensation mechanism..

From the perspective of the correlation between overall quality and specific indicators, the vaccination rate of school-age children (87.24%±4.29%) and public satisfaction (7.68±1.90 points) showed a positive trend consistent with the overall quality score, while the incidence of adverse reactions (1.55‰±0.89‰) and the complaint rate (9.66%±6.11%) showed opposite

change patterns. This data consistency shows that the comprehensive score of the quality monitoring management system can indeed reflect the actual effect of vaccination to some extent, which verifies the practical value of the evaluation system. In particular, the actual incidence of adverse reactions in outpatient clinics with low adverse reaction management scores is also relatively high, which highlights the importance of strengthening adverse reaction management in improving the quality of vaccination.

6.3.2 Professional service management in vaccination earns high scores

The dimension of professional service management within vaccination holds significant weight in the quality monitoring and management evaluation system of vaccination clinics. Analysis indicates that vaccination clinics in China have achieved high scores in this area, attributable to several key factors.

Firstly, there is robust policy support and a comprehensive regulatory framework surrounding vaccines. The Chinese government prioritizes vaccination efforts, enacting a suite of relevant policies and regulations, including the Vaccine Management Law. These regulations provide clear guidelines covering all facets of vaccination work, from vaccine production and distribution to administration, monitoring, and evaluation. The stringent and well-developed legal framework ensures standardized and safe vaccination practices, offering solid legal support for vaccination clinics.

Moreover, substantial government investment in vaccination initiatives is evident, with the establishment of vaccination sites, staffing with qualified professionals, provision of necessary equipment, and ensuring an ample supply of vaccines.

Secondly, vaccination clinic staff are required to undergo systematic professional training, gaining familiarity with vaccine characteristics, vaccination procedures, and necessary precautions. Training encompasses theoretical instruction, practical skills development, and case study analysis, equipping vaccinators with essential knowledge and competencies. These training programs bolster their professional capabilities and ensure proficiency in vaccination protocols.

Furthermore, regular skill assessments and ongoing education opportunities facilitate continuous learning and advancement, enhancing professional acumen in the vaccination field. Additionally, Chinese vaccination clinics demonstrate a high level of professionalism and rigor in vaccine management and quality control. They have established comprehensive vaccine quality control systems that include regular testing and prompt evaluation to identify and address potential quality issues.

The enhancement of vaccination expertise is closely linked to raising public awareness and engagement. The government actively promotes vaccine awareness and education campaigns to highlight the importance and safety of vaccinations, address public inquiries, bolster confidence in vaccination, and foster a societal understanding of its value. Such public outreach and educational efforts not only improve societal awareness and acceptance of vaccinations but also create a more conducive working environment for vaccination clinics, aiding in the advancement of professional vaccination services.

6.3.3 Information management of vaccination outpatient services remains a relative weakness

As societal operational models evolve, urban and rural populations shift, and living standards rise, so too does the demand for vaccination services. Consequently, the public's expectations for the quality of vaccination services are increasing. However, traditional vaccination clinics often struggle with high management workloads, relatively low efficiency, and frequent errors and omissions in vaccination records and vaccine replacement. Moreover, the limited sharing of vaccination information between regions leads to considerable inconvenience (Wang, 2014; Xue et al., 2020).

In response, many vaccination clinics have started to transition into digital formats. In 2009, Jiangsu Province pioneered the concept of digital vaccination clinics, establishing construction standards. From 2010 to 2016, the development of digital vaccination clinics in China was slow. However, incidents such as the 2016 Shandong vaccine scandal and the 2018 Changchun vaccine case heightened public demand for electronic and standardized vaccination services. With the progress of informatization and digital healthcare, the implementation rate of digital vaccination clinics in China reached 27.11% in 2017 and saw a significant increase, growing by 16.95% in 2021 compared to 2020, indicating a notable surge in the establishment of digital clinics (Cao et al., 2022; Pang et al., 2021).

Nevertheless, there are still challenges in the information infrastructure of vaccination clinics in China. Firstly, the real-time exchange of cross-provincial vaccination information is hindered by the absence of a unified national vaccination management platform. Provincial platforms rely on the national platform for real-time data interaction, but variations in standards and inconsistent data quality between provinces complicate the transfer and migration of vaccination records, leading to issues with record duplication, loss, and inaccuracies.

Secondly, funding shortages are a significant barrier to advancing the informatization of vaccination clinics. Information systems necessitate substantial financial investment in

hardware, software, and network infrastructure. However, the lack of clear support policies for vaccination services in some provinces results in limited financial resources. Additionally, the loss of senior talent, an imbalanced workforce, and a general deficiency in professional IT literacy are also critical factors contributing to the weak informatization capabilities of vaccination clinics (Wang et al., 2020). In some institutions, vaccinators nearing retirement, such as nurses, may lack computer proficiency and the adaptability to engage with information systems. They often have a limited understanding of IT concepts and present high training costs, which can dampen their enthusiasm for participating in the informatization efforts of vaccination clinics, thereby impeding the enhancement of their informatization capabilities.

6.3.4 Professional management of vaccination outpatient staff needs to be improved

The vaccination clinic is a critical component in the maintenance of public health, with the technicians' professional quality being directly linked to the quality and safety of vaccination services. In China, the professional level of technical personnel in vaccination clinics requires further enhancement.

Firstly, the issue may stem from the varying professional backgrounds and skills of vaccinators. Vaccination requires expertise in diverse fields such as medicine, immunology, and pharmacy. However, the professional makeup of some vaccination outpatient technicians is not ideal, with a majority being nursing professionals and a minority specializing in public health and clinical medicine. This disparity could potentially compromise their ability to make accurate judgments and respond effectively to complex vaccination situations.

Additionally, the lack of training for technical personnel and the slow updating of knowledge are also contributing factors. As medicine and immunology progress, so does the knowledge and technology associated with vaccination. Yet, some vaccination clinics have training deficiencies, making it challenging for staff to keep up with the latest advancements in vaccination. Additionally, due to constraints like funding and time, some clinics are unable to provide sufficient training opportunities, which hampers the timely updating and improvement of the staff's knowledge and skill levels.

Excessive workload and pressure are key factors affecting the professional ability of vaccination clinic technicians (Li et al., 2021). National survey data from 2019 indicated significant differences in the per capita daily workload of vaccination units nationwide, with 29.05% of units reporting a workload exceeding 30 doses under routine vaccination. Between 2019 and 2020, regional studies further confirmed the uneven work intensity among vaccination units, with some facing high levels of workload. Beyond the inherent demands of the profession,

technicians also encounter various emergencies, such as complaints from parents, leading to multifaceted pressures. Heavy workload and work pressure can lead to emotional exhaustion among skilled personnel, contributing to job burnout and affecting their professional ability.

6.3.5 Enhancement of social service management in vaccination clinics is essential

To bolster public health literacy and increase awareness and trust in vaccinations, vaccination clinics must excel in social service and educational outreach. However, there is a recognized need to improve the social service capabilities of current vaccination clinics, particularly in the realm of social education. The explanations provided by vaccination clinic technicians regarding vaccination content are not sufficiently in-depth or comprehensive. Presently, the educational focus in China's vaccination clinics is predominantly on the significance of vaccination and the vaccination process, with a lack of detailed interpretation on vaccine types, mechanisms of action, and safety (Zheng et al., 2018). Moreover, there is a scarcity of personalized educational content tailored to individuals of varying ages, occupations, and health conditions, resulting in suboptimal educational outcomes.

The missionary education approach primarily utilizes static media like posters and brochures, which are limited in interactivity, appeal, and engagement. Despite the proliferation and advancement of the internet, the integration of innovative educational methods such as online platforms and social media has not been extensively or deeply leveraged, thus failing to capitalize on their potential for rapid dissemination and extensive reach. Additionally, the frequency and scope of missionary work are inadequate due to constraints in human and material resources (Yu et al., 2014). Consequently, many members of the public have not received sufficient pre-vaccination education, leading to a lack of understanding and the potential for doubts and concerns.

Furthermore, there is a dearth of necessary post-vaccination education and follow-up services to address questions and resolve issues promptly. During the educational process, vaccination clinics often operate in a unidirectional mode of communication, lacking interaction and dialogue with the public. This results in varied levels of understanding and acceptance of the educational content among the public and hinders the clinics from receiving timely feedback and suggestions, which are crucial for refining their educational efforts.

6.3.6 Addressing disparities in vaccination outpatient service quality across urban and rural regions

The variation in the quality of vaccination outpatient services across different urban and rural areas and regions is influenced by a myriad of factors. Firstly, the uneven allocation of medical resources significantly impacts service quality (You et al., 2021). Urban areas typically boast advanced medical facilities, a larger pool of medical personnel, and abundant medical resources, whereas remote or rural regions often grapple with a scarcity of such resources. This disparity in resource distribution results in a divergence in service standards.

Moreover, the discrepancy in personnel training and the level of medical technology is another pivotal factor contributing to the service quality gap. Vaccination clinics in urban settings commonly undergo more extensive and specialized training, equipping them with superior professional knowledge and skills, thereby enabling them to deliver higher quality services. Conversely, clinics in some remote or rural areas, constrained by limited training opportunities and resources, may fall short in terms of professionalism, which can compromise the quality of medical services provided.

Additionally, information asymmetry and an outdated technological level are critical factors that contribute to the differences in service quality (You et al., 2021). The absence of timely and effective channels for information dissemination, coupled with technological limitations, hinders the ability of some services to stay current and ensure the provision of high-quality vaccination services.

Lastly, inadequate funding and policy support may also exert an impact on service quality (Lin et al., 2019). In regions where funding or policy support is lacking, local vaccination clinics struggle to secure the necessary backing for their development, which in turn affects the quality and reach of their services.

Furthermore, the quality of vaccination outpatient services may correlate with the household income levels, cognitive differences, health awareness, and accessibility of services among urban and rural residents (Zhang et al., 2018). These socio-economic and demographic factors can influence both the demand for and the utilization of vaccination services, thereby affecting overall service quality.

6.3.7 Post-intervention Assessment of vaccination outpatient work quality

To elevate the operational quality within vaccination clinics, this study introduced a suite of intervention strategies, such as integrating continuous education and capacity-building sessions

both offline and online, facilitating external visits and exchange programs, and offering Total Quality Management (TQM) and social service skills training courses. These initiatives are designed to enhance the professional caliber, service consciousness, and social service capabilities of outpatient staff across various aspects, thereby improving the overall work quality. An analysis and comparison of pertinent metrics indicate that these interventions have indeed contributed to the improvement of vaccination outpatient work quality to a noticeable extent.

Firstly, the integration of offline and online continuing education and capacity-building sessions offer vaccination clinic staff a platform for ongoing learning and skill enhancement. Through a variety of educational formats and training methods, staff can promptly acquire the most recent vaccination knowledge and techniques, thereby enhancing their professional quality and work competencies. Continuous education allows staff to maintain a cutting-edge professional perspective, improving work efficiency and precision, which in turn directly propels the enhancement of work quality.

Secondly, external visits and exchange programs provide staff with opportunities to engage with other institutions and peers, expanding their professional perspectives and exchanging work experiences and technical approaches. Through communication and interaction, staff can draw insights from exemplary practices in other regions, invigorate their enthusiasm for work and foster innovative thinking, thus promoting inter-team learning and collaboration.

Thirdly, TQM training courses equip staff with a systematic understanding of quality management principles and methodologies. By enhancing management proficiency, reinforcing quality control, and internal audits, staff can more effectively manage the critical aspects of work quality, standardize service delivery, and significantly improve work quality and efficiency.

Lastly, social service skills training sessions offer staff more opportunities to hone their social service abilities. By elevating the staff's comprehensive service awareness and competencies, they can more effectively interact with patients, elevate service quality, and increase patient satisfaction, which subsequently strengthens the team's cohesion and service capabilities.

Following the implementation of these interventions, the work quality in vaccination clinics has seen marked improvement. The vaccination process has become more standardized and efficient, reducing the public's waiting times. Staff exhibit a more enthusiastic and considerate service attitude, resulting in a significant boost in public satisfaction. However, it is important to acknowledge that while these interventions have yielded substantial outcomes, they represent

the beginning rather than the culmination of our efforts to improve work quality. As medical technology evolves and public health needs shift, it is imperative to persistently explore and refine our practices, continuously refining and optimizing intervention strategies to ensure ongoing enhancement of vaccination outpatient work quality.

6.4 Summary of the chapter

This chapter's research findings have shed light on the current state and challenges pertaining to the quality monitoring and management of vaccination outpatient clinics in China. Collectively, the evaluation scores for vaccination outpatient services were found to be on the lower side. Across the four dimensions assessed, while professional service management demonstrated relative strength, notable shortcomings in information management, professional personnel business management, and social service management have emerged as the primary obstacles hindering further enhancements in work quality.

Moreover, the study has identified significant disparities in the quality of vaccination outpatient services across various urban and rural regions. These disparities not only impact the public's access to equitable health services but also underscore the existing imbalances within the public health service sector in China. To address these issues, this chapter has proposed targeted intervention strategies, which have yielded significant improvements. It is important to recognize that the enhancement of vaccination outpatient work quality is an ongoing endeavor that necessitates ongoing refinement and innovation.

Looking ahead, there is a commitment to persistently reinforce the management and evaluation mechanisms for the quality of vaccination outpatient work. It is imperative to continuously refine and optimize the intervention strategies to ensure a sustained upward trajectory in the quality of vaccination outpatient services.

Chapter 7: Enhancing Quality Monitoring and Management in Vaccination Clinics

Vaccination remains one of the most effective strategies for controlling and eradicating infectious diseases. The quality management within vaccination clinics is directly tied to vaccination efficacy and overall public health. This study developed a quality monitoring and management index system for vaccination clinics, assessing 50 clinics across China's eastern, central, and western regions. Targeted management interventions addressed identified weaknesses, yielding positive outcomes.

Post-intervention results showed improvements in overall scores and all dimensions of the quality monitoring index system. Key indicators, including vaccination rates, adverse reaction reporting, and customer satisfaction, all improved. Full-time vaccinators responded positively to the training and management initiatives, demonstrating that continuous quality improvement, guided by the index system, can effectively raise standards in clinic management.

However, due to challenges like regional disparities and limited resources, grassroots vaccination clinics still face gaps in infrastructure, personnel skills, and technology use. Strengthening policy support and quality management efforts is essential.

Based on these findings and best practices domestically and internationally, this chapter presents strategic recommendations at macro, meso, and micro levels to guide administrators and policymakers in advancing vaccination clinic quality.

7.1 Macro strategy: national-level legislative support and resource allocation

7.1.1 Legal framework development: ensuring vaccination legislation

To standardize and ensure vaccination quality, comprehensive legislation is essential to establish a robust legal framework. This framework should outline clear guidelines regarding clinic organization, staffing qualifications, service standards, and quality oversight. It must also include supervisory mechanisms and penalties to enforce compliance and address violations.

Effective supervision and management are key to improving service quality. A dedicated oversight body should be established to regularly assess vaccination clinics, promote data collection, and enhance transparency through public information disclosure. Service scope,

quality assessments, and patient satisfaction ratings should be made available on a public platform to encourage higher service standards and enable patients to choose quality care.

The state can further support vaccination quality through targeted policies, including financial assistance, tax relief, and special funding. These incentives would facilitate infrastructure development, personnel training, and technological advancements, ensuring continuous service improvement.

7.1.2 Resource allocation strategy: ensuring equitable distribution of vaccination services

Vaccination serves as a vital instrument for safeguarding public health. To enhance the quality of vaccination outpatient services in China and to ensure an equitable distribution of these services along with the optimized allocation of resources, a strategic approach is imperative.

Firstly, acknowledging the disparities in service distribution between urban and rural areas, as well as different regions, the nation must amplify its support for underdeveloped regions. This can be achieved through financial aid, training programs for personnel, and subsidies for equipment, thereby elevating the standard of vaccination services in these areas.

Secondly, it is essential to institute a mechanism for the equitable allocation of resources between urban and rural vaccination clinics. This involves facilitating the cross-regional distribution of resources and establishing a network for resource sharing that links urban and rural areas, ensuring a balanced reach of services. Additionally, to refine the allocation of vaccination outpatient resources, there is a need to channel public health resources towards vaccination services, escalating investment to bolster service capacity.

Thirdly, the establishment of a centralized national platform for information sharing and management of vaccination outpatient services is crucial. This platform should consolidate service information, resource distribution, and vaccination rate data from various clinics, enabling information sharing and providing a scientific foundation for strategic decision-making.

Furthermore, leveraging information technology, an intelligent resource scheduling system should be developed. This system would facilitate the swift and rational distribution of resources, enhance the overall service level, and ensure the balanced development of vaccination services across the board.

7.1.3 Enhancing quality assurance: instituting a system for vaccination quality assessment and enhancement

To foster ongoing advancements in the quality of vaccination outpatient services in China, it is essential to establish a comprehensive, scientific, and efficacious system for evaluating and enhancing vaccination quality at the national level.

Firstly, the development of consistent and explicit quality assessment criteria and metrics for vaccination outpatient services is imperative. These should encompass aspects such as outpatient facilities, staffing, operational protocols, and information management, ensuring that the evaluation process is guided by clear standards.

Secondly, the establishment of a dedicated national agency to oversee the organization and execution of evaluations and supervision of vaccination clinics across the country is crucial. This agency will ensure that the evaluation outcomes are both objective and precise. The scope of evaluation and supervision should be extensive, encompassing both quantitative verification of indicators and qualitative assessments, to gain a holistic view of the operational status in various regions.

Furthermore, the dissemination of evaluation results should be conducted in an open and transparent manner, with timely public disclosure through an information disclosure platform. This approach will not only enhance transparency but also motivate local governments to elevate the quality of their services, encouraging healthy competition and peer learning among clinics.

The national strategy should also promote collaboration and exchange among regional vaccination clinics, creating mechanisms for cross-regional medical cooperation. This will facilitate resource sharing, mutual learning, and collective improvement in service quality. Additionally, the creation of intellectual property rights and a mechanism for sharing results will stimulate the dissemination of research findings, driving technological innovation and progress in outpatient services.

Ultimately, based on the evaluation findings, strategies should be adjusted in a timely manner to ensure the continuous refinement and enhancement of vaccination service quality.

7.2 Meso strategy: integrated management and technical support by functional departments

7.2.1 Integrated management: define roles and enhance cross-departmental collaboration

Defining the roles of pertinent departments and bolstering collaboration across sectors is instrumental in creating a cohesive approach, thereby enhancing the collective efficiency and decision-making caliber of vaccination initiatives. Initially, it is crucial to delineate the distinct responsibilities of health administration departments at various levels, the CDC, and vaccination clinics. Health administration departments should be tasked with the formulation of vaccination policies and strategies, offering guidance and oversight, and ensuring seamless execution of vaccination programs. The CDC's role involves vaccine procurement, cold chain maintenance, technical direction, and surveillance to guarantee the quality and safety of vaccinations. Vaccination clinics, as the direct service providers to the public, should focus on administering vaccinations, providing health consultations, monitoring adverse reactions, and reporting pertinent information. The clear assignment of duties establishes a well-defined operational flow and accountability framework, preventing task redundancy and overlap, and thus enhancing operational efficiency.

Furthermore, inter-departmental communication and collaboration should be fortified to jointly devise and execute vaccination programs. A regular mechanism for inter-departmental coordination meetings should be established to discuss and formulate the annual vaccination agenda and goals, clarify the roles and tasks of each department within the plan, and to routinely assess the plan's implementation progress. Timely sharing of updates on work advancements, challenges, and proposed solutions is essential.

Additionally, establishing a cross-departmental information sharing and feedback system is vital for increasing work efficiency and decision-making quality. It is recommended to develop a unified information management system that facilitates the integration of data across departments, enabling real-time data sharing on vaccine availability, vaccination statistics, and adverse event tracking. Concurrently, instituting a routine data analysis and evaluation process will allow for the prompt identification of issues, the formulation of corrective measures, and the consequent enhancement of decision-making acumen and operational effectiveness.

7.2.2 Enhancing technical support: development of a vaccination training regimen and expert consortium

To elevate and refine the quality of vaccination outpatient services, there is an imperative need to refine the professional training regimen and establish an expert consortium, ensuring ongoing technical support that equips outpatient staff with robust expertise.

Firstly, it is essential to institute a comprehensive vaccination training system. This involves the regular conduct of professional development programs for vaccination clinic staff, encompassing updates on vaccine knowledge, training in vaccination techniques, and instruction in emergency response protocols. Staff should be motivated to pursue relevant professional certifications to elevate their proficiency and capabilities. Concurrently, the creation of training records and an evaluation system is crucial to monitor and assess the impact of training initiatives, ensuring their ongoing relevance and efficacy.

Secondly, the formation of a vaccination expert consortium is advised. The establishment of an expert database, encompassing specialists in vaccinology, infectious diseases, immunology, and related fields, will provide technical consultation and support services to vaccination clinics. These experts could periodically convene academic seminars, engage in complex case deliberations, and foster other forms of collaborative discourse to encourage the dissemination of expertise and professional interaction.

Moreover, encouraging outpatient staff to engage with experts for timely resolution of issues and uncertainties will enhance their capacity to manage challenging scenarios.

Lastly, offering sustained technical support and mentorship to vaccination clinics is equally vital. It is recommended to develop a technical support platform for vaccination clinics, featuring online guidance, video consultations, and remote training sessions, among other modalities, to assist clinics in addressing technical quandaries and work-related challenges.

Additionally, instituting a routine mechanism for technical exchange and case sharing will facilitate knowledge sharing and technical collaboration across different regions and clinics, thereby collectively enhancing the technical proficiency and service quality of vaccination efforts.

7.2.3 Health education: boosting public knowledge and engagement in vaccination

Enhancing health education is pivotal in the ongoing efforts to improve the quality of vaccination services. To this end, functional departments involved in vaccination can implement the following strategies to heighten public awareness and encourage active

participation:

Firstly, amplify the promotion of vaccination and intensify the educational impact. Departments should utilize a range of media, including television, radio, the internet, and other platforms, to disseminate vaccination knowledge more extensively. They should also offer detailed scientific explanations and practical advice tailored to the needs of various groups, helping the public to grasp the significance, safety, and benefits of vaccination and to adopt sound vaccination practices.

Secondly, employ a variety of publicity methods. Organize health lectures, offer free clinic services, and conduct community outreach to engage the public and foster interaction. Additionally, leverage new media channels such as social networking sites and mobile applications to broaden the reach of educational messages, thereby enhancing the spread and effectiveness of information dissemination.

Thirdly, produce and disseminate educational materials on vaccination. Design and create an array of informative materials like brochures, posters, instructional videos, and social media content to present vaccination information concisely and clearly. This will guide the public in understanding and utilizing vaccines correctly. Actively engage in health fairs and educational campaigns to distribute these materials, further raising awareness and participation.

Lastly, proactively address societal concerns and doubts reflected in public opinion. Utilize mechanisms for monitoring public sentiment to promptly identify and understand the public's reservations about vaccination, addressing them to alleviate concerns and uphold trust. Engage actively in current social events to propagate evidence-based preventive health concepts, guiding the public to develop accurate vaccination views, thereby increasing the vaccination

7.3 Micro strategy: enhancing service quality and information innovation at the outpatient level

7.3.1 Service refinement: creating an efficient operational framework for vaccination clinics

First and foremost, instituting a robust management system for vaccination outpatient services is fundamental to developing an efficient operational structure. The clinic's operational procedures, job responsibilities, and safety benchmarks should be meticulously defined to guarantee the work is conducted in a standardized and uniform manner. This standardization ensures that outpatient staff adhere to established protocols and maintain professional conduct.

Moreover, it is beneficial to draw upon advanced international practices and to devise relevant policies and regulatory frameworks that align with domestic realities, offering clear guidance and support for outpatient operations.

Secondly, regular training and assessment of outpatient staff are vital to uphold the integrity of the system. Training curricula should encompass a range of topics, including vaccination knowledge, procedural operations, vaccination techniques, and emergency response protocols. Staff must undergo periodic evaluation to ensure adherence to the system; those who fall short should undergo additional training or be reassigned to preserve the standardized and professional nature of outpatient services.

Additionally, to oversee and manage outpatient quality in real-time, it is advisable to establish a dedicated quality control unit or appoint a quality control officer. This entity would be tasked with monitoring outpatient quality, analyzing data, and addressing issues as they arise. The quality control officer would be responsible for day-to-day supervision of the outpatient process, identifying issues promptly, and implementing solutions. Furthermore, instituting an outpatient quality evaluation system will facilitate regular assessments of service performance, encouraging ongoing enhancement and advancement of outpatient services.

Lastly, the development of an efficient operational system must also prioritize information infrastructure. Implementing electronic management of outpatient services will enable real-time updates and queries of vaccine inventories, vaccination records, and adverse reaction reports, thereby increasing the efficiency and accuracy of work processes. The information system should also support remote monitoring and management capabilities, facilitating easier oversight and guidance from higher-level authorities.

7.3.2 Emphasizing human touch: cultivating a welcoming service environment in vaccination clinics

The enhancement of vaccination outpatient service quality in China is significantly bolstered by the creation of a congenial service environment that embodies a caring ethos.

Firstly, streamlining the vaccination service process is pivotal for increasing the efficiency of vaccination services and elevating public satisfaction. Clinics should organize vaccination schedules to minimize the public's waiting time. The vaccination procedure can be made more straightforward, with the introduction of systems like appointment registration, dedicated queues, and optimized medical processes, enabling the public to undergo vaccination services swiftly and with ease.

Secondly, bolstering communication and interaction with the public is integral to enhancing

service quality. Outpatient staff should proactively engage with the public to comprehend their needs and sentiments, thereby offering tailored services. For instance, the clinic can provide specific vaccination advice and considerate measures for individuals of varying ages and those with unique needs. Additionally, the clinic can periodically organize health seminars and interactive Q&A sessions to bolster the public's understanding and confidence in vaccinations.

Furthermore, offering personalized services is crucial for establishing a friendly service environment. The clinic should focus on the public's experience throughout the vaccination process, ensuring warm and caring service. For example, a child-friendly vaccination clinic like the one established by the Donghuan Street Health Service Center in Panyu District, spans 200 square meters and includes a waiting area, consultation area, physical examination area, vaccination area, and observation area. It is equipped with an intelligent queuing system, electronic displays, and additional facilities such as children's play areas, family sofas, and nursing rooms to provide a comfortable waiting environment.

Lastly, to ensure ongoing service quality improvement, the clinic should routinely conduct self-assessments of service quality and solicit public satisfaction surveys. Establishing a dedicated information desk or feedback channels can facilitate the reception of public suggestions and feedback, enabling proactive enhancements in service quality.

7.3.3 Leveraging information technology: advancing digital infrastructure and data utilization in vaccination clinics

Firstly, enhancing the digital framework of vaccination clinics is essential for the modernization of their information systems. Electronic information management should be implemented for efficient electronic input, storage, and retrieval of data. A centralized vaccination information management system should be established to electronically maintain records of vaccinations, monitor vaccine inventories, and manage demographic information, enabling swift data sharing and integration. Utilizing the information system will facilitate the tracking of vaccination statuses, reminders for vaccination schedules, and the logging of vaccination histories, thereby enhancing the efficiency and precision of vaccination management processes.

Secondly, employing advanced technologies such as big data and artificial intelligence for the in-depth analysis and mining of vaccination data is crucial. Beyond electronic information management, large-scale data analysis can reveal patterns, predict vaccine shortages, and understand preferences among different vaccination groups. Such insights are invaluable for shaping policies and refining services. Moreover, artificial intelligence can offer intelligent forecasting and decision support for vaccination data, elevating the sophistication and nuance

of vaccination operations.

Additionally, establishing a vaccination information sharing platform with standardized data protocols and interfaces is vital to ensure data sharing and interoperability across systems.

Lastly, while advancing information infrastructure and data application, it is imperative to prioritize information security and privacy. Robust technical safeguards and management practices should be implemented to bolster the security of information systems, conduct risk assessments, and mitigate the risks of data breaches and misuse, ensuring the integrity and trustworthiness of vaccination data.

By executing these strategies, data-driven service enhancements can be realized, propelling the ongoing refinement of vaccination outpatient service quality in China.

7.3.4 Engaging society: enhancing public oversight, participation, and health literacy

In the context of the Healthy China initiative, engaging the public in oversight and participation, along with enhancing health literacy, has become a vital strategy for disseminating knowledge on disease prevention.

Firstly, intensifying public health education is crucial for advancing public health literacy. Health education initiatives should raise awareness and understanding of the significance of vaccination, emphasizing its importance and benefits. Information dissemination platforms and community outreach programs should be established to communicate accurate vaccination information and scientific insights, guiding the public to adopt proper vaccination practices and health behaviors, thereby elevating overall health literacy.

Secondly, instituting a robust mechanism for public supervision and participation is essential, offering diverse channels for oversight and engagement. Mechanisms such as public supervision hotlines and online complaint platforms can be implemented to enable real-time monitoring and feedback on the quality of vaccination clinic services. Concurrently, clinics should periodically disclose work reports and vaccination statistics to enhance transparency, allowing the public to understand and engage in the vaccination process.

Thirdly, establishing an incentive mechanism for social participation is beneficial. Encouraging the involvement of social organizations and volunteer groups in the promotion and oversight of vaccinations can be facilitated through public supervision reward systems that acknowledge and reward active participants with incentives for their contributions and suggestions. Additionally, clinics can collaborate with community and educational institutions to organize vaccination knowledge contests, volunteer services, and other engaging activities to boost public enthusiasm and interest in participation.

Lastly, reinforcing the social supervision infrastructure is imperative to augment the public's capacity to oversee vaccination efforts. A tiered and multi-channel supervision system should be developed, which may include the formation of an independent third-party oversight entity and a transparent platform for the public disclosure of vaccination data.

7.3.5 Personal initiative: developing and applying personal health literacy

Individuals, as the primary beneficiaries of vaccinations, have a health literacy level that is intrinsically linked to the efficacy of vaccinations, their personal health, and the overall quality of outpatient services.

Firstly, individuals should proactively develop their health knowledge base and elevate their health literacy. By engaging in health education programs and consuming health-related literature, they can deepen their understanding of vaccination. This active engagement promotes health consciousness, encourages the cultivation of positive health behaviors and habits, and stimulates participation in the development of healthy communities.

Secondly, individuals can enhance their health literacy by actively refining their behaviors and lifestyle choices. Maintaining healthy routines, such as a balanced diet, regular exercise, and adequate rest, contributes to bolstering personal immunity and resistance to diseases. Moreover, refraining from unhealthy practices like excessive alcohol consumption and smoking can lower disease risks and elevate an individual's overall health literacy.

Thirdly, participation in community health activities and volunteer work is a practical way to nurture health literacy. Engaging in community health seminars, free clinics, and health-themed public welfare events like health runs can strengthen personal social responsibility and health awareness. Volunteering also allows individuals to disseminate their health concepts and behaviors, contributing to the collective enhancement of societal health literacy.

Lastly, individuals can further their health literacy by engaging in beneficial health practices through online platforms and social media health communities. By following health-focused public accounts and joining discussions on health topics, they can continuously acquire updated health knowledge and information, interact with others, build a health support network, and collaboratively advance health literacy for all.

7.4 Summary of the chapter

Drawing upon the research findings presented earlier, this chapter has delineated a multi-tiered approach to enhancing the quality of vaccination outpatient services in China, structured across

the macro, meso, and micro levels.

At the macro level, the chapter underscores the necessity for robust legislative backing and strategic resource optimization at the national tier. It advocates for the fortification of legal frameworks and the bolstering of financial and material support to underpin vaccination services, through the refinement of pertinent laws and the enhancement of resource distribution.

Moving to the meso level, the focus shifts towards the collaborative governance and technical reinforcement from functional departments. The chapter suggests that departments enhance inter-departmental communication and collaboration, bolster training for personnel, and cultivate a synergistic effort across sectors. Additionally, it recommends leveraging modern information technologies to escalate management efficiency and service quality.

At the micro level, the emphasis is on service quality enhancement and information innovation within the outpatient context. The chapter proposes strategies to elevate the quality of vaccination services through the streamlining of service processes, the application of information technology to catalyze service improvements, the promotion of broad social engagement, and the encouragement of proactive individual behaviors.

Looking ahead, it is imperative to iteratively refine and optimize these strategies and recommendations, ensuring they remain responsive to the evolving social landscape and the dynamic needs of the public. This adaptive approach will be instrumental in elevating China’s vaccination efforts to new standards of excellence.

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Chapter 8: Conclusion, Limitations, and Prospects

Vaccination stands as one of the most economically viable interventions within the public health sector, offering an indispensable contribution to the reduction of disease burdens and the advancement of public health. As specialized providers of vaccination services, the caliber of service quality management in vaccination clinics is inherently connected to the success of immunization programs and the well-being of the populace.

Anchored in the forefront of the discipline and practical management, this study concentrated on the subject of "Development and Application of a Quality Monitoring and Management Index System for Preventive Vaccination Outpatient Services." It conducted a systematic and exhaustive investigation encompassing theoretical foundations, index formulation, status appraisal, intervention strategies, and research on countermeasures, yielding a set of beneficial research outcomes.

Building upon the synthesis of key research findings, this chapter will proceed to scrutinize the research's shortcomings and constraints. It will also project potential avenues for future exploration in the domain of quality monitoring and management for vaccination outpatient clinics. The aim is to offer guidance for the practical management of vaccination clinics and to contribute to the body of research in associated fields.

8.1 Summary of key research findings

Centering on the theme of quality monitoring and management of vaccination clinic, this study conducted a thorough and systematic theoretical discussion and empirical study, and revealed the following key conclusions through index system construction, status quo investigation and intervention research:

8.1.1 Scientific and feasible quality monitoring and management indicator system for preventive vaccination clinics

Through literature analysis and empirical investigation, the four core elements of quality monitoring of vaccination clinics were determined: professional service management, professional business management, social service management and information management.

According to the evaluation results, the key problems facing the current vaccination clinic include: weak monitoring and management of adverse reactions, insufficient information application level, lack of emergency response ability of professionals, and a single communication channel of social services. These problems constitute the bottleneck restricting the improvement of the quality of vaccination clinics, and are also the key areas of supervision.

8.1.2 Regional imbalance in the quality management of China's vaccination clinics

The empirical study found significant urban-rural differences in the quality management of vaccination clinics, but not between the eastern, central and western regions. The difference between urban and rural areas is mainly manifested in the two dimensions of information management and social service management, and the root cause lies in the unbalanced resource allocation, serious brain drain and insufficient technical support. The study also found that about 28% of vaccination clinics lacked a standardized quality monitoring process, and 42% did not establish a sound emergency response mechanism for adverse reactions, indicating structural defects in the quality monitoring system. In addition, the relationship between scale and quality is not simply linear, and medium-scale outpatient clinics (annual service of 15,000 to 30,000 people) face greater service pressure and quality risk.

8.1.3 Continuous quality improvement strategies have significant effects

Studies have validated the effectiveness of the continuous quality improvement strategy in enhancing the service quality of vaccination clinics. Intervention research indicates that following the implementation of this strategy, there has been a notable enhancement in the clinic's quality management metrics. Additionally, vaccination rates have risen, the documentation of adverse reactions has been standardized, and there has been a significant boost in the satisfaction levels of service recipients. This intervention achieve the double improvement of quality and efficiency.

8.1.4 The urgent need to establish a multi-level quality management system

The present study proposes the framework of “trinity” system for quality supervision of vaccination clinics, specifically: (1) macro level: clarify the key role of national legislative guarantee and resource optimization; (2) meso level: confirm the importance of collaborative management and technical support of functional departments; (3) micro level: implement the multiple supervision mechanism of “internal self-examination + external supervision + public

participation", optimize service process, drive service innovation by information means, encourage social participation in vaccination supervision, and build a transparent and efficient grassroots quality management system. This three-tier supervision system is theoretically complete, which lays a solid foundation for the construction of a long-term quality management mechanism.

8.2 Innovations of the study

This research, focusing on the theme of quality monitoring and management in vaccination clinics, offers several significant insights, both in theoretical discussions and practical implementations. The key innovative aspects of the study are outlined below:

8.2.1 Innovative research perspective

This research pioneers a novel approach by merging public health management insights with quality management theories and applying them to the practical management of vaccination clinics. The adoption of an interdisciplinary and management-focused perspective on the topic is a significant contribution to expanding the scope of quality management research within the vaccination field.

8.2.2 Holistic research framework

The study presents a systematic and comprehensive analysis of the core, characteristics, and factors influencing quality management in vaccination clinics. It has crafted an all-encompassing quality monitoring and management index system that includes professional service management, dedicated personnel operations management, social service management, and information management. This addresses the shortcomings of previous research, which often lacked a holistic view and concentrated on isolated elements of management.

8.2.3 Methodological advancements

In constructing the index system, the study employs a diverse array of methodologies, such as literature reviews, expert consultations, and field studies. It utilizes the Analytic Hierarchy Process (AHP) to determine the weights of the indices, blending qualitative and quantitative analysis to bolster the scientific integrity and practical applicability of the system. In the empirical research phase, the study employs multi-stage sampling techniques, surveys, and on-

site inspections to ensure the quality of the survey and the reliability of the data collected. These methodological enhancements provide a robust foundation for the study's findings and recommendations.

8.3 Theoretical significance

8.3.1 Expanded the application of total quality management theory in the field of public health

This study introduced TQM theory into the research on quality management of vaccination outpatient services, systematically organizing and constructing a quality monitoring index system that covers professional service management, personnel management, information management, and other aspects. This has enriched the application scenarios of TQM theory in the field of healthcare. The research findings not only provide theoretical support for the improvement of vaccination outpatient service quality but also offer new perspectives and case support for the further development of TQM theory.

8.3.2 Deepened the application of the structure-process-outcome theory

The Structure-Process-Outcome theory emphasizes the organic integration of inputs (resources), processes (management behaviors), and outcomes (results) in management. This study, by constructing a quality monitoring and management index system, closely links the management process of vaccination outpatient clinics to its outcomes (such as service quality, vaccination rates), further validating the applicability of the theory in the quality management of health services, while also providing empirical support for future related theoretical research.

8.3.3 Promoted the application of integrated dynamic governance theory in the field of public services

The integrated dynamic governance theory emphasizes systemness, dynamism, and collaborative governance. This study explores strategies for the management of vaccination outpatient clinics from macro, meso, and micro perspectives, proposing a 'multi-level, comprehensive' continuous quality improvement strategy. This strategy aligns with the core ideas of the Integrated Dynamic Governance theory, emphasizing the enhancement of service quality through multi-party collaboration and continuous dynamic improvement. It provides a new direction for the application and development of this theory in the field of public health.

8.4 Practical significance

8.4.1 Theoretical framework for clinic management

This research provides a structured application of quality management theory within the specific context of vaccination outpatient services. By devising a comprehensive index system that encompasses professional service management, dedicated personnel business management, social service management, and information management, the study offers a theoretical framework and an analytical tool for the practical application of quality management in vaccination clinics.

8.4.2 Tools for quality assessment

The quality monitoring and management index system developed in this study, known for its reliability, validity, and user-friendliness, serves as a standardized tool for assessing the quality of preventive vaccination outpatient services. This instrument assists managers in gaining a comprehensive understanding of the current service quality status and in accurately identifying management shortcomings and quality issues.

8.4.3 Strategies for continuous quality enhancement

In response to the key issues identified during the quality assessment phase, this study proposes a multi-tiered approach to continuous quality improvement. The intervention practices that have yielded positive outcomes include enhancing quality management training, refining management systems and processes, instituting performance evaluations and feedback mechanisms, optimizing the outpatient service environment, and bolstering health education and outreach initiatives. These strategies offer a reference for vaccination clinics aiming to implement ongoing quality improvements.

8.4.4 Informing decision-making in clinic management

By dissecting the current state, characteristics, and influencing factors of quality management in China’s vaccination outpatient services, this study presents targeted countermeasures and suggestions. These encompass organizational and managerial support, professional service management, personnel training and assessment, optimization of social services, application of information management, and quality monitoring and analysis. This input can assist vaccination outpatient managers in devising quality improvement measures and can guide health

administration departments in refining vaccination management policies.

8.4.5 Ensuring quality for sustainable immunization programs

Vaccination clinics are a pivotal entry point for the execution of immunization programs, and their service quality is directly linked to the success of vaccination efforts and the achievement of program goals. By focusing on elevating the quality management level of vaccination clinics through evaluation, intervention, and improvement measures, this study contributes to the advancement of standardized clinic development and robust quality control throughout the vaccination process. It offers a solid foundation for ensuring the sustainability and equilibrium of immunization programs, thereby supporting the long-term health and well-being of the population.

8.5 Social significance

8.5.1 Promote the improvement of public health service quality

Vaccination is one of the most important interventions in the field of public health, and the quality of its services directly affects the effectiveness of vaccination and the level of public health. This study, by constructing a scientific quality monitoring and management system and proposing operational improvement measures, helps to enhance the service level of vaccination outpatient clinics as a whole, thereby increasing vaccination coverage, reducing the burden of disease, and safeguarding public health.

8.5.2 Narrow the urban-rural gap in medical services

This study assessed the current state of service quality in vaccination outpatient clinics across eastern, central, and western regions, as well as urban and rural areas, revealing significant disparities between urban and rural services, and proposed targeted improvement strategies. These strategies help to enhance the service quality of vaccination outpatient clinics in less developed areas, narrow the urban-rural service gap, promote the balanced allocation of medical resources, and advance social equity.

8.5.3 Promote the implementation of the healthy China initiative

This study supports the effective implementation of the national immunization program and contributes to the achievement of the Healthy China Initiative's goals by standardizing and

enhancing the quality of vaccination services. By improving the coverage and quality of vaccination, this study has significant social benefits in terms of safeguarding the health of the entire population and reducing the risk of disease outbreaks.

8.6 Limitations of the study

While this study employs a scientific theoretical framework and research methodologies to conduct a systematic and in-depth examination of the quality monitoring and management of preventive vaccination outpatient clinics, yielding valuable findings, it is not without its limitations due to objective constraints. These are primarily evident in the following areas:

8.6.1 Enhancing the representativeness of research subjects

Although a multi-stage sampling approach was utilized, selecting 50 vaccination clinics across eastern, central, and western China, the vast number of clinics with varying management levels across different regions and types means that a comprehensive representation of all clinics is challenging. This may limit the generalizability of the research findings.

8.6.2 Refining the quality assessment index system

The quality monitoring and management index system developed in this study, while reliable and valid, requires further validation of the sensitivity and specificity of certain indices. This should be done within larger and more diverse samples to enhance the system's ability to accurately detect and warn of quality issues.

8.6.3 Evaluating the long-term impact of quality improvement measures

The study developed and implemented targeted measures for continuous quality improvement, achieving promising short-term results. However, the long-term sustainability of these improvements was not assessed due to research timeframe limitations, necessitating further research to determine the enduring effects of these interventions. Our three months intervention window, while showing initial positive outcomes, is insufficient to evaluate whether these changes become permanently integrated into organizational practice. Meaningful organizational changes typically require 12-18 months to become fully embedded in clinical workflows and institutional culture. Without follow-up measurements at 6, 12, and 24 months post-intervention, we cannot determine if the observed improvements represent temporary

responses or sustainable change that persists through staff turnover, leadership changes, and evolving regulatory requirements.

8.6.4 Broadening the dissemination and implementation of research outcomes

The strategies and recommendations for quality monitoring and management proposed in this study hold theoretical merit and practical instructional value. Yet, their efficacy in guiding the management practices of grassroots clinics depends on increased efforts to disseminate the findings, establish routine management systems, and ensure that the research outcomes are effectively translated into tangible improvements in the management of preventive vaccination outpatient services.

8.7 Future research directions

The domain of quality monitoring and management in vaccination clinics constitutes a sophisticated and multifaceted endeavor that necessitates ongoing theoretical exploration, empirical scrutiny, and practical application. While this study has ventured significant contributions, there are areas for future research to address its limitations and expand its scope:

8.7.1 Expanding research scope

Future research should broaden the spectrum of subjects under investigation, incorporating a more diverse array of vaccination clinics across various levels and types to bolster the representativeness of the research sample. It should also delve into the nuances of quality management across different operational models, unravel the dynamics of quality-influencing factors, and enrich the theoretical underpinnings of quality management research.

8.7.2 Advancing the index system

The quality management index system must evolve in tandem with contemporary trends and adapt to the shifting demands and characteristics of vaccination outpatient services. Subsequent studies should aim to institute a dynamic optimization mechanism for the index system, adjusting its components and weightings in response to changes in disease patterns, service expectations, and management focal points. Additionally, there should be an emphasis on refining the sensitivity and specificity of the index system to enhance its capacity for detecting and preempting key quality issues.

8.7.3 Sustaining quality improvement initiatives

Recognizing that continuous quality improvement is an enduring journey, it is essential to forge long-term mechanisms that drive managerial evolution and engender intrinsic motivation. Future work should concentrate on the durability of quality enhancement measures, investigate the development of motivational and regulatory frameworks for quality management, and intertwine quality advancement with performance metrics and resource distribution strategies. Furthermore, cost-benefit analyses should be conducted to balance the investment in quality management with the improvements gained.

8.7.4 Integrating information technology

Harnessing the potential of big data, artificial intelligence, and other information technologies can pave new avenues for innovation in vaccination clinic quality management. Future research should capitalize on these technological advancements to fortify the development of information systems for vaccine management, vaccination processes, and monitoring of adverse reactions, thereby augmenting the timeliness, precision, and comprehensiveness of data aggregation. Moreover, emphasis should be placed on data synthesis, mining, and analysis to offer insightful and intelligent support for quality assessments, performance evaluations, and strategic decision-making.

8.7.5 Multidisciplinary approach

Given the multidisciplinary nature of vaccination clinic quality management, which spans management, public health, epidemiology, statistics, psychology, and more, it is imperative to embrace a comprehensive multidisciplinary approach. Future studies should draw upon the sophisticated concepts and methodologies from fields such as management and psychology, examine quality management in vaccination outpatient clinics from a multifaceted vantage point, and engage in interdisciplinary research to steer the evolution of vaccination outpatient management towards a more scientific, refined, and humanized trajectory.

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Annex A: Expert Interview Outline

Position： Title： Age： Years of experience in immunology-related profession：

I. Project Introduction

1. Self-introduction, stating the purpose and significance of the interview.

2. Obtain the interviewee's consent, explaining that the interview will be strictly confidential.

3. Indicate the approximate duration of the interview and inquire if it is convenient for the interviewee.

II. Interview Questions

1. Content of the Quality of Service in Vaccination Clinics

(1) What aspects do you think should be included in the quality of service at vaccination clinics?

(2) Among these aspects you mentioned, which do you think are the most important? Why?

2. Factors Affecting the Quality of Service in Vaccination Clinics

(1) In terms of personnel, what factors do you think can affect the quality of service at vaccination clinics?

(2) Regarding materials, what factors do you believe have a significant impact on the quality of service at vaccination clinics?

(3) What issues do you think currently exist in the management of vaccination clinics that affect the quality of service?

(4) In terms of service, which factors do you feel can impact the quality of service at vaccination clinics?

(5) What characteristics of the service recipients do you think can affect the quality of service at vaccination clinics?

3. Measures to Strengthen the Monitoring and Management of Vaccination Clinic Quality

(1) Under the current conditions, what measures do you think can be taken to enhance the

monitoring of the quality of vaccination clinics?

(2) Regarding the quality management of vaccination clinics, what suggestions and ideas do you have?

4. Improving the Quality Assessment Indicator System for Vaccination Clinics

(1) In terms of constructing a quality assessment indicator system for vaccination clinics, what principles do you think should be followed?

(2) When designing quality assessment indicators, what issues do you think need to be paid attention to?

(3) Do you have any specific suggestions for improving the existing quality assessment indicator system for vaccination clinics?

5. Main Content of Vaccination Clinic Work

(1) Please rank the following tasks according to their importance and explain the reasons:

A. Parent education sessions B. Vaccine appointment scheduling C. Informed consent D. Safe vaccination E. Management of age-appropriate children in the jurisdiction F. Information technology infrastructure G. Vaccine storage and distribution H. Others (please specify)

(2) Besides the above content, what other elements do you think should be included in the work of vaccination clinics?

6. Additional Comments

(1) Do you have any other suggestions or ideas to improve the quality of service at vaccination clinics?

III. Closing Remarks

1. Express gratitude to the interviewee for their sharing.

2. Ask the interviewee if they have any additional comments or supplements.

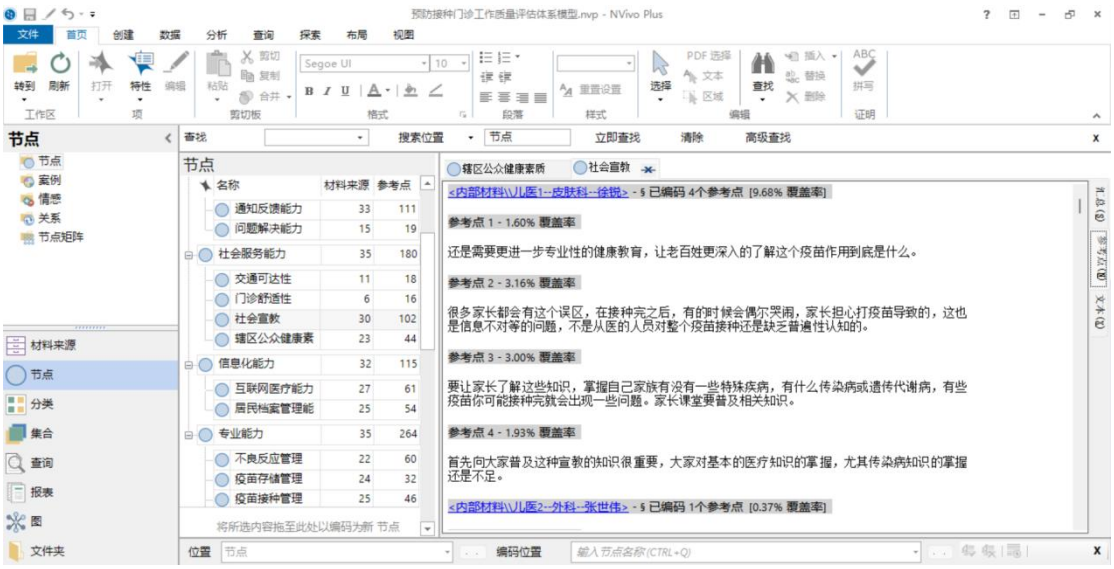
3. Reiterate the confidentiality of the information and inquire about the possibility of conducting future interviews.

Annex B: Basic Information of Respondents

ID	Name	Age	Educational Background	Professional Role	Interview Type
A01	Mr. Xu	40	Master's Degree	Dermatologist at a City's Children's Hospital	In-Person In-Depth Interview
A02	Mr. Zhang	53	Doctorate	Deputy Director at a Provincial Children's Hospital	In-Person In-Depth Interview
A03	Ms. Wan	51	Master's Degree	Pediatrician at a City's Children's Hospital	In-Person In-Depth Interview
A04	Ms. Li	42	Master's Degree	Head of the Pediatrics Department at a City's Children's Hospital	In-Person In-Depth Interview
A05	Ms. Li	32	Master's Degree	Parent of School-Age Children in a Community	In-Person In-Depth Interview
A06	Ms. Wang	29	Bachelor's Degree	City Library Administrator	In-Person In-Depth Interview
A07	Ms. Lai	35	Bachelor's Degree	Deputy Researcher for Immunization Planning at a National Center	In-Person In-Depth Interview
A08	Ms. Wu	32	Bachelor's Degree	Leader of Immunization Planning Team at a Provincial CDC	In-Person In-Depth Interview
A09	Ms. Zhang	34	Master's Degree	Health Supervisor at a Provincial Health Supervision Office	In-Person In-Depth Interview
A10	Ms. Hong	33	Bachelor's Degree	Community Health Physician	In-Person In-Depth Interview
A11	Ms. Qu	44	Bachelor's Degree	Chief Nurse at a Community Health Center	In-Person In-Depth Interview
A12	Ms. Zhu	43	Bachelor's Degree	Chief Nurse at a Community Health Center	In-Person In-Depth Interview
A13	Mr. Liu	27	Master's Degree	Community Health Physician	In-Person In-Depth Interview
A14	Mr. Wu	47	Master's Degree	Director of Immunization Planning at a City CDC	In-Person In-Depth Interview
A15	Mr. Wang	50	Doctorate	Professor of Public Health at a University	In-Person In-Depth Interview
A16	Ms. Yu	37	Bachelor's Degree	Deputy Director of Disease Control at a City Health Commission	In-Person In-Depth Interview
A17	Ms. Wang	32	Bachelor's Degree	Nurse for Pre-Screening and Vaccination at a Community Health Center	In-Person In-Depth Interview
A18	Ms. Mao	55	Bachelor's Degree	Vaccine Scheduling Specialist at a Community Health Center	In-Person In-Depth Interview
A19	Ms. Zhang	32	Bachelor's Degree	Staff Member at a Provincial Center for Monitoring Adverse Drug Reactions	In-Person In-Depth Interview
A20	Ms. Zhou	23	Bachelor's Degree	Nurse for Vaccination at a Community Health Center	In-Person In-Depth Interview
A21	Ms. Ma	33	Secondary Vocational Education	Community Member in a City	In-Person In-Depth Interview

A22	Ms. Zhuang	35	Junior College	Community Member in a City	In-Person In-Depth Interview
A23	Ms. Song	45	Bachelor's Degree	Deputy Director of Disease Control at a City Health Commission	In-Person In-Depth Interview
A24	Ms. Jiang	52	Secondary Vocational Education	Nurse for Vaccination at a Community Health Center	In-Person In-Depth Interview
A25	Ms. Shi	59	Secondary Vocational Education	Nurse for Vaccination at a Community Health Center	In-Person In-Depth Interview
A26	Ms. Liu	59	Secondary Vocational Education	Expert in Immunization Planning at a City CDC	In-Person In-Depth Interview
A27	Ms. Yu	22	Bachelor's Degree	Nurse at a Community Health Center	In-Person In-Depth Interview
A28	Ms. Wen	40	Bachelor's Degree	Community Member in a City	In-Person In-Depth Interview
A29	Ms. Wei	32	Junior College	Community Member in a City	In-Person In-Depth Interview
A30	Ms. Li	43	Bachelor's Degree	Nurse at a Community Health Center	In-Person In-Depth Interview
A31	Ms. Gao	36	Bachelor's Degree	Nurse at a Community Health Center	In-Person In-Depth Interview
A32	Ms. Yang	30	Junior College	Nurse at a Community Health Center	In-Person In-Depth Interview
A33	Ms. Niu	56	Secondary Vocational Education	Nurse at a Community Health Center	In-Person In-Depth Interview
A34	Ms. Li	35	Bachelor's Degree	Community Member in a City	In-Person In-Depth Interview
A35	Ms. Wang	31	Junior College	Community Member in a City	In-Person In-Depth Interview

Annex C: Some Free-floating Nodes Generated Through Open Coding in Nvivo12



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Annex D: "Research on the Construction of the Quality Assessment System for Vaccination Clinic Work" Consultation Invitation Letter

Dear Expert,

Greetings! First and foremost, we would like to express our gratitude for taking the time out of your busy schedule to review our questionnaire.

We are the research team from Harbin Traditional Chinese Medicine Hospital working on the project titled "Research on the Construction of the Quality Assessment System for Vaccination Clinic Work." Recognizing your authority in health management and immunization planning, we cordially invite you to provide consultation on the "Quality Assessment System for Vaccination Clinic Work" that we have designed. We hope to receive your generous guidance and valuable opinions to help us refine the indicator system. Please feel free to contact us at any time with your precious questions and suggestions. Thank you for your cooperation and support!

Due to the tight schedule, we kindly request that you complete and return this questionnaire by email no later than **March 10th**: E-mail: 13091433000@126.com

Contact numbers: Li Xikun: 13091433000
Zhang Yan: 13510829827

We sincerely appreciate your strong support and guidance!

Southern Medical University School of Health Management "Research on the Construction of the Quality Assessment System for Vaccination Clinic Work" Research Group
Leaders: Zhang Yan, Li Xikun

March 5, 2024

"Research on the Construction of the Quality Assessment System for Vaccination Clinic Work" Expert Consultation Questionnaire (First Round)

I. Framework for the Quality Assessment System of Vaccination Clinic Work

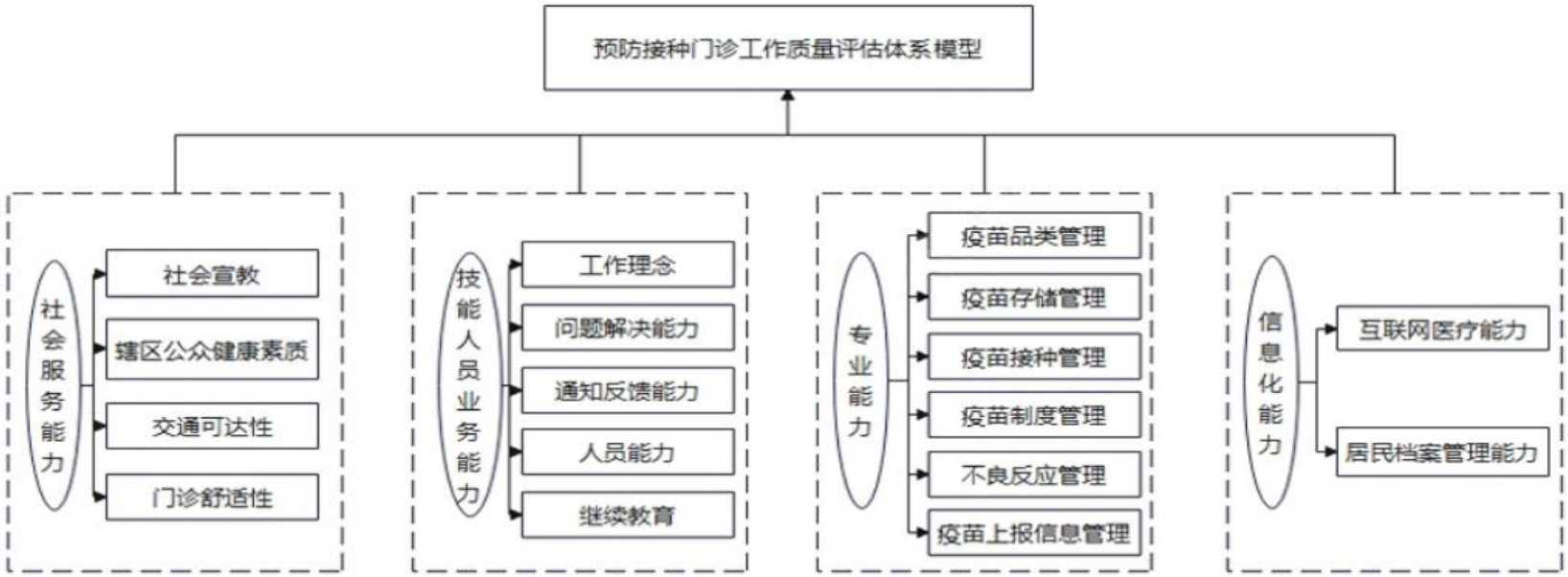
This consultation is for the selection of indicators, and the setting of weights is not considered at this stage. Please, based on your professional knowledge, work experience, and understanding of public health science and technology projects, provide your evaluations and suggestions regarding the structure of the indicator system and each candidate indicator. The indicator system in this consultation questionnaire consists of 4 first-level indicators and 17 second-level indicators.

Scoring Principles: Please assign a score from 0 to 10 for each indicator, with higher scores representing greater importance of the indicator within the indicator system.

Importance: The selected indicators are widely recognized as important and practical, reflecting a certain aspect of the situation.

Sensitivity: The selected indicators are sensitive and have good discrimination, capable of quickly identifying changes in the level of things.

Availability: The selected indicators are easily obtainable and can make as much use as possible of routine registration reports.



II. Expert Consultation Questionnaire

Level 1 Indicator	Importance	Serial Number	Level 2 Indicator	Inclusion (1 for Yes, 2 for No)	Importance	Sensitivity	Availability	Serial Number	Level 3 Indicator	Indicator Content and Definition	Inclusion (1 for Yes, 2 for No)	Importance	Sensitivity	Availability
A1 Professional Basic Competence		B1	Vaccination Management	1	10	8	9	C1	Physical Examination and Diagnosis		1	9	8	9
								C2	Preliminary Pre-		1	9	8	9

									Examination					
								C3	Standardized Operation		1	10	10	9
								C4	Observation and waiting		1	9	9	9
		B2	Vaccine Storage Management	1	10	9	9	C5	Vaccine Storage		1	10	10	9
								C6	Vaccine Distribution		1	9	8	8
								C7	Inventory Management		1	8	8	9
								C8	Operation Records		1	8	9	9
								C9	Cold Chain Maintenance		1	7	8	9
								C10	Temperature Recording		1	10	10	10
		B3	Vaccine Category Management	1	9	8	9	C11	Prominent Vaccine Names		1	9	9	10
								C12	Comprehensive Vaccine Types		1	8	8	9
								C13	Accurate Vaccine Batch Numbers		1	10	10	10
								C14	Safe Vaccine Sources		1	10	10	10
								C15	Reasonable Vaccine		1	10	9	9

									Pricing					
								C16	Diverse Vaccine Options		1	8	8	9
		B 4	Vaccine System Management	1	8	8	8	C17	Biologics Management System		1	9	9	8
								C18	Cold Storage Management System		1	9	9	8
								C19	Vaccine Transportation System		1	9	9	8
		B5	Adverse Reaction Management	1	10	10	8	C20	Adverse Reaction Notification		1	10	9	9
								C21	Guidance on Relief Methods		1	8	8	9
								C22	Adverse Reaction Record		1	10	9	9
		B6	Vaccine Reporting Information Management	1	10	9	9	C23	Quality Management		1	10	10	10
								C24	Quality Index		2			
								C25	Completeness of Reports		1	9	8	9
								C26	Timeliness of Reporting		1	10	8	8
								C27	Omission		1	8	8	9

									Rate					
								C28	Wastage Rate		1	10	8	8
								C29	Validation Index		2			
								C30	Reliability Coefficient		2			
Indicators to be Added and Suggestions														
A2 Staff Professional Competence		B7	Personnel Capability	1	10	8	8	C31	Proportion of Staff with Bachelor's Degree or Above		1	8	8	9
								C32	Average Years of Work Experience		1	8	8	9
								C33	Engagement in Scientific Research		2			
		B8	Continuing Education	1	8	8	8	C34	Number of Continuing Education Courses		1	8	8	9
		B9	Work Philosophy	1	8	9	8	C35	Rigorousness of Work Style		1	10	8	8
								C36	Reasonableness of Work Procedures		1	8	7	7
								C37	Efficiency of Work		1	8	7	8

									Execution					
								C38	Flexibility in Work Scheduling		1	8	7	7
		B10	Problem-Solving Ability	1	9	8	8	C39	Dedicated Personnel for Problem Handling		1	8	8	7
								C40	Speed of Problem Judgment		1	7	7	8
								C41	Problem Consultation and Answering		1	10	7	7
								C42	Frequency of Problem Occurrence		1	7	8	8
								C43	Timeliness of Guidance on Problems		1	9	7	8
		B11	Notification and Feedback Ability	1	8	7	8	C44	Advance Notification		1	10	9	9
								C45	Comprehensive Notification		1	10	8	9
								C46	Full Disclosure		1	10	8	9
								C47	Substantive Notification		1	10	8	8
								C48	Advance Notification Letter		1	10	9	10
Indicators to be Added and														

Suggestions													
A3 Social Service Capability		B12	Social Education	1	10	8	8	C49	Parent Workshops		1	9	8	8
								C50	Community Lectures		1	9	8	7
								C51	Knowledge Popularization		1	10	8	8
								C52	Efficacy Promotion		1	9	7	7
		B13	Public Health Literacy	1	9	8	7	C53	Resident Health Literacy		1	9	8	7
								C54	Proactive Appointments		1	9	8	8
		B14	Transport Accessibility	1				C55	Transport Convenience		1	9	7	7
								C56	Driving Duration		1	8	7	7
								C57	Transport Distance		1	8	7	8
		B15	Outpatient Comfort	1				C58	Consultation Room Comfort		1	10	7	8
								C59	Observation Room Comfort		1	9	7	8
								C60	Pre-Examination and Triage Room Comfort		1	9	7	8
Indicators to be Added and														

Suggestions													
A4 Information Technology Capability		B16	Internet Medical Capability	1	10	9	9	C61	Online Appointment Time		1	10	8	9
								C62	Online Appointment Difficulty		1	9	7	8
								C63	Online Appointment Convenience		1	9	8	8
								C64	Online Appointment Channels		1	10	8	8
								C65	Online Appointment Accuracy		1	9	8	7
		B 17	Record Management Capability	1	10	8	8	C66	Management Capacity for Vulnerable Groups in the Jurisdiction		1	8	7	7
								C67	Management Capacity for Children of School Age in the Jurisdiction		1	9	7	8
Indicators to be Added and Suggestions			Recommendations for Additions: 1. Staff Turnover Frequency; 2. Vaccination Clinic Service Cycle; 3. Birth Rate in the Jurisdiction.											

III. Basic Information of Experts

Gender	□Male
Age (in years)	44
Work Unit	Heilongjiang Provincial Center for Disease Control and Prevention
Professional Title	□Associate senior
Position	Deputy director
Professional Background	Immunization planning
Years of Experience in Your Field	20
Your Familiarity with the Content of This Consultation	□Very familiar
Your Basis for Judgment	□Practical experience □Literature data

Thank you for your support to our research group. Please leave your contact information for the second round of expert consultation, during which the questionnaire will be sent to your email in the form of an electronic message. Upon completion of the entire expert consultation process, we will offer you a certain remuneration based on the consultation you have provided.

Expert Signature: Gao Shirui
Contact Number：13796038123
Email：748345@qq.com

Thank you again for your support! Wishing you good health!

Annex E: Profiles of Experts

ID	Gender	Age	Professional Title	Job Title	Field of Expertise	Experience (Years)
1	Female	60	Senior Professional	Head, Immunization Planning Division, Provincial CDC	Immunization Planning	40
2	Male	43	Senior Professional	Researcher, Immunization Planning Center, National CDC	Public Health	20
3	Female	42	Associate Senior Professional	Chief, Preventive Health Care Department, Provincial First-Class Hospital	Clinical Medicine	19
4	Male	50	Senior Professional	Head, Immunization Planning Division, Provincial CDC	Preventive Medicine	27
5	Female	46	Associate Senior Professional	Chief, Preventive Nursing Department, Provincial First-Class Hospital	Nursing	23
6	Female	55	Associate Senior Professional	Deputy Head, Immunization Planning Division, Provincial CDC	Immunization Planning	32
7	Male	34	Senior Professional	Researcher, Immunization Planning Center, National CDC	Preventive Medicine	11
8	Female	38	Associate Senior Professional	Head, Immunization Planning Division, Municipal CDC	Public Health	15
9	Female	50	Associate Senior Professional	Deputy Head, Immunization Planning Division, Provincial CDC	Immunization Planning	27
10	Female	33	Associate Senior Professional	Deputy Researcher, Immunization Planning Center, National CDC	Preventive Medicine	10
11	Female	48	Associate Senior Professional	Chief, Preventive Health Care Department, Provincial First-Class Hospital	Clinical Medicine	25
12	Male	38	Associate Senior Professional	Head, Immunization Planning Division, Municipal CDC	Immunization Planning	15
13	Female	55	Associate Senior Professional	Chief, Preventive Nursing Department, Provincial First-Class Hospital	Nursing	32
14	Male	34	Associate Senior Professional	Head, Immunization Planning Division, Municipal CDC	Preventive Medicine	11
15	Female	42	Associate Senior Professional	Chief, Preventive Health Care Department, Provincial First-Class Hospital	Clinical Medicine	19

16	Female	53	Associate Senior Professional	Deputy Head, Immunization Planning Division, Municipal CDC	Preventive Medicine	31
17	Female	33	Associate Senior Professional	Chief, Preventive Health Care Department, Provincial First-Class Hospital	Clinical Medicine	10
18	Female	37	Associate Senior Professional	Chief, Preventive Health Care Department, Municipal First-Class Hospital	Clinical Medicine	14
19	Female	36	Associate Senior Professional	Deputy Head, Immunization Planning Division, Municipal CDC	Preventive Medicine	13
20	Male	34	Associate Senior Professional	Deputy Head, Immunization Planning Division, Provincial CDC	Immunization Planning	11

Annex F: Indicator Familiarity Scoring (ca)

Level of Familiarity with Indicators (Ca) Score	Score
Very familiar	1
Familiar	0.8
Moderate	0.6
Relatively unfamiliar	0.4
Very unfamiliar	0.2

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Annex G: Scoring for Basis of Indicator Judgment

Basis of Judgment (Cs)	Impact level	Score
Practical Experience	High	0.5
	Medium	0.4
	Low	0.3
Theoretical Analysis	High	0.3
	Medium	0.2
	Low	0.1
Understanding of Peers Domestic and International	High	0.1
	Medium	0.1
	Low	0.1
Personal Intuition	High	0.1
	Medium	0.1
	Low	0.1

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Annex H: Expert Authority Coefficient Status

Round	Familiarity	Judgment degree	Authority coefficient
1st	Mean	0.890	0.908
	Standard Deviation	0.152	0.129
2nd	Mean	0.920	0.933
	Standard Deviation	0.136	0.115

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Annex I: Criteria for Scoring the Importance of Indicators

Evaluation Item	Level	Score
Importance	Very Important	5
	Quite Important	4
	Moderate	3
	Less Important	2
	Very Unimportant	1

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Annex J: Degree of Concentration of Expert Opinion in the First Round - Tertiary Indicators

Primary Indicator	No.	Secondary Indicator	No.	Tertiary Indicator	Importance			Sensitivity			Accessibility		
					Mean	Standard Deviation	Coefficient of Variation (CV)	Mean	Standard Deviation	Coefficient of Variation (CV)	Mean	Standard Deviation	Coefficient of Variation (CV)
A1 Professional Service Management	B1	Vaccination Management	C1	Physical Examination and Diagnosis	4.725	0.658	0.139	4.625	0.666	0.144	4.525	0.734	0.162
			C2	Preliminary Pre-screening	4.875	0.275	0.056	4.750	0.618	0.130	4.750	0.444	0.094
			C3	Standardized Operation	4.900	0.308	0.063	4.825	0.373	0.077	4.800	0.377	0.079
			C4	Observation and waiting	4.650	0.709	0.152	4.550	0.759	0.167	4.650	0.516	0.111
			C5	Vaccine Storage	4.775	0.595	0.125	4.825	0.373	0.077	4.775	0.413	0.086
	B2	Vaccine Storage Management	C6	Vaccine Distribution	4.775	0.413	0.086	4.625	0.559	0.121	4.625	0.510	0.110
			C7	Inventory Accounting	4.775	0.472	0.099	4.675	0.545	0.117	4.775	0.343	0.072
			C8	Operation Records	4.750	0.473	0.100	4.800	0.377	0.079	4.800	0.377	0.079
			C9	Cold Chain Maintenance	4.725	0.525	0.111	4.650	0.671	0.144	4.600	0.718	0.156
			C10	Temperature Recording	4.825	0.373	0.077	4.775	0.444	0.093	4.725	0.573	0.121
	B3	Vacci	C1	Prominent	4.750	0.444	0.094	4.600	0.661	0.144	4.675	0.467	0.100

	ne Category Management	1	Vaccine Naming									
		C12	Complete Range of Vaccines	4.625	0.604	0.131	4.675	0.467	0.100	4.600	0.447	0.097
		C13	Accurate Vaccine Batch Numbers	4.875	0.393	0.081	4.700	0.594	0.126	4.700	0.548	0.117
		C14	Safe Vaccine Sourcing	4.850	0.401	0.083	4.800	0.410	0.085	4.725	0.638	0.135
		C15	Reasonable Vaccine Pricing	4.750	0.444	0.094	4.525	0.752	0.166	4.625	0.646	0.140
		C16	Diverse Vaccine Options	4.575	0.674	0.147	4.550	0.776	0.171	4.575	0.634	0.139
	Vaccine	C17	Biological Product Management System	4.825	0.373	0.077	4.650	0.630	0.136	4.625	0.686	0.148
B4	System Management	C18	Cold Storage Management System	4.775	0.444	0.093	4.625	0.723	0.156	4.675	0.568	0.122
		C19	Vaccine Transportation System	4.775	0.413	0.086	4.775	0.444	0.093	4.650	0.671	0.144
	Adverse	C20	Adverse Reaction Notification	4.775	0.472	0.099	4.625	0.604	0.131	4.775	0.499	0.105
B5	Reaction Management	C21	Guidance on Alleviation Methods	4.650	0.671	0.144	4.525	0.658	0.146	4.675	0.494	0.106
		C22	Adverse Reaction Recording	4.700	0.677	0.144	4.650	0.587	0.126	4.675	0.591	0.126

			C23	Quality Management	4.725	0.617	0.131	4.700	0.637	0.135	4.625	0.723	0.156
			C24	Quality Index	4.675	0.634	0.136	4.575	0.730	0.160	4.600	0.620	0.135
		Vaccine Reporting Information Management	C25	Completeness of Reporting	4.825	0.494	0.102	4.750	0.500	0.105	4.575	0.748	0.164
	B6		C26	Timeliness of Reporting	4.775	0.617	0.129	4.675	0.634	0.136	4.550	0.809	0.178
			C27	Omission Rate	4.650	0.587	0.126	4.375	0.776	0.177	4.275	0.819	0.192
			C28	Loss Rate	4.525	0.752	0.166	4.350	0.763	0.175	4.300	0.801	0.186
			C29	Verification Index	4.675	0.520	0.111	4.400	0.821	0.187	4.350	0.780	0.179
			C30	Reliability Coefficient	4.650	0.540	0.116	4.350	0.727	0.167	4.425	0.613	0.139
A2 Full-time Staff Business Management	B7	Staff Capacity	C31	Proportion with Bachelor's Degree or Above	3.800	1.018	0.268	3.850	0.975	0.253	4.275	0.910	0.213
			C32	Average Years of Work Experience	4.325	0.799	0.185	4.250	0.819	0.193	4.400	0.771	0.175
			C33	Engagement in Scientific Research	4.050	1.134	0.280	4.050	1.169	0.289	4.125	1.122	0.272
	B8	Continuing Education	C34	Continuing Education Frequency	4.550	0.583	0.128	4.475	0.595	0.133	4.450	0.724	0.163
	B9	Work Philosophy	C35	Rigor in Work Style	4.775	0.413	0.086	4.675	0.467	0.100	4.600	0.641	0.139
			C36	Rationality of Work	4.775	0.413	0.086	4.675	0.406	0.087	4.700	0.410	0.087

			C37	Procedures Efficiency in Work Execution	4.725	0.444	0.094	4.675	0.467	0.100	4.700	0.410	0.087
			C38	Flexibility in Work Scheduling	4.475	0.786	0.176	4.450	0.776	0.174	4.425	0.783	0.177
			C39	Dedicated Problem Handling	4.750	0.500	0.105	4.425	0.816	0.184	4.375	0.825	0.189
		Problem-Solving Ability	C40	Speed of Problem Judgment	4.650	0.609	0.131	4.600	0.447	0.097	4.625	0.393	0.085
	B10		C41	Problem Consultation and Answering	4.650	0.564	0.121	4.600	0.476	0.103	4.600	0.503	0.109
			C42	Frequency of Problem Occurrence	4.525	0.678	0.150	4.475	0.658	0.147	4.500	0.669	0.149
			C43	Timely Guidance on Problems	4.800	0.377	0.079	4.750	0.344	0.072	4.650	0.462	0.099
			C44	Advance Notification	4.725	0.444	0.094	4.700	0.441	0.094	4.725	0.444	0.094
		Notification and Feedback Ability	C45	Comprehensive Notification	4.800	0.410	0.085	4.525	0.803	0.177	4.550	0.667	0.147
	B11		C46	Adequate Notification	4.800	0.410	0.085	4.475	0.786	0.176	4.525	0.658	0.146
			C47	Substantial Notification	4.800	0.410	0.085	4.500	0.795	0.177	4.475	0.786	0.176
			C48	Pre-knowledge Notification Letter	4.775	0.595	0.125	4.725	0.595	0.126	4.600	0.771	0.168
A3 Social	B12	Social Educa	C49	Parent Workshop	4.675	0.634	0.136	4.550	0.626	0.138	4.575	0.613	0.134

Service Management		tion	C50	Community Lecture	4.400	0.788	0.179	4.275	0.835	0.195	4.325	0.799	0.185
			C51	Knowledge Popularization	4.400	0.718	0.163	4.250	0.819	0.193	4.300	0.818	0.190
			C52	Efficacy Promotion	4.400	0.598	0.136	4.325	0.654	0.151	4.425	0.634	0.143
	B13	Public Health Literacy	C53	Resident Health Literacy	4.325	0.730	0.169	4.325	0.712	0.165	4.375	0.646	0.148
			C54	Proactive Appointment Scheduling	4.450	0.686	0.154	4.400	0.700	0.159	4.450	0.647	0.145
	B14	Accessibility of Transportation	C55	Traffic Convenience	4.400	0.700	0.159	4.250	0.698	0.164	4.250	0.734	0.173
			C56	Driving Duration	4.375	0.723	0.165	4.350	0.709	0.163	4.325	0.693	0.160
			C57	Travel Distance	4.350	0.727	0.167	4.325	0.654	0.151	4.300	0.637	0.148
			C58	Comfort of the Reception Room	4.425	0.766	0.173	4.375	0.759	0.173	4.350	0.780	0.179
	B15	Outpatient Comfort	C59	Comfort of the Observation Room	4.525	0.638	0.141	4.475	0.550	0.123	4.450	0.583	0.131
			C60	Comfort of the Pre-examination Room	4.500	0.649	0.144	4.450	0.705	0.158	4.275	0.769	0.180
A4 Information Management	B16	Internet Medical Capability	C61	Online Appointment Time	4.625	0.646	0.140	4.425	0.654	0.148	4.325	0.847	0.196
			C62	Difficulty of Online Appointment	4.225	0.924	0.219	4.250	0.786	0.185	4.250	0.851	0.200
			C6	Convenience	4.600	0.700	0.152	4.300	0.909	0.211	4.450	0.759	0.171

		3	of Online Appointment									
		C64	Online Appointment Channels	4.575	0.730	0.160	4.525	0.697	0.154	4.475	0.752	0.168
		C65	Accuracy Rate of Online Appointments	4.475	0.678	0.152	4.350	0.796	0.183	4.450	0.667	0.150
		C66	Management Capability for Vulnerable Groups within the Jurisdiction	4.475	0.786	0.176	4.375	0.759	0.173	4.375	0.705	0.161
B17	Record Management Capability	C67	Management Capability for Eligible Children within the Jurisdiction	4.625	0.646	0.140	4.450	0.841	0.189	4.450	0.724	0.163

Annex K: Importance Evaluation Scale (Saaty 1-9 Scale)

Comparison score	Level of importance	Explanation
l	Equally Important	The two indicators are of equal importance to the goal.
3	Moderately Important	The indicator on the left is slightly more favorable than the one on top.
5	Clearly Important	The indicator on the left is significantly more favorable than the one on top.
7	Strongly Important	The indicator on the left is strongly more favorable than the one on top and has been demonstrated in practice.
9	Extremely Important	The importance level is evident.
2，4，6，8	Intermediate Values	Intermediate values between two adjacent levels of importance, used when a compromise is needed.

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Annex L: Judgment Matrix

Table L.1 First-Level Indicator Judgment Matrix

A	A1	A2	A3	A4	V_j	W_i
A1	1	2	2	2	1.750	0.394
A2	1/2	1	1	2	1.125	0.239
A3	1/2	1	1	1	0.875	0.197
A4	1/2	1/2	1	1	0.750	0.169

Table L.2 A1 Professional Service Management - Second-Level Indicator Judgment Matrix

A1	B1	B2	B3	B4	B5	B6	V_j	W_i
B1	1	1	2	2	1	1/2	1.250	0.177
B2	1	1	1	2	3	2	1.667	0.245
B3	1/2	1	1	1	1	1/2	0.833	0.126
B4	1/2	1/2	1	1	1	1/3	0.722	0.101
B5	1	1/3	1	1	1	1/2	0.805	0.114
B6	2	1/2	2	3	2	1	1.750	0.238

Table L.3 A2 Full-time Staff Business Management - Second-Level Indicator Judgment Matrix

A2	B7	B8	B9	B10	V_j	W_i
B7	1	1	2	1	1.250	0.285
B8	1	1	1	1/3	0.833	0.184
B9	1/2	1	1	1/2	0.750	0.163
B10	1	3	2	1	1.750	0.368

Table L.4 A3 Social Service Capability - Second-Level Indicator Judgment Matrix

A3	B11	B12	B13	V_j	W_i
B11	1	1/3	2	1.110	0.288
B12	3	1	1	1.667	0.449
B13	1/2	1	1	0.833	0.263

Table L.5 A4 Information Management - Second-Level Indicator Judgment Matrix

A3	B14	B15	V_j	W_i
B14	1	1	1.000	0.500
B15	1	1	1.000	0.500

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Annex M: Vaccination Outpatient Clinic Quality Monitoring and Management Survey Questionnaire

Dear person in charge of the vaccination outpatient clinic,

Hello! We are conducting a study on the quality monitoring and management of vaccination outpatient clinics, aimed at assessing the current state of service management and providing a basis for the continuous improvement of service quality. Thank you for taking the valuable time to complete this questionnaire; your opinions are very important to us. We promise to strictly protect your personal information, and the survey results will only be used for scientific research analysis.

I. Basic Information

1. Name of the vaccination outpatient clinic: _____

2. Level of the vaccination outpatient clinic: □ County Level □ City Level □ Provincial Level

3. Annual number of services provided by the vaccination outpatient clinic: _____

4. Number of full-time vaccination staff at the vaccination outpatient clinic: _____

5. Location: _____ Province _____ City _____ District

II. Assessment of Quality Monitoring and Management in Vaccination Outpatient Clinics (Score from 0 to 10, with higher scores indicating better quality)

First-Level Indicator	Sequence Number	Second-Level Indicator	Score	Sequence Number	Third-Level Indicator	Score
A1 Professional Service Management	B1	Vaccination Management		C1	Physical Examination and Diagnosis	
				C2	Preliminary Pre-Examination	
				C3	Standardized Operation	
				C4	Observation and waiting	
	B2	Vaccine Storage Management		C5	Vaccine Storage	
				C6	Vaccine Distribution	
				C7	Inventory Management	
				C8	Operation Records	
				C9	Cold Chain Maintenance	
				C10	Temperature Recording	
	B3	Vaccine Category Management		C11	Vaccine Names Prominent	
				C12	Comprehensive Range of Vaccines	
				C13	Accurate Vaccine Batch Numbers	
				C14	Safe Vaccine Sourcing	
				C15	Reasonable Vaccine Pricing	
				C16	Diverse Vaccine Options	

	B4	Vaccine System Management	C17	Biological Products Management System
			C18	Cold Storage Management System
			C19	Vaccine Transportation System
	B5	Adverse Reaction Management	C20	Adverse Reaction Notification
			C21	Guidance on Alleviation Methods
			C22	Adverse Reaction Record Keeping
	B6	Vaccine Reporting Information Management	C23	Quality Management
			C24	Quality Index
			C25	Completeness of Reports
			C26	Timeliness of Reporting
			C27	Omission Rate
			C28	Wastage Rate
			C29	Validation Index
			C30	Reliability Coefficient
A2 Full-Time Staff Business Management	B7	Continuing Education	C31	Continuing Education Sessions
	B8	Work Philosophy	C32	Rigorous Work Style
			C33	Reasonable Work Procedures
			C34	Efficient Work Execution
			C35	Flexible Work Scheduling
	B9	Problem-Solving Ability	C36	Dedicated Problem Handling
			C37	Speed of Problem Assessment
			C38	Consultation and Problem Resolution
			C39	Frequency of Problem Occurrence
			C40	Timely Guidance on Problems
	B10	Notification and Feedback Ability	C41	Advance Notification
			C42	Comprehensive Notification
			C43	Adequate Notification
			C44	Substantive Notification
			C45	Pre-informed Consent Form
A3 Social Service Management	B11	Social Education	C46	Parent Workshops
			C47	Community Lectures
			C48	Knowledge Popularization
	B12	Public Health Literacy	C49	Efficacy Promotion
			C50	Resident Health Literacy
			C51	Proactive Appointment Scheduling
	B13	Transport Accessibility	C52	Transportation Convenience
			C53	Driving Time
			C54	Travel Distance
A4 Information Management	B14	Internet Medical Capability	C55	Online Appointment Time
			C56	Difficulty of Online Scheduling
			C57	Convenience of Online Scheduling
			C58	Online Scheduling Channels
			C59	Accuracy of Online Scheduling
	B15	Record Management Ability	C60	Management Capacity for Vulnerable Groups in the Jurisdiction
			C61	Management Capacity for Age-Appropriate Children in the Jurisdiction

III. Service Quality

6. Vaccination rate for children of age-appropriate age in the jurisdiction: _____%

7. Vaccination rate for people over 60 years old in the jurisdiction: _____%

8. Incidence rate of suspected adverse reactions to vaccination: __‰

9. Complaint rate from service recipients: __%

10. Satisfaction rate of service recipients: ____%

Thank you for your cooperation and support! We wish you success in your work and happiness in your life!

Survey Unit: _____

Contact Person: _____

Contact Number: _____

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Annex N: Harbin Traditional Chinese Medicine Hospital Ethics Committee Review and Approval Document

哈尔滨市中医医院伦理委员会审查审批件

编号：HRBTCMH20231011

<table>
<tr><td>项目名称</td><td colspan="5">预防接种门诊质量检测管理指标体系的应用与评价研究</td></tr>
<tr><td>申办者</td><td colspan="3">李玺琨</td><td>项目负责人</td><td>李玺琨</td></tr>
<tr><td>审查类别</td><td colspan="5">会议审查</td></tr>
<tr><td rowspan="4">表决结果</td><td>委员人数</td><td>出席人数</td><td>回避人数</td><td colspan="2">弃权人数</td></tr>
<tr><td>12</td><td>8</td><td>0</td><td colspan="2">0</td></tr>
<tr><td>同意</td><td>作必要的修正后同意</td><td>作必要的修正后重审</td><td>不同意</td><td>终止或暂停先前批准的实验</td></tr>
<tr><td>8</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>结论</td><td colspan="5">同意</td></tr>
<tr><td>审查意见</td><td colspan="5">同意</td></tr>
<tr><td colspan="6">结合此前对该临床研究的伦理审查意见，现已对申办方提交的材料进行备案，同意批准“预防接种门诊质量检测管理指标体系的应用与评价研究”项目的实施。</td></tr>
<tr><td colspan="6">伦理委员会主任委员签字：李玺琨 日期：2023.10.11
哈尔滨市中医医院伦理委员会（盖章）</td></tr>
<tr><td colspan="6">备注：</td></tr>
</table>

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Annex O: Informed Consent Form

Research Title: Application and evaluation of quality monitoring and management indicator system in vaccination outpatient clinics

Dear person in charge of the vaccination outpatient clinic,

Greetings! We are a research team from Harbin Traditional Chinese Medicine Hospital, currently conducting a study on the quality monitoring and management of vaccination outpatient clinics. The purpose of this study is to apply the quality monitoring and management indicator system previously established by our team to assess the current state of service management in vaccination outpatient clinics. Based on the assessment results, targeted quality improvement interventions will be implemented with the aim of providing practical experience and policy recommendations for the continuous enhancement of service quality and management standards in vaccination outpatient clinics.

We cordially invite your clinic to participate in our research. The specific content and steps of the study include:

(1) Conducting a questionnaire survey among all full-time vaccination staff, covering their awareness, implementation, and training needs related to quality management measures;

(2) Researchers will use on-site observations, document reviews, and interviews to score 61 quality indicators, including clinic environment, vaccination processes, staff capabilities, and service attitudes;

(3) Randomly selecting 20 members of the public to conduct a satisfaction survey;

(4) Developing and implementing targeted quality improvement measures based on the assessment results, with an intervention period of 3 months;

(5) Conducting another quality assessment after the intervention to evaluate its effectiveness.

This study will not impose any additional risks or inconveniences on your work and life. All information will be strictly confidential and used solely for research purposes. Your participation is entirely voluntary, and you may withdraw from the study at any stage without conditions. The publication of the research process and results will be carried out anonymously, ensuring full protection of personal privacy.

If you agree to participate in this study, please sign the informed consent form below. Should you have any questions, feel free to contact us at any time.

Contact information for researchers: Zhang Yan, Li Xikun. Phone numbers: 13510829827, 13091433000.

Thank you again for your great support and cooperation!

Harbin Traditional Chinese Medicine Hospital
Vaccination Outpatient Clinic Quality Monitoring and Management Research Team
December 2023

Informed Consent Form

I have read and understood the information regarding the purpose, content, and methods of this study as described above, and I have had the opportunity to ask the researchers questions and receive satisfactory answers.

I understand that participation in the study is voluntary, and I can withdraw at any time without any adverse consequences. My personal privacy will be protected.

I agree to the researchers using the data collected from this clinic for academic research, publication of theses, or academic exchange, and that these will only be done in an anonymous manner.

I consent to participate in this study.

Participating Institution (Seal):

Signature of Institution Head:

Date:

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Annex P: Questionnaire for Evaluating the Effectiveness of Quality Monitoring and Management Interventions in Vaccination Outpatient Clinics

Dear Vaccination Staff:

Greetings! Thank you for participating in our project on quality monitoring and management interventions in vaccination outpatient clinics. To fully assess the effectiveness of the intervention measures, we sincerely invite you to complete this questionnaire. Your valuable feedback will provide important references for further optimizing management practices. We promise to strictly protect your personal information, and the survey results will be used solely for scientific research analysis.

I. Basic Information

1. Your age: _____ years old

2. Your gender: □ Male □ Female

3. Your education level: □ Below secondary vocational □ College □ Bachelor's degree or above

4. Years of experience in vaccination work: _____ years

II. Evaluation of Training Effectiveness

5. Do you think the content of this quality management training is reasonable:

□ Very reasonable □ Reasonably reasonable □ Neutral □ Not very reasonable □ Very unreasonable

6. How do you rate the effectiveness of this quality management training:

□ Very good □ Good □ Neutral □ Poor □ Very poor

7. Do you find the knowledge and skills learned from the training helpful for your actual work:

□ Very helpful □ Helpful □ Neutral □ Not very helpful □ Not helpful at all

III. Evaluation of Management Measures

8. Do you think the implemented management measures in the vaccination outpatient clinic are helpful in standardizing the service process:

□ Very helpful □ Somewhat helpful □ Neutral □ Not very helpful □ Not helpful at all

9. Do you think the performance assessment mechanism is conducive to stimulating work enthusiasm:

□ Very beneficial □ Somewhat beneficial □ Neutral □ Not very effective □ Completely ineffective

10. Through performance assessment, have you improved your service awareness and level:

□ Significantly improved □ Improved □ Not much change □ Declined □ Significantly declined

IV. Evaluation of Service Changes

11. Compared to before the intervention, do you feel that the environment of the vaccination outpatient clinic has improved:

□ Significantly improved □ Improved □ Basically unchanged □ Declined □ Significantly declined

12. Compared to before the intervention, have you improved in the standardization of vaccination procedures:
□ Significantly improved □ Improved □ Not much change □ Declined □ Significantly declined
13. Compared to before the intervention, have you become more proactive in communicating and explaining to service recipients:
□ Significantly improved □ Improved □ Not much change □ Declined □ Significantly declined

V. Overall Evaluation

14. Overall, are you satisfied with the effects of this quality monitoring and management intervention:
□ Very satisfied □ Fairly satisfied □ Neutral □ Fairly dissatisfied □ Very dissatisfied
15. In your opinion, what issues and deficiencies still exist in the current management of the vaccination outpatient clinic:

16. What suggestions do you have for further improving the quality of services in the vaccination outpatient clinic:

Thank you again for your support and cooperation! We wish you success in your work and happiness in your life!

Affiliation: _____
Contact Person: _____
Contact Number: _____