International Journal of Clinical and Experimental Medicine Research, 2026, 10(1), 5-9
https: //www.hillpublisher.com/journals/ijcemr/
ISSN Online: 2575-7970
ISSN Print: 2575-7989

Co-word Clustering Analysis of Research Hotspots in NICU Hospital Infections in China in the Past 10 Years

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How to cite this paper: Meixiang Wang. (2026) Co-word Clustering Analysis of Research Hotspots in NICU Hospital Infections in China in the Past 10 Years. *International Journal of Clinical and Experimental Medicine Research*, 10(1), 5-9.
DOI: 10.26855/ijcemr.2026.01.002

Received: November 18, 2025
Accepted: December 15, 2025
Published: January 13, 2026

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Abstract

Objective: To explore the research hotspots and development trends of NICU hospital infections in China. **Methods:** A review of relevant literature on NICU hospital infections in China over the past 10 years was conducted using the CNKI and Wanfang databases. Co-word clustering analysis was performed with NoteExpress and SPSS 26.0, and a strategic coordinate map was generated. **Results:** A total of 1,000 papers were retrieved. Co-word clustering analysis identified 8 research hotspots: risk factors and preventive nursing measures for NICU hospital infections, antibiotic-resistant pathogens and antimicrobial resistance in NICU infections, nursing care for ventilator-associated pneumonia in NICU, application of developmental support nursing in infections of extremely low birth weight infants in NICU, compliance management of hand hygiene among NICU healthcare workers, risk assessment of catheter-related bloodstream infections in NICU, clinical features of NICU fungal sepsis, and Klebsiella pneumoniae infections in NICU outbreaks. **Conclusion:** Co-word clustering analysis helps to understand the research hotspots in NICU hospital infections in China.

Keywords

NICU; Hospital infections; Co-word analysis; Clustering analysis; Research hotspots

1. Introduction

The definition of NICU hospital infections refers to infections acquired within 48 hours of admission, infections acquired during or after birth, the development of infections in different locations on top of pre-existing infections, and infections caused by newly cultured pathogens [1]. Due to the rapid progression of their condition, severity of illness, frequent invasive procedures, and immature immune systems, neonates in the NICU are highly susceptible to hospital-acquired infections [2]. In recent years, reducing NICU hospital infections has become a key focus in medical and nursing research, yielding significant results. This study uses co-word clustering analysis to review literature on NICU hospital infections published over the past decade, aiming to reveal research hotspots and trends, providing guidance for further scientific development and clinical work in the field.

2. Materials and Methods

2.1 Data Sources

Literature was retrieved from the CNKI and Wanfang journal databases using a professional search model with the search terms: "(Subject: (Neonatal Intensive Care Unit) OR (Subject: (Neonatal Intensive Care Room) OR (Subject:

(NICU))) AND (Subject: (Hospital Infections)).” The search was limited to academic journals published between 2010 and 2022. A total of 1688 papers were identified. After excluding duplicates, invalid articles, and those from unrelated fields, 1,000 valid articles were retained.

2.2 Methods

The data analysis was performed using NoteExpress and SPSS 26.0 software. The process was as follows: (1) Export results from CNKI and Wanfang databases in NoteExpress format, batch import the data into NoteExpress software, and perform duplicate checking. Frequency analysis was conducted on the keywords, and 43 high-frequency keywords with a frequency greater than or equal to 6 were selected. A co-word matrix and dissimilarity matrix were then constructed. (2) The dissimilarity matrix was imported into SPSS 26.0 software for clustering analysis.

3. Results

3.1 High-Frequency Keywords Statistical Results

Based on the word frequency distribution formula derived from Zipf's law, a total of 43 high-frequency keywords with a frequency of 6 or higher were selected. The distribution of these keywords is shown in Table 1.

Table 1. High-Frequency Keywords and Frequency Distribution of NICU Hospital Infections-Related Literature in China in the Last 10 Years

Rank	High-Frequency Keyword	Frequency	Rank	High-Frequency Keyword	Frequency
1	Hospital Infection	471	23	Pathogen Distribution	14
2	Neonatal Intensive Care Unit (NICU)	361	24	Staphylococcus aureus	13
3	Risk Factors	162	25	Bacterial Infection	13
4	Nursing Management	122	26	Hospital Infection Rate	13
5	Drug Resistance	82	27	Acinetobacter baumannii	13
6	Ventilator-Associated Pneumonia	65	28	Procalcitonin	11
7	Extremely Low Birth Weight Infants	56	29	Extended-Spectrum Beta-Lactamase	11
8	Preventive Measures	52	30	Bundled Care	10
9	Targeted Monitoring	52	31	Peripheral Central Venous Catheter	10
10	Clinical Features Analysis	45	32	Fungal Infection	10
11	Hand Hygiene Compliance	42	33	High-Sensitivity C-Reactive Protein	10
12	Catheter-Related Bloodstream Infection	32	34	Healthcare Workers	10
13	Sepsis	30	35	Hospital Infection Outbreaks	10
14	Klebsiella pneumoniae	29	36	PDCA Cycle Management Model	9
15	Multidrug-Resistant Infections	26	37	Pseudomonas aeruginosa	8
16	Mechanical Ventilation	21	38	Risk Assessment	8
17	Colonization	20	39	Drug Sensitivity	8
18	Breastfeeding	18	40	Intervention Measures	6
19	Cross Infection	18	41	Fine-Tuned Care	6
20	Disinfection and Isolation	17	42	Developmental Support Care	6
21	Antimicrobial Agents	16	43	Hospital Stay	6
22	Quality Control and Improvement	16			

3.2 High-Frequency Keyword Clustering Results

According to the clustering results and combined with professional knowledge, 8 thematic clusters were identified (see Figure 1): K1: Research on Risk Factors and Preventive Nursing Measures for NICU Hospital Infections. K2: Research on Drug-Resistant Pathogens and Antibiotic Resistance in NICU Hospital Infections. K3: Research on Nursing Care for Ventilator-Associated Pneumonia in NICU. K4: Application of Developmental Support Nursing in Infections of Extremely Low Birth Weight Infants in NICU. K5: Research on Hand Hygiene Compliance among NICU Healthcare Workers. K6: Research on Risk Assessment of Catheter-Related Bloodstream Infections in NICU. K7: Research on Clinical Features of Fungal Sepsis in NICU. K8: Research on Outbreaks of Klebsiella Pneumoniae Infections in NICU.

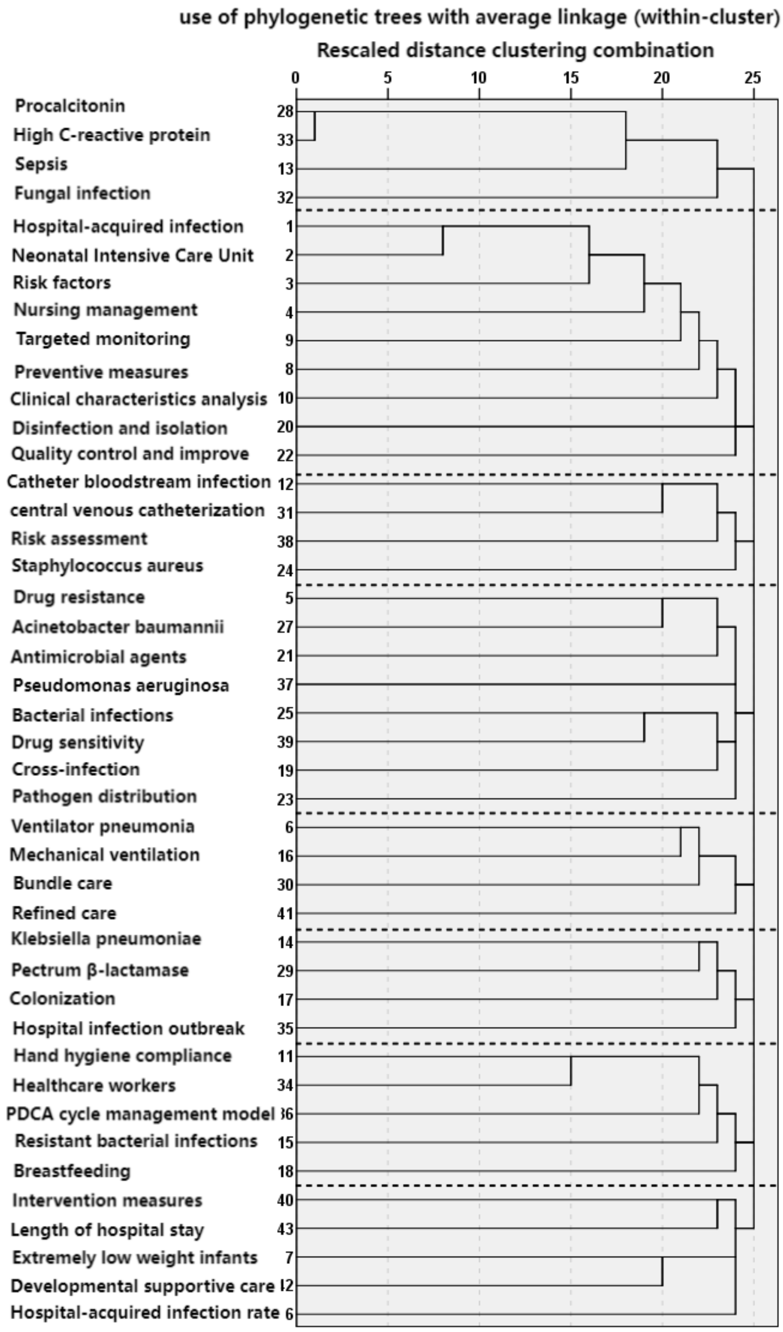

Figure 1. Co-word Clustering Analysis Dendrogram of High-Frequency Keywords in NICU Hospital Infections.

4. Discussion

4.1 Research on the Risk Factors and Preventive Nursing Measures for NICU Hospital Infections

The research in this area primarily focuses on the risk factors for neonatal hospital infections in the NICU, as well as quality improvement nursing measures such as target monitoring, disinfection and isolation, and hand hygiene. For example, Zhang Yanting et al. [3] applied the PDCA management model to hospital infection management quality improvement, addressing aspects such as infection-related regulation training, hand hygiene management and monitoring, environmental and equipment disinfection, and isolation. The results showed that after implementing the PDCA model, the incidence rate of hospital infections in NICU neonates (4.09%) was lower than before (6.3%), and the hand hygiene compliance rate of medical staff was higher than before. This suggests that the PDCA management model improves NICU hospital infection management quality and reduces the incidence of hospital infections. Although the risk factors for neonatal hospital infections are objectively difficult to change, hand hygiene remains the most effective preventive measure [4]. Future research could further extend the study of hand hygiene to include various personnel positions, expanding from healthcare staff to key departments and vulnerable groups (such as interns, caregivers, laboratory personnel, etc.), with the goal of identifying long-term mechanisms to improve overall hand hygiene quality and effectively reduce the incidence of hospital infections.

4.2 Research on Pathogens of NICU Hospital Infections

This research primarily focuses on bacteria and fungi such as Klebsiella pneumoniae, Escherichia coli, Staphylococcus aureus, and Group B Streptococcus, investigating the clinical characteristics of these pathogens and their drug treatment. Specific studies include the clinical characteristics and treatment of Klebsiella pneumoniae infections, the resistance of multidrug-resistant bacteria and their sensitivity to antimicrobial agents, and the clinical features of fungal sepsis. Wang Qingqing et al. [5] conducted a retrospective analysis of NICU hospital infections at Wenzhou Children's Hospital from 2010 to 2015. The results showed that during these six years, the primary pathogens in the NICU were Gram-negative bacteria, such as Klebsiella pneumoniae and Escherichia coli, though the incidence was decreasing. However, the detection rate of fungi increased from 2.1% in 2010 to 9.29% in 2015. Therefore, future research could focus on the clinical characteristics of fungal sepsis, constructing a risk prediction model for fungal sepsis, and identifying high-risk children for targeted early medication to prevent fungal sepsis.

4.3 Research on Device-Related Infections in the NICU

This research area primarily involves device-related bloodstream infections, such as catheter-associated bloodstream infections (CLABSI) and ventilator-associated pneumonia (VAP), with a focus on infection rates, pathogen distribution, drug resistance, influencing factors, and bundled care measures. Ren Junhong et al. [6] conducted prospective monitoring of 12,998 neonates treated in 17 hospitals across nine provinces and municipalities from 2013 to 2014. The results showed that the central venous catheter usage rate was 15.56%, with a CLABSI incidence rate of 0.66‰; the ventilator usage rate was 7.67%, with a VAP incidence rate of 7.23‰. The study indicates that the usage rate of devices and related infection rates in NICUs in China are relatively high, and the key challenge lies in how to improve nursing practices. Currently, the preventive nursing model for VAP and CLABSI is bundled care, which involves a series of evidence-based treatments and nursing measures for managing difficult clinical conditions [7]. In the future, risk prediction models for VAP and CLABSI could be developed to identify high-risk populations early, with targeted bundled interventions. This not only helps prevent the occurrence of VAP and CLABSI but also saves nursing resources, thereby improving compliance.

4.4 Developmental Supportive Care for Hospital Infections in Extremely Low Birth Weight Neonates

This research area focuses on the length of hospitalization, infection rates, and developmental supportive care measures for extremely low birth weight (ELBW) neonates in the NICU. The high infection rate in low birth weight neonates is primarily due to their immature immune system, making them highly susceptible to various pathogens. Therefore, nursing measures should be implemented to promote development and enhance immunity. Zhan Yuxiang et al. [8] conducted developmental supportive care interventions, including nest care, breast milk enteral nutrition support, pain management, and music touch therapy, on 100 ELBW infants. The results showed that the incidence of hospital infections in the intervention group was lower than in the control group, and the time for intravenous nutrition, regaining birth weight, and achieving full feeding was shorter (all $P<0.05$). Therefore, developmental supportive care promotes growth and development, enhances immunity, reduces hospital infection rates in ELBW infants, shortens hospitalization time, and improves quality of life. Currently, developmental supportive care is mainly applied to premature infants and ELBW infants, but future studies could further explore its effects in NICUs for large-for-gestational-age infants, high-risk infants with gestational diabetes, hypertension, and other conditions.

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