

Educational Framework For Preventing Contact-Transmitted Infections: A Macao Delphi Study With Nursing Students

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Abstract:

The increasing threat of contact-transmitted infectious diseases underscores the urgent need for robust emergency preparedness among nursing professionals, yet standardized training curricula for undergraduate nursing students, particularly those tailored to local contexts like Macao, remain underdeveloped. This study aimed to develop and achieve expert consensus on a structured emergency nursing knowledge training curriculum for undergraduate nursing students in Macao, focusing on contact-transmitted infectious diseases. A modified Delphi method was employed over six months. An initial curriculum framework, developed through qualitative semi-structured interviews, was systematically refined and validated through a two-round Delphi survey with a panel of 10 highly experienced experts (Round 1: $n = 10$; Round 2: $n = 9$). The expert panel demonstrated high credibility (authority coefficients > 0.87) and achieved a moderate, statistically significant consensus (Kendall's $W = 0.402$ in Round 1, improving to 0.474 in Round 2; $p < .001$). This iterative process refined an initial 60-item framework into a finalized curriculum consisting of four modules, nine course titles, and 57 distinct items covering theoretical knowledge, infection control, psychological stress management, and practical skills. This study successfully developed a scientifically rigorous and contextually relevant emergency nursing curriculum that provides a vital educational tool to enhance the preparedness and competence of future nurses. This structured training model has significant implications for strengthening nursing education and public health resilience in Macao and other similar regions.

Keywords: Emergency nursing, Nursing students, Contact-transmitted infections, Training curriculum, Delphi technique, Macao.

INTRODUCTION

The rapid progression of globalisation has greatly increased the speed at which infectious diseases spread across populations. Both longstanding infections, such as hepatitis, and newly emerging pathogens, including Ebola and the recent SARS-CoV-2 (causing COVID-19), continue to pose serious threats to global public health and have considerable economic and societal impacts [1,2]. Even with advances in immunisation programmes and public health strategies, the ongoing evolution of viruses and changes in environmental conditions lead to recurring disease outbreaks and pandemics [3,4,5]. Among various transmission routes, contact-based spread remains a primary mechanism for many infectious diseases and is a major factor in public health crises worldwide [5,6].

In the context of epidemic preparedness and response, the capacity of healthcare professionals to act swiftly and effectively is crucial. However, evidence suggests that many nurses and nursing students lack adequate knowledge and skills in disaster management and emergency response [6,7,8,18,19]. In China, research indicates that newly graduated nurses and current nursing students often exhibit insufficient core competencies related to managing infectious disease emergencies, which may stem from a lack of structured educational interventions and practical training [18,19]. Studies have shown that targeted emergency nursing education can enhance both the readiness and confidence of nurses in handling outbreak situations [7]. As future frontline healthcare providers, nursing students are expected to play a vital role during public health emergencies, highlighting the importance of incorporating comprehensive disaster nursing training into their academic preparation [8,14].

Recognizing this need, global health bodies such as the World Health Organization (WHO) and the International Council of Nurses (ICN) advocate for the inclusion of disaster nursing content within undergraduate nursing programs to better equip future nurses for potential health crises [13,14]. In China, while progress is being made, the current emergency nursing education system remains underdeveloped, with inconsistencies in curriculum design and limited availability of specialized faculty. Therefore, the development of a focused, evidence-based emergency

nursing education program—particularly addressing contact-transmitted infectious diseases—is essential to strengthen national readiness and safeguard public health.

This study aims to design and implement a structured teaching framework on emergency nursing practices for undergraduate nursing students, with the goal of improving their clinical preparedness, response capabilities, and self-efficacy. It is anticipated that this initiative will contribute to the enhancement of infectious disease emergency nursing education in China.

LITERATURE

Infectious disease outbreaks represent some of the most immediate and significant threats within the spectrum of large-scale public health emergencies [8]. Among these, contact-transmitted infectious diseases account for the majority of outbreaks worldwide. According to the World Health Organization's June 2023 data on affected countries and regions, six of the top ten infectious diseases globally are primarily spread through contact transmission. The public health risks posed by these diseases are substantial, with outbreaks capable of occurring unpredictably across any region. Notable examples include the COVID-19 pandemic in China and the Ebola virus disease epidemic in West Africa, both of which have intensified global health challenges and underscored the severity of both traditional and emerging infectious diseases [9–11].

A critical challenge in infectious disease nursing is the development of effective strategies to halt disease transmission [5]. Emergency nursing plays a pivotal role in this context, as it can significantly reduce morbidity and mortality rates associated with specific diseases [12]. The capacity of healthcare workers, especially nurses, to respond rapidly and competently during the early stages of an outbreak is crucial for effective prevention and control [6]. Nurses play a vital and multifaceted role in executing public health emergency responses, including timely patient care, health education, and coordination efforts, often intervening within minutes or hours to prevent death or disability [13].

Despite the growing importance of emergency nursing in infectious disease outbreaks, there remains a need to strengthen the emergency response competencies of clinical nurses. Studies conducted in countries such as the United States, the Philippines, Saudi Arabia, Sierra Leone, and Japan reveal that nurses' knowledge, skills, and awareness of their roles in infectious disease response and emergency preparedness are generally moderate to low [14]. This deficiency is mainly due to limited educational resources and inadequate simulation-based training, leading to gaps between nurses' professional knowledge and the practical skills needed during public health emergencies [15].

To address these gaps, emergency nursing education must focus on developing nurses' knowledge, skills, and procedural competencies essential for effective crisis response [16]. Comprehensive and thorough knowledge is crucial for timely and efficient management of infectious disease outbreaks, directly impacting the success of containment efforts. Furthermore, emergency nursing education has been demonstrated to improve nurses' willingness and capacity to participate effectively in public health emergency responses [7].

The maturity of emergency nursing education varies internationally. In 2001, the American Association of Colleges of Nursing recommended mandatory emergency nursing education for all nurses to improve pandemic preparedness [17]. By 2008, emergency nursing training had been incorporated into undergraduate nursing curricula in the United States, with disaster drills becoming compulsory for medical students [18]. The U.S. has also integrated biodefense into its emergency training programs. Conversely, disaster training remains limited in many regions, including parts of Africa and the Middle East, with only a few exceptions [19].

In China, emergency nursing education developed relatively late, gaining momentum after the 2003 SARS outbreak. Despite progress, standardized teaching models and frameworks for public health emergency training remain lacking. While undergraduate curricula include public health emergency knowledge, most research has focused on assessing nursing students' current knowledge levels rather than curriculum development. Given that undergraduate nursing students will be frontline responders in future infectious disease outbreaks, their preparedness is crucial for enhancing hospital response capabilities. The COVID-19 pandemic exposed global shortages in medical resources and healthcare personnel, prompting some countries to deploy medical students to frontline roles to alleviate workforce deficits [20]. Consequently, strengthening emergency nursing education focused on infectious diseases during public health crises has become a key research priority.

Developing a structured emergency nursing curriculum tailored to contact-transmitted infectious diseases is therefore imperative. The Delphi survey method, which synthesizes academic expertise with practitioner and stakeholder perspectives, offers a rigorous and systematic approach to curriculum development. This anonymous, iterative process mitigates biases common in traditional group discussions, such as dominance by vocal participants [21,22]. Foth et al. (2016) demonstrated the effectiveness of the Delphi method in developing and evaluating emergency care courses for public health emergencies [21].

Study Aim

This study aims to develop a structured emergency nursing knowledge training course tailored for undergraduate nursing students in Macao, focusing on contact-transmitted infectious diseases, and to achieve expert consensus using the Delphi method.

METHODS

Design: This study employed a modified Delphi survey to systematically develop and refine the emergency nursing knowledge training course. The initial curriculum draft was generated through qualitative research involving semi-structured, question-focused interviews and group discussions with clinical nurses and academic experts. Two rounds of Delphi surveys were subsequently conducted with a panel of 10 experts to achieve consensus, following established Delphi guidelines [23]. The overall study process is illustrated in Figure 1.

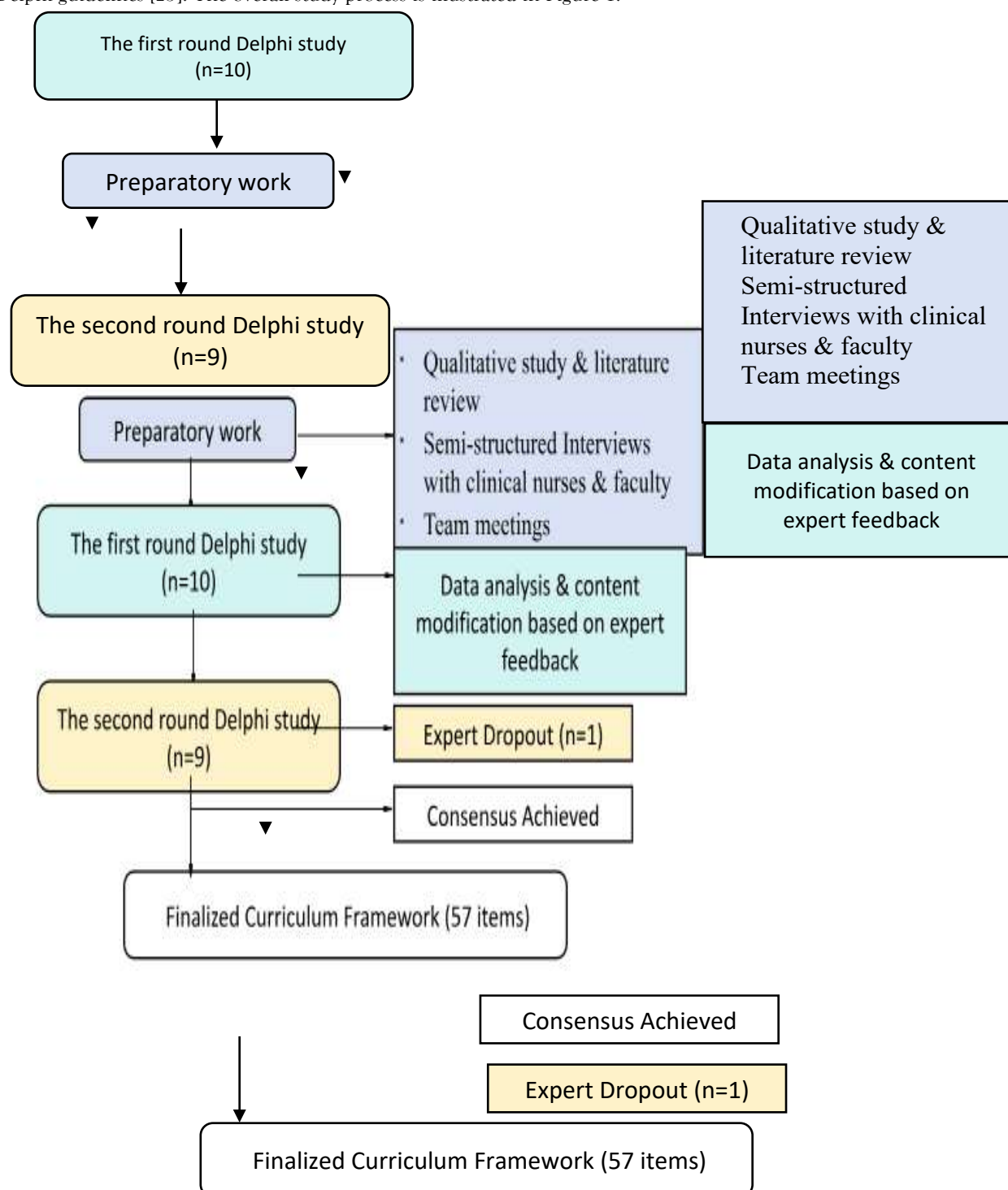


Figure 1. The Process of the Delphi Study

Sampling and Group Assignment (Expert Panel Selection): Experts were purposively selected based on their extensive knowledge and experience in public health emergencies related to contact-transmitted infectious diseases. Inclusion criteria included: (a) expertise in emergency nursing, clinical practice, nursing education, or management; (b) possession of a bachelor's degree or higher; (c) holding

intermediate or senior professional titles; (d) at least five years of clinical experience; (e) voluntary participation with informed consent; and (f) proficiency in Chinese language and effective communication skills.

Study objectives and procedures were communicated via face-to-face meetings, emails, and WeChat documents.

Setting (Initial Course Content Development): The preliminary course content was developed from qualitative interviews with experienced clinical nurses and nursing faculty from Macao and Mainland China, each with over five years of professional experience. The interviews focused on the question: “What essential topics should be included in emergency nursing knowledge training for Macao undergraduate nursing students to effectively manage public health emergencies involving contact-transmitted infectious diseases?” Informed consent was obtained prior to data collection. The research team held multiple internal meetings to analyze interview transcripts, extract relevant themes, and organize them into nine practical course modules.

Research Instruments (Delphi Questionnaires): The initial course draft was compiled into a structured questionnaire and distributed to experts through multiple channels. Experts completed a “Basic Information Form” capturing demographic data, familiarity with the subject (rated on a five-point scale from “very familiar” to “not familiar at all”), and the basis of their judgments (e.g., theoretical analysis, work experience). Each course item was rated for importance using a five-point Likert scale ranging from “very important” to “not important at all.” Experts were requested to return completed questionnaires within two weeks, with reminders sent as necessary to ensure timely responses.

Based on feedback from the first round, the questionnaire was revised to incorporate expert suggestions, including item modifications, additions, or deletions. The updated questionnaire was redistributed to the same panel for further evaluation. The second round followed the same procedures as the first. Data from this round were analyzed to finalize the course content structure.

Instruments for Data Collection: Questionnaires were distributed and collected via face-to-face meetings, email, and WeChat documents. Reminders were sent to ensure timely responses and maximize the response rate.

Data Analysis: Quantitative data were analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Expert engagement was evaluated based on questionnaire response rates and the proportion of suggestions submitted. The authority coefficient (Cr), calculated from the judgment basis (Ca) and familiarity level (Cs) of the experts, was used to quantify expert credibility, with higher values indicating greater authority. Expert consensus was assessed using the coefficient of variation (CV) and Kendall’s W coefficient, where lower CV and higher W values reflect stronger agreement among experts. Qualitative data, comprising textual comments, were independently coded by two researchers. The research team convened regularly to discuss qualitative findings and guide iterative revisions of the course content.

Ethical Considerations: This study was approved by the Institutional Review Board of Macao Polytechnic University (Approval No. RP/FCSD-02/2023). Written informed consent was obtained from all participants prior to their involvement. Participants were informed of their right to withdraw from the study at any time without any consequences or penalties.

RESULTS

The Delphi survey was completed in two rounds. In the first round, all 10 experts (100% participation) responded. In the second round, 9 experts (90% participation) completed the survey, with one expert being unavailable due to other commitments. All participating experts possessed at least five years of clinical experience, and a significant majority of 7 (77.8%) had over 20 years of professional experience, indicating a highly experienced panel (see Table 1).

Table 1 Demographic Information of Experts

Characteristics	Round 1 (n=10)		Round 2 (n=9)	
	Frequency	Percentage(%)	Frequency	Percentage(%)
Age (year)				
• < 30	2.00	20.0	2.00	22.2
• 30-40	4.00	40.0	3.00	33.3
• > 40	4.00	40.0	4.00	44.4
Gender				
• Men	1.00	10.0	1.00	11.1
• Women	9.00	90.0	8.00	88.9
Occupation				
• Nurse	2.00	20.0	2.00	22.2
• Clinic specialist nurse	3.00	30.0	2.00	22.2
• Professor	5.00	50.0	5.00	55.6
Education				
• Undergraduate	2.00	20.0	2.00	22.2
• Master	3.00	30.0	2.00	22.2
• Doctor	5.00	50.0	5.00	55.6
Research field				
• Clinical nursing	4.00	40.0	3.00	33.3
• Nurse education	4.00	40.0	4.00	44.4
• Infectious diseases	1.00	10.0	1.00	11.1
• Severe acute disease	1.00	10.0	1.00	11.1
Work years				
• 5-10	1.00	10.0	1.00	11.1
• 11-20	2.00	20.0	1.00	11.1
• >20	7.00	70.0	7.00	77.8

Expert trustworthiness was confirmed by high authority coefficients (Cr). Across the two rounds, the average familiarity with the content (Ca) was 0.94 and 0.98, and the average basis of judgment (Cs) was 0.80 and 0.91, respectively. This resulted in average Cr values of 0.87 for Round 1 and 0.94 for Round 2, both exceeding the generally accepted threshold of 0.70, affirming the strong credibility of the expert panel. Regarding consensus, Kendall's W coefficients were 0.402 for Round 1 ($\chi^2 = 217.084$, $df = 9$, $p < .001$) and 0.474 for Round 2 ($\chi^2 = 216.025$, $df = 8$, $p < .001$). These values, coupled with their statistical significance, indicate a moderate level of consensus among experts that improved as the Delphi process progressed, confirming statistically significant agreement on the item rankings.

In the first round, experts evaluated the initial course content, which was structured into 4 modules, 9 course titles, and 60 items (Table 2, Round 1 data). Within this initial design, all items within the "Infection Control Basics," "Infection Control Strategy and Measures," and "Method of Psychological Crisis Assessment, Self-Adjustment, and Stress Management" modules achieved unanimous importance ratings (100% of scores ≥ 4.0). While a high level of agreement was observed across most items, some, such as "Positive prevention before public health emergencies" (Item 3) and "Ethical principles of emergency nursing in public health emergencies" (Item 8), showed 90% and 88.9% agreement respectively (see Table 2).

Based on expert feedback, several content modifications were implemented. For example, the item "2. Characteristics of Emergency Nursing in Public Health Emergencies" was merged into "1. Concept and Characteristics of Public Health Emergencies" to streamline content. Items identified with less professional wording, such as "Positive prevention before public health emergencies," were revised to "Precautionary principle before public health emergencies," reflecting expert suggestions (supported by over 50% of experts). Additionally, four items were either modified, streamlined, or ultimately removed from the curriculum. "Definition of needle stick injury" from "Prevention and Treatment of Occupational Accidental Exposure" (Item 29, 80% agreement) was revised as experts considered its standalone definition less critical given limited teaching hours, suggesting its integration into broader content. Furthermore, three specific infectious diseases—Rift Valley fever (Item 43, 60% agreement), cholera (Item 45, 60% agreement), and highly pathogenic avian influenza (Item 46, 60% agreement)—from "Knowledge of Contact-Transmitted Infectious Diseases" were removed due to their lower agreement percentages and experts deeming them less relevant to Macao's context. Concurrently, two new items were added: "Protective measure of needle stick injuries" within "Prevention and Treatment of Occupational

Accidental Exposure" and "Protection method, technique and precaution of contact-transmitted patient" under "Knowledge of Contact-Transmitted Infectious Diseases."

The second round of expert evaluation, involving 9 specialists, successfully achieved robust consensus for each course item. Agreement levels, quantified by the percentage of experts rating items at 4 or higher, ranged from 88.9% to 100%. Furthermore, the coefficients of variation (CV) for all items remained below 0.24, collectively indicating a high degree of internal consistency and strong expert agreement on the importance of each curricular component. Expert feedback in this round also facilitated the strategic refinement of the course modules' titles. The finalized modules were specifically renamed as: "One—Theory: Overview of Public Health Emergencies," "Two—Theory: Knowledge and Coping Strategies of Infection Control," "Three—Theory: Knowledge and Stress Management of Contact-Transmitted Infectious Diseases," and "Four—Practical Skills Training—Nursing Operations for Contact-Transmitted Infectious Diseases." The complete structure of the finalized course content, encompassing 4 modules, 9 course titles, and 57 items, is detailed in Table 3.

DISCUSSION

This Delphi study successfully developed a structured emergency nursing knowledge training curriculum for undergraduate nursing students in Macao, specifically addressing contact-transmitted infectious diseases. Through a rigorous two-round expert consensus process, a comprehensive course framework was finalized, encompassing four modules, nine course titles, and 57 distinct items. This outcome directly addresses the study's aim and provides a much-needed educational resource to enhance the preparedness of future nursing professionals in a dynamic public health landscape, which faces increasing complexities and demands for adaptable education systems [30].

The methodological rigor of this study is underscored by the high authority coefficients (Cr values of 0.87 and 0.94 across rounds), affirming the exceptional credibility and expertise of the participating panel. Comprising ten highly experienced clinical nurses and nursing faculty from Macao and Mainland China, with a notable 77.8% possessing over 20 years of professional experience, the experts provided robust and well-informed judgments, lending significant weight to the development of the curriculum. This high level of expert authority is critical for the validity of Delphi-derived curricula, as the quality of expert input directly impacts the reliability of the consensus achieved [31]. While Kendall's W coefficients were in the moderate range (0.402 in Round 1, improving to 0.474 in Round 2), their statistical significance ($p < .001$) confirms that the observed agreement was not due to chance. The improvement in Kendall's W across rounds further demonstrates the effectiveness of the iterative Delphi process in facilitating a convergence of expert opinions, where initially diverse perspectives are progressively harmonized into a consensus [32]. This moderate level of consensus, coupled with high individual expert authority, suggests a thoughtful and nuanced refinement process rather than mere statistical uniformity.

The curriculum's foundation, meticulously designed through initial semi-structured interviews with societal and subject matter experts, ensured its practical relevance and applicability within the current context of Macao's public health needs. This detailed needs analysis captured the lived experiences and perceived needs of local clinical nurses and educators, translating these insights into core course modules, which is a key strength of needs-based curriculum development [33]. The subsequent Delphi rounds facilitated systematic validation and refinement by a broader expert panel. This iterative expert review led to crucial modifications, such as the professional rewording of items (e.g., "Positive prevention" to "Precautionary principle") and the strategic removal of content deemed less pertinent to Macao's specific public health context (e.g., certain less prevalent infectious diseases), thereby optimizing teaching hours for high-priority knowledge. Conversely, the curriculum's focus on vital practical skills was refined and emphasized. For instance, while the theoretical "Definition of needlestick injury" was revised for integration, practical items like "Protective measures for needlestick injuries" were prioritized. Furthermore, a new comprehensive item, "Protection method, technique, and precaution of contact-transmitted patient," was added to address a key practice gap identified by experts.

The final course content, structured into four modules, is particularly responsive to the multi-faceted demands of emergency nursing for infectious diseases. Modules One, Two, and Three are theoretical, establishing foundational knowledge essential for effective response. Module One, "Overview of Public Health Emergencies," comprehensively covers concepts, characteristics, emergency plans, and critically, the ethical considerations and legal frameworks [24]. This emphasis on the legal environment is vital, as compliance and principles of transparency are crucial in mitigating risks of liability during disaster responses. Module Two, "Knowledge and Coping Strategies of Infection Control," provides foundational

infection control knowledge alongside prevention and treatment of occupational accidental exposures. The inclusion of occupational exposure is paramount, given the substantial global estimates of healthcare worker infections [25], highlighting the direct relevance of this content to nurse safety. Module Three, "Knowledge and Stress Management of Contact-Transmitted Infectious Diseases," delves into specific pathogens like monkeypox, Ebola, and plague, with current global and local context [26,27,28]. This specialized knowledge is crucial given nurses' role as first responders. Furthermore, the inclusion of psychological crisis assessment and stress management in this module is highly pertinent, recognizing the prevalence of psychological distress among healthcare workers during outbreaks and the need for self-adjustment skills in situations where professional support may be limited [29]. Module Four, "Practical Skills Training—Nursing Operations for Contact-Transmitted Infectious Diseases," translates theoretical knowledge into practical skills, addressing the critical need for robust practical competencies in public health emergency response. This comprehensive approach, combining theoretical grounding with practical application, equips nursing students with essential skills for immediate disaster response, contributing to a more resilient public health workforce [34].

Limitations and Future Research

Despite its strengths, this study has several limitations. The relatively small size of the expert panel (n=10/9) and its geographical concentration may constrain the generalizability of the findings. While the curriculum is rigorously tailored to the local context, its direct applicability to broader international settings might require further adaptation [35]. Secondly, this study did not encompass an empirical evaluation of the curriculum's actual impact on student learning outcomes, which represents a crucial next step [36]. Building upon these insights, future research will primarily focus on the empirical validation of this curriculum. The immediate next step involves implementing a short-term course utilizing the established curriculum framework, followed by case-based drills using SIMMAN simulation to assess practical competencies. Systematically evaluating its effectiveness through pre- and post-intervention assessments of students' knowledge, skills, and self-efficacy is paramount [37]. Finally, continuous review and update of the curriculum will be essential to ensure its sustained relevance and responsiveness to future health crises [38].

CONCLUSIONS AND IMPLICATIONS FOR NURSING PRACTICE

This study culminates in the successful development of a structured emergency nursing knowledge training curriculum for undergraduate nursing students in Macao, meticulously tailored to address contact-transmitted infectious diseases. Through a rigorous and expert-driven two-round Delphi process, a comprehensive and evidence-based framework has been finalized, comprising four modules, nine course titles, and 57 distinct items. This achievement directly fulfils the study's aim and provides a vital educational resource to enhance the preparedness of future nursing professionals within a continually evolving global health landscape [30].

The implications for nursing practice are profound. By systematically equipping aspiring nurses with targeted competencies, this initiative is poised to bridge the critical gap between academic learning and the complex realities of frontline emergency response. This curriculum not only addresses identified knowledge and skill gaps but also directly contributes to cultivating a more resilient and adaptable nursing workforce, crucial for effectively responding to future public health emergencies and ensuring optimal patient outcomes [34]. In conclusion, this study provides a robust, replicable, and contextually sensitive model for nursing education reform, empowering nursing graduates to lead and innovate in the face of emerging infectious disease threats.

Acknowledgment

The authors would like to express their sincere gratitude to all the experts who generously contributed their time and invaluable insights during the Delphi survey process. Their professional expertise and thoughtful feedback were instrumental in the development and refinement of the curriculum framework presented in this study. We are also deeply appreciative of the clinical nurses and nursing faculty who participated in the initial qualitative interviews, providing the foundational knowledge and practical perspectives that guided this research.

Table 2 The Results of the First Round

Curriculum Module	Course Title	Items	Mean	SD	CV (%)	Percentage of Scores ≥ 4.0
One: Theory	Concept and characteristics of public health emergencies, emergency plan	1. Concept and characteristics of public health emergencies	4.90	.32	6.45	100.0
		2. Characteristics of emergency nursing in public health emergencies	4.80	.42	8.78	100.0
		3. Positive prevention before public health emergencies	4.40	.70	15.89	90.0
		4. Positive rescue of public health emergencies occurs	4.60	.52	11.23	100.0
		5. Proper handling after public health emergencies	4.60	.52	11.23	100.0
		6. Risk assessment of public health emergencies	4.90	.32	6.45	100.0
		7. Warning grading of public health emergencies	4.80	.42	8.78	100.0
	Ethics of public health emergencies	8. Ethical principles of emergency nursing in public health emergencies	4.80	.63	13.18	90.0
		9. Ethical requirements of emergency nursing in public health emergencies	4.60	.70	15.20	90.0
	Law and regulation of public health emergencies	10. Mainland China: Regulation on Preparedness for and Response to Emergent Public Health Hazards—Chapter 2: Prevention and Emergency Preparedness	4.80	0.42	8.78	100.0
		11. Chapter 3: Report and information release	4.80	0.42	8.78	100.0
		12. Chapter 4: Emergency response	4.80	0.42	8.78	100.0
		13. Chapter 5: Legal responsibility	4.70	0.42	10.28	100.0
		14. Macao, China: Legal Framework for Civil Protection—Chapter 2: Public emergencies	4.90	0.32	6.45	100.0
		15. Chapter 4: Implementation of civil defence activities	4.70	0.42	10.28	100.0
		16. Chapter 5: Obligation and responsibility	4.80	0.32	8.78	100.0
		17. Macao, China: Civil Protection Legal Framework Regulation—Chapter 2: Early warning system for public emergencies	4.70	0.63	14.36	90.0
		18. Macao, China: Communicable Diseases Control Law—Chapter 2: General Measure	4.70	0.32	14.36	90.0
		19. Macao, China: Communicable Diseases Control Law—Chapter 3 Special Measure	4.90	0.32	14.36	100.0
		20. Macao, China: Communicable Diseases Control Law—Chapter 4: Rights and protection	4.90	.32	6.45	100.0
		21. Macao, China: Communicable Diseases Control Law—Chapter 5: Criminal liability	4.90	.32	6.45	100.0
Two: Theory	Infection control basics	22. Objective and principle of infection control	4.90	.32	6.45	100.0
		23. Chain of infection (source of infection, route of transmission, susceptible host)	4.90	.32	6.45	100.0
	Infection control strategy and measures	24. The principle of standard precautions	4.80	.42	8.78	100.0
		25. Definition, purpose, principle, requirement, indication for sterilisation, timing of hand hygiene	4.90	.32	6.45	100.0
		26. Purpose, using time of personal protective equipment, principle of supply selection, treatable method and precaution after contamination	4.80	.42	8.78	100.0
		27. Purpose, function, and precaution of the isolation ward	4.90	.32	6.45	100.0
		28. Environmental decontamination, object disinfection, reusable device reprocessing, and contaminated waste handling.	4.90	.32	6.45	100.0
	Prevention and treatment of occupational accidental exposure	29. Definition of needlestick injuries	4.50	1.08	24.00	80.0
		30. Major risk factor of needlestick injuries	4.50	1.08	24.00	80.0
		31. Hazards of needlestick injuries	4.50	1.08	24.00	80.0
		32. Preventive Measures for Needlestick Injuries	4.50	1.08	24.00	80.0
		33. Post-exposure management protocol for needlestick injuries	4.50	1.08	24.00	80.0
		34. Definition of splashes and sprays of liquids or blood	4.40	1.07	24.43	80.0

Three: Theory		35.	Main Risk Factors for Splashes and Sprays of Liquids or Blood	4.40	1.07	24.43	80.0
		36.	Liquid or Blood Splash and Splatter Hazards	4.50	1.08	24.00	80.0
		37.	Related Preventive Measures	4.50	1.08	24.00	80.0
		38.	Procedures for Handling Liquid or Blood Splash/Splatter Incidents	4.50	1.08	24.00	80.0
	Knowledge of contact-transmitted infectious diseases	39.	Definition of Contact Transmission	4.80	.63	13.18	90.0
		40.	Disease Categories (Ebola, Monkeypox, Rift Valley Fever, Plague, Cholera, Human Infection with Highly Pathogenic Avian Influenza)	4.60	.70	15.20	90.0
		41.	Monkeypox: Definition, Symptoms, Transmission Routes, Epidemiology	4.70	.67	14.36	90.0
		42.	Ebola: Definition, Symptoms, Transmission Routes, Epidemiology	4.60	.84	18.33	80.0
		43.	Rift Valley Fever: Definition, Symptoms, Transmission Routes, Epidemiology	4.10	1.20	29.20	60.0
		44.	Plague: Definition, Symptoms, Transmission Routes, Epidemiology	4.60	.84	18.33	80.0
		45.	Cholera: Definition, Symptoms, Transmission Routes, Epidemiology	4.10	1.20	29.20	60.0
		46.	Highly Pathogenic Avian Influenza (HPAI): Definition, Symptoms, Transmission Routes, Epidemiology	4.10	1.20	29.20	60.0
		47.	Protective Measures, Techniques, and Considerations for Contact with Patients with Contact-Transmitted Diseases	4.90	.32	6.45	100.0
	Method of psychological crisis assessment, self-adjustment and stress management	48.	Definition of psychological crisis assessment	4.80	.42	8.78	100.0
		49.	Assessment Methods	4.80	.42	8.78	100.0
		50.	Intervention Content	4.80	.42	8.78	100.0
		51.	Intervention Measures	4.80	.42	8.78	100.0
		52.	Self-Adjustment and Stress Management (Macau Context)	4.90	.32	6.45	100.0
		53.	Introduction to Self-Perception and Stress Detection	4.90	.32	6.45	100.0
		54.	Adjustment and stress management methods	4.70	.48	10.28	100.0
Four: Practical skills training	Skill operation of contact-transmitted infectious diseases	55.	Commonly used items sterilised classification	4.70	.67	14.36	90.0
		56.	Medical Waste Classification for Infectious Disease Patients	4.70	.67	14.36	90.0
		57.	Needle Stick Injury Management Methods	4.50	1.08	24.00	80.0
		58.	(Demonstration and Student Practice) PPE Donning and Doffing & Isolation Zone Setup	4.80	.42	8.78	100.0
		59.	(Demonstration and Student Practice) Deceased Body Management for Infectious Disease or Suspected Infectious Disease Patients	4.90	.32	6.45	100.0
		60.	(Demonstration and Student Practice) Wound Care for Contact Transmission	5.00	.00	.00	100.0

Note. SD= standard deviation; CV= Coefficient of Variation.

Table 3 The Results of the Second Round

Curr iculu m Mod ule	Course Title	Items	Mean	SD	CV	Perc enta ge of Scor es≥4 .0
One: Theo ry	Concept and characteristics of public health emergencies, emergency plan	1. Concept and characteristics of public health emergencies	5.00	.00	.00	100.0
		2. Characteristics of emergency nursing in public health emergencies	5.00	.00	.00	100.0
		3. Positive prevention before public health emergencies	4.67	.71	15.15	88.9
		4. Positive rescue of public health emergencies occurs	4.89	.33	6.82	100.0
		5. Proper handling after public health emergencies	4.89	.33	6.82	100.0
		6. Risk assessment of public health emergencies	4.89	.33	6.82	100.0
		7. Warning grading of public health emergencies	4.89	.33	6.82	100.0
	Ethics of public health emergencies	8. Ethical principles of emergency nursing in public health emergencies	5.00	.00	.00	100.0
		9. Ethical requirements of emergency nursing in public health emergencies	5.00	.00	.00	100.0
	Law and regulation of public health emergencies	10. Mainland China: Regulation on Preparedness for and Response to Emergent Public Health Hazards—Chapter 2: Prevention and Emergency Preparedness	4.78	.44	9.23	100.0
		11. Mainland China: Regulation on Preparedness for and Response to Emergent Public Health Hazards—Chapter 3: Report and information release	4.78	.44	9.23	100.0
		12. Mainland China: Regulation on Preparedness for and Response to Emergent Public Health Hazards—Chapter 4: Emergency response	4.78	.44	9.23	100.0
		13. Mainland China: Regulation on Preparedness for and Response to Emergent Public Health Hazards—Chapter 5: Legal responsibility	4.78	.44	9.23	100.0
		14. Macao, China: Legal Framework for Civil Protection—Chapter 2: Public emergencies	4.78	.44	9.23	100.0
		15. Macao, China: Legal Framework for Civil Protection—Chapter 4: Implementation of civil defence activities	4.67	.71	15.15	88.9
		16. Macao, China: Legal Framework for Civil Protection—Chapter 5: Obligation and responsibility	4.67	.71	15.15	88.9
		17. Macao, China: Civil Protection Legal Framework Regulation—Chapter 2: Early warning system for public emergencies	5.00	.00	.00	100.0
		18. Macao, China: Communicable Diseases Control Law—Chapter 2: General Measure	4.78	.67	13.95	88.9
		19. Macao, China: Communicable Diseases Control Law—Chapter 3 Special Measure	4.78	.67	13.95	88.9
		20. Macao, China: Communicable Diseases Control Law—Chapter 4: Rights and protection	4.78	.67	13.95	88.9
		21. Macao, China: Communicable Diseases Control Law—Chapter 5: Criminal liability	4.78	.67	13.95	88.9
	Infection control basics	22. Objective and principle of infection control	4.78	.67	13.95	88.9
		23. Chain of infection (source of infection, route of transmission, susceptible host)	4.78	.67	13.95	88.9
Two: Theo ry	Infection control strategy and measures	24. The principle of standard precautions	4.78	.67	13.95	88.9
		25. Definition, purpose, principle, requirement, indication for sterilisation, timing of hand hygiene	4.67	.71	15.15	88.9

		26. Purpose, using time of personal protective equipment, principle of supply selection, treatable method and precaution after contamination	4.67	.71	15.15	88.9
		27. Purpose, function, and precaution of the isolation ward	4.56	.73	15.95	88.9
		28. Environmental decontamination, object disinfection, reusable device reprocessing, and contaminated waste handling.	4.56	.73	15.95	88.9
Prevention and treatment of occupational accidental exposure	29.	Definition of needlestick injuries	4.44	.73	16.35	88.9
	30.	Major risk factor of needlestick injuries	4.44	.73	16.35	88.9
	31.	Hazards of needlestick injuries	4.44	.73	16.35	88.9
	32.	Preventive Measures for Needlestick Injuries (including operational, environmental, and material handling aspects)	4.44	.73	16.35	88.9
	33.	Post-exposure management protocol for needlestick injuries	4.67	.71	15.15	88.9
	34.	Definition of splashes and sprays of liquids or blood	4.67	.71	15.15	88.9
	35.	Main Risk Factors for Splashes and Sprays of Liquids or Blood	4.67	.71	15.15	88.9
	36.	Liquid or Blood Splash and Splatter Hazards	4.67	.71	15.15	88.9
	37.	Related Preventive Measures (Operational, Environmental, Tool Use, Material Handling/Disposal)	4.67	.71	15.15	88.9
	38.	Procedures for Handling Liquid or Blood Splash/Splatter Incidents	4.67	.71	15.15	88.9
Theory: Knowledge of contact-transmitted infectious diseases	39.	Definition of Contact Transmission	4.78	.44	9.23	100.0
	40.	Disease Categories (Ebola, Monkeypox, Plague)	4.67	.50	10.71	100.0
	41.	Monkeypox: Definition, Symptoms, Transmission Routes, Epidemiology	4.67	.50	10.71	100.0
	42.	Ebola: Definition, Symptoms, Transmission Routes, Epidemiology	4.78	.44	9.23	100.0
	43.	Plague: Definition, Symptoms, Transmission Routes, Epidemiology	4.67	.50	10.71	100.0
	44.	Protective Measures, Techniques, and Considerations for Contact with Patients with Contact-Transmitted Diseases	4.89	.33	6.82	100.0
	45.	Definition of psychological crisis assessment	4.78	.44	9.23	100.0
	46.	Assessment Methods	4.78	.44	9.23	100.0
	47.	Intervention Content	4.67	.71	15.15	88.9
	48.	Intervention Measures	4.67	.71	15.15	88.9
	49.	Self-Adjustment and Stress Management (Macau Context)	4.78	.44	9.23	100.0
Four : Practical skills training	50.	Introduction to Self-Perception and Stress Detection	4.78	.44	9.23	100.0
	51.	Adjustment and stress management methods	4.78	.44	9.23	100.0
	52.	Commonly used items sterilised classification	4.56	.73	15.95	88.9
	53.	Medical Waste Classification for Infectious Disease Patients	4.67	.50	10.71	100.0
	54.	Needle Stick Injury Management Methods	4.44	.73	16.35	88.9
	55.	(Demonstration and Student Practice) PPE Donning and Doffing & Isolation Zone Setup	4.78	.44	9.23	100.0
	56.	(Demonstration and Student Practice) Deceased Body Management for Infectious Disease or Suspected Infectious Disease Patients	5.00	.00	.00	100.0
	57.	(Demonstration and Student Practice) Wound Care for Contact Transmission	5.00	.00	.00	100.0

Note. SD= standard deviation; CV= Coefficient of Variation.

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