



Empirical Study on the Evaluation of Emergency Management Capabilities for Public Health Emergencies at Local Universities in Guangxi

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Abstract

This study evaluates the emergency management capabilities of higher education institutions (HEIs) in Guangxi in response to public health emergencies by constructing and applying a systematic evaluation model. The study had three objectives: to construct the evaluation model, to assess the capability of the universities using it, and to provide a reference for capability enhancement. A comprehensive set of evaluation indicators was developed using the Delphi expert consultation method. Data were collected through a Chinese-language questionnaire survey conducted across 20 HEIs in Guangxi, yielding 1,701 valid responses. Radar charts were used to illustrate the scores of five core dimensions of emergency management systems, and the Rank Sum Ratio (RSR) evaluation model was employed to classify and rank the institutions based on their capabilities.

Findings indicate that most universities performed well across the five dimensions; however, significant shortcomings were observed in contingency plan updates, emergency drills, interdepartmental coordination, and post-event evaluations. RSR analysis revealed notable disparities among institutions: vocational colleges exhibited stronger overall capabilities than undergraduate universities, while disciplines such as science and engineering, public security, and law outperformed medical and arts-related programs. Institutions were categorized into three tiers: high capability (20%), medium capability (65%), and low capability (15%).

Keywords: Local universities in Guangxi, sudden public health emergencies, emergency management capabilities, model construction, empirical research.



Introduction

A sudden public health emergency in a school refers to an event that occurs suddenly within a school premises, posing a serious threat to the health of faculty, staff, and students, including infectious disease outbreaks, unexplained mass illnesses, mass adverse reactions, food poisoning, occupational poisoning, and other public health incidents that significantly impact the health of faculty, staff, and students^[1]. In 2011, a total of 858 school-related public health emergencies were reported nationwide, accounting for 73.71% of all reported emergencies nationwide^[2]. These public health emergencies severely disrupt the normal teaching and living order of schools, damage their social reputation, and pose risks to the physical and mental health of faculty and students^[3-4]. A typical example is the rapid spread of the COVID-19 pandemic in higher education institutions in 2019, which vividly highlighted the extreme importance of campus public health emergency management.

Guangxi is home to numerous higher education institutions, with a total of 87 institutions, including 38 universities and 49 colleges, and a combined student population of 1,552,200. Guangxi has frequently experienced sudden public health emergencies in schools. From 2014 to 2016, the number of reported sudden public health emergencies in schools ranked third among all provinces (autonomous regions and municipalities) nationwide^[5]. This clearly indicates that higher education institutions in Guangxi face severe and complex challenges in responding to sudden public health emergencies. Therefore, prioritizing schools as key venues for public health risk prevention and control, and comprehensively enhancing emergency management capabilities for sudden public health emergencies on campus, has become an urgent and critical task for Guangxi at present^[6-7].

Objectives

This study has three objectives:

- (1) To construct an evaluation model of the emergency management capacity of universities in Guangxi for public health emergencies;
- (2) To assess the emergency management capacity of universities in Guangxi for public health emergencies using the model; and
- (3) To provide a reference for enhancing the emergency management capacity of universities in responding to public health emergencies.



Literature review

Developed countries have constructed a relatively perfect emergency management system for public health emergencies on campus, which is characterized by three main aspects: first, the government establishes a top-down full-cycle management system (covering pre-warning, treatment and recovery), forming a dynamic and comprehensive emergency response framework, such as the U.S., U.K., Japan and other countries; second, the university level focuses on proactive prevention and control, with specific measures including improving emergency regulations and systems, strengthening campus risk assessment, and establishing a regular emergency supplies and technical reserve mechanism; third, the focus on improving the effectiveness of risk communication and promoting the institutionalization of psychological intervention to ensure the humanistic dimension of crisis response ^[8-9].

In contrast, the current emergency management system for public health emergencies in domestic universities still faces multiple structural dilemmas. The core problem lies in the failure to effectively incorporate students into the emergency subject participation framework, which is manifested in the following: insufficient cultivation of students' subject consciousness and emergency response ability, lack of institutional mechanism to guarantee their participation, and formalization and lack of depth of publicity and education. At the same time, there is a significant gap between theory and practice in emergency education, i.e. excessive emphasis on theoretical teaching and neglect of practical exercises, resulting in students' weak practical response ability. At the level of mechanism operation, the existing system is generally characterized by systematic problems such as defective design of the plan, ineffective implementation, insufficient recovery ability, and weak support of resources and institutional safeguards ^[10-12].



Conceptual Framework

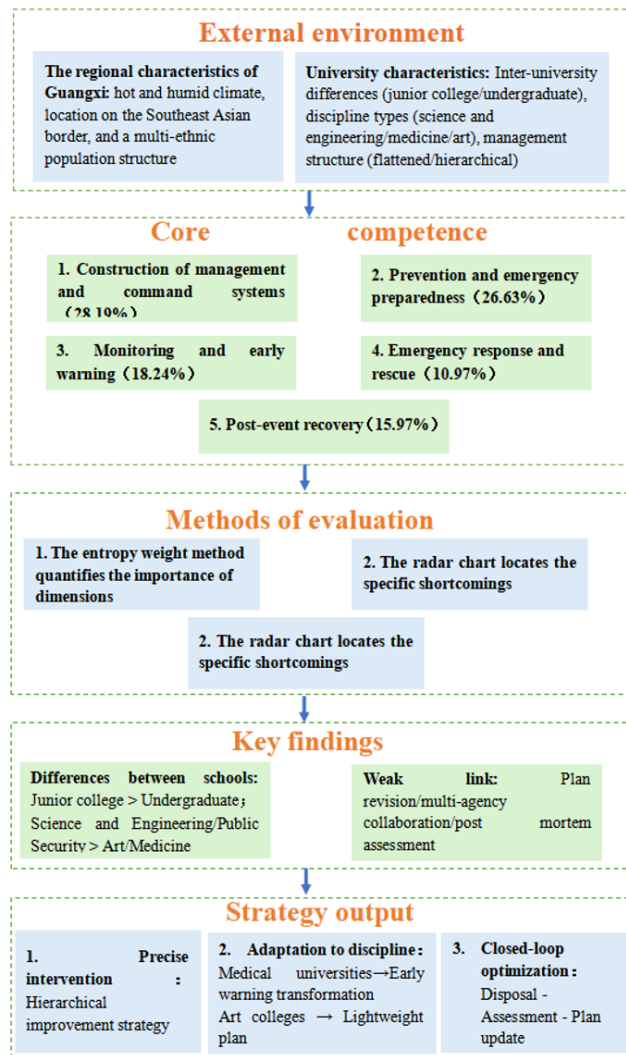


Figure 1: Conceptual Framework

Methodology

In this study, students and teachers from 20 colleges and universities in Guangxi Zhuang Autonomous Region were selected as survey respondents between February and June 2025 using convenience sampling method. The sample colleges and universities covered 10 specialized (higher-vocational) colleges and universities and 10 undergraduate colleges and universities; here, “specialized colleges” refers to higher-vocational institutions, as distinct from degree-granting undergraduate universities. The inclusion criteria were: active faculty members or students of the university at the time of the survey. Data collection was conducted using an electronic questionnaire administered in Chinese, the respondents’ native language. Prior to data collection,

the researcher contacted and obtained consent from the management of the 20 colleges and universities and pushed the link to the questionnaire, which was organized by the university to be distributed at each level. The study protocol was reviewed and approved by the Research Ethics Committee of [Committee of Guangxi Medical University] (approval no. 2024 Y0325); participation was voluntary and informed consent was obtained electronically before respondents began the questionnaire. The English indicator labels reported here were produced from the original Chinese instrument using forward–back translation.

Survey tools

The questionnaire was designed independently by the researcher and covered information such as gender, educational qualification, age, nature of status in the university (faculty/student), years of experience (for faculty) and job title (for staff) of the respondents.

Survey Questionnaire on Public Health Emergency Management Capabilities

The construction of this questionnaire was based on the systematic search and analysis of the literature related to emergency management, emergency management of universities, emergency management of public health events and emergency management of public health events in universities at home and abroad, and was refined by using the Delphi expert consultation method (2 rounds of consultation were conducted, involving 17 experts). The questionnaire content was revised according to the results of the experts' correspondence, and finally formed the evaluation index system of public health emergencies management capacity applicable to universities in Guangxi region. The effective recovery rate of the questionnaire in the two rounds of expert consultation was 100.00% and 91.67%, respectively, and the expert authority coefficient was 0.94. In the second round of consultation, the coefficient of harmonization of experts' opinions (Kendall's W) was 0.306 ($P < 0.01$), which indicated that the harmonization of experts' opinions was good. The finalized questionnaire contains five dimensions with a total of 30 entries. Throughout this paper, the five dimensions are referred to as the “first-level indicators,” and the 30 entries nested within them (six per dimension) are referred to as the “second-level indicators.” The five dimensions are: (1) management and command system construction; (2) prevention and emergency preparedness; (3) monitoring and early warning; (4) emergency response and rescue; and (5) aftermath recovery. There are 6 entries under each dimension. All entries are single-choice questions with 0, 1, 2 points or 0, 1, 2, 3 points, and the higher the score, the stronger the

corresponding ability, and the specific indicators and their scores are shown in Exhibit 1. The Cronbach's α coefficients of the five dimensions of the questionnaire are 0.841, 0.867, 0.914, 0.915, and 0.883, respectively, which indicate that there is a good internal consistency of the dimensions.

Statistical analysis

SPSS 26.0 statistical software was used to analyze the basic characteristics of the sample colleges and universities as well as the demographic characteristics of the survey respondents. Based on the 1,701 valid questionnaires recovered, the arithmetic mean scores of each secondary indicator entry for each university were calculated, and radar charts were used to visualize the performance level of the 30 specific indicators under the five core dimensions of the emergency management system of the 20 sample colleges and universities, with some indicators adopting a 0, 1, 2-point system. When the average score is ≥ 1.5 points, the school is considered to have a better level of performance on the indicator; some indicators use the 0, 1, 2, 3 point system, and when the average score is ≥ 2.25 points, the school is considered to have a better level of performance on the indicator.

Since this study aims to evaluate the emergency management capability of 20 universities in Guangxi region for public health emergencies, it needs to reflect the overall level and individual characteristics, identify the gaps between universities and rank them; therefore, the rank-sum-ratio (RSR) method is used to sort and rank each indicator, and the RSR value is calculated to comprehensively reflect its relative advantages and disadvantages in all indicators, and combined with the probability unit (Probit) conversion to sort and grade the evaluation objects. Based on the Probit values under different ordering, the RSR method follows the principle of optimal grading, and finally divides the evaluation objects into high, medium and low grades. The RSR method analysis can be performed with the help of the SPSSPRO platform (<https://www.spsspro.com>) [13-15].

Results

Basic information on sample universities and survey respondents

As shown in Table 1, this study selected 20 higher education institutions in the Guangxi Zhuang Autonomous Region as survey respondents, including 10 undergraduate colleges and 10 specialized colleges, and used convenience sampling method to conduct the questionnaire survey. A total of 1,701 valid questionnaires were recovered from the survey, of which the sample size of undergraduate colleges was 1,079 (63.4%) and that of specialized colleges was 622 (36.6%).

The demographic characteristics of the surveyed population are distributed as follows: in terms of identity composition, there were 1,254 student samples (73.7%) and 447 faculty and staff samples (26.3%); the gender ratio was 1.09:1 (male/female). The age structure exhibits a distinct youthful trend, with 72.7% of the population aged 25 or younger and 21.4% aged 26–45. Educational attainment is primarily bachelor's degree (54.4%). Among the faculty and staff group, the professional title structure is dominated by intermediate-level titles (44.5%), and work experience exhibits a bimodal distribution, with 38.9% having 6–12 years of service and 40.0% having 13 years or more of service.

Table 1: Basic information of the sample colleges and universities

Sample school	Area	Type	Total	Students	Teachers/staff
Undergraduate			1079	835	244
A1	Nanning	Medicine	368	342	26
A2	Nanning	General	148	121	27
A3	Nanning	Medicine	103	56	47
A4	Nanning	Finance and Economics	101	91	10
A5	Liuzhou	Science and Engineering	92	65	27
A6	Nanning	General	90	78	12
A7	Baise	Medicine	67	21	46
A8	Nanning	Public Security and Law	46	27	19
A9	Guilin	Science and Engineering	34	22	12
A10	Guilin	Medicine	30	12	18
Specialty			622	419	203
B1	Nanning	Science and Engineering	113	88	25
B2	Liuzhou	General	83	50	33
B3	Nanning	Science and Engineering	74	60	14
B4	Nanning	Science and Engineering	74	58	16
B5	Nanning	Teacher Training	65	39	26
B6	Nanning	Science and Engineering	58	35	23
B7	Nanning	Science and Engineering	50	32	18
B8	Nanning	Art	37	21	16
B9	Nanning	Science and Engineering	35	24	11
B10	Nanning	Medicine	33	12	21

Scoring results of secondary indicators

Based on the data analysis of 1,701 valid questionnaires, this study used the arithmetic mean method to assess the performance of the 20 sampled colleges and universities in the five dimensions of the emergency management system for public health emergencies. As shown in Figure 2, the study visualized the distribution of the average scores of the 30 secondary indicators under the framework of the five primary indicators of management and command system construction, prevention and emergency preparedness, monitoring and early warning, emergency response and rescue, and post-event recovery of each university through the radar chart.

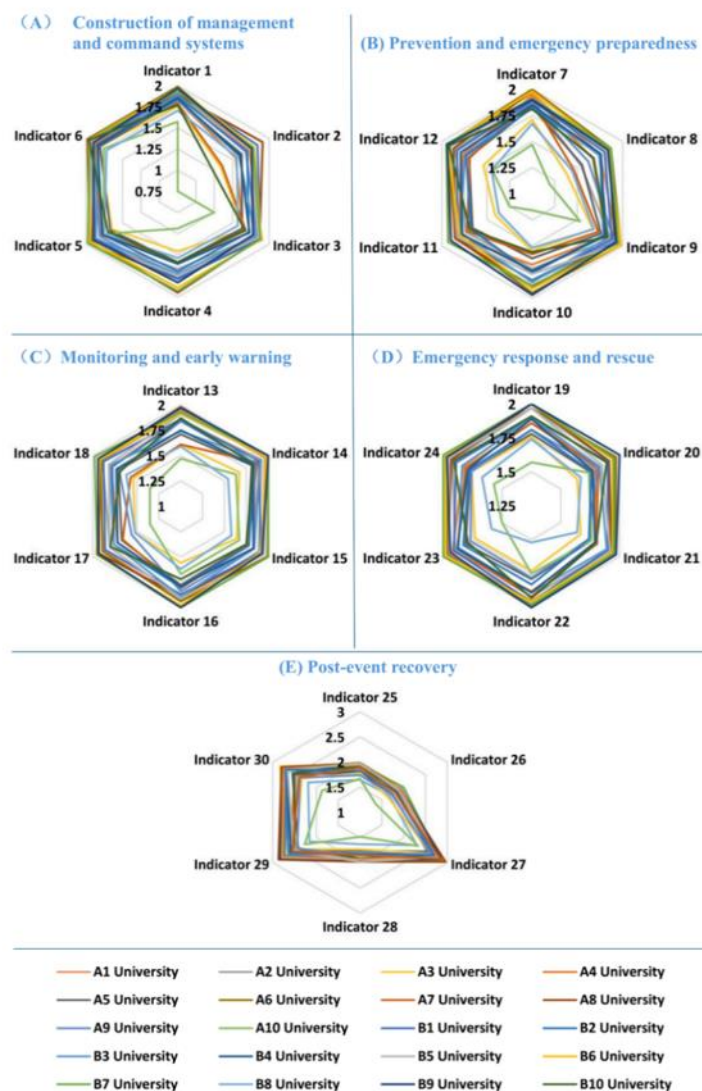


Figure 2: Radar chart of secondary indicators of emergency management capacity for public health emergencies in Guangxi universities



(A) Management and command system construction. There are six secondary indicators under this first-level dimension. As shown in Figure 2 (A), the average scores of most sample HEIs in Guangxi were higher than 1.5. However, A10, B10, and A3 colleges performed poorly overall in this dimension, significantly lower than the other 17 colleges. Specifically, in terms of the emergency command team holding regular meetings related to health emergencies (Indicator 2), all three of these colleges scored less than 1.5, with A10 scoring the lowest (only 0.75). In terms of clarifying the main parties responsible for health emergencies (Indicator 4), the scores of A10 and A3 were also below 1.5. In addition, A10 also scored less than 1.5 on the degree of collaboration between multiple departments (e.g., logistics, teaching, student administration) in the emergency command system (Indicator 3).

(B) Prevention and emergency preparedness. There are six secondary indicators under this first-level dimension. As shown in Figure 2 (B), most of the sample HEIs scored an average of more than 1.5 points. However, the overall performance of A10, B8 and A3 colleges was significantly worse than the other 17 sample colleges.

(C) Monitoring and early warning. As shown in Figure 2 (C), medical colleges including A3, A7, A10 and B10 scored low on the monitoring and early-warning informatization level (Indicators 17–18), indicating room for improvement in this dimension despite their professional resources.

(D) Emergency response and rescue. There are six secondary indicators under this first-level dimension. As shown in Figure 2 (D), the average scores of all the sample colleges are higher than 1.5, indicating that the domain as a whole is at a high level. However, the scores of A10 and B8 are slightly behind other colleges, indicating that there is still room for improvement.

(E) Post-event recovery. As shown in Figure 2 (E), most sample universities scored higher than 1.5 on Indicators 25, 26, and 28, and higher than 2.25 on Indicators 27, 29, and 30, reflecting a generally high level in this area. Those that did not do enough in post-event recovery were A10 and B8, both of which showed significant deficiencies in Indicator 25 (A10: 1.67; B8: 1.65), Indicator 26 (A10: 1.35; B8: 1.67), Indicator 28 (A10: 1.48; B8: 1.63), and Indicator 30 (A10: 1.87; B8: 2.19).

Rank-Sum Ratio (RSR) evaluation of emergency management capabilities

The evaluation results based on the Rank Sum Ratio (RSR) method indicate that there are significant hierarchical differences in the comprehensive emergency management capabilities for public health emergencies among the 20 universities in Guangxi. As shown in Table 2, the top five universities ranked by RSR values are: B7, A6, B6, A8, and B9, of which 60% are science and engineering-oriented,



20% comprehensive, and 20% public security and law-related. In contrast, the bottom five universities are A10, B8, A3, A5, and A7, of which 60% are medical and pharmaceutical institutions, and 20% each are arts and science and engineering institutions.

The study used a three-level grading scale to categorize the sample colleges and universities, with higher grading levels representing greater emergency management capabilities. The grading results show a gradient distribution: 4 colleges (20%) belong to the high-capability group (grade 3), 13 colleges (65%) belong to the medium-capability group (grade 2), and 3 colleges (15%) belong to the low-capability group (grade 1).

Table 2: RSR method for comprehensive assessment of emergency management capacity of 20 sample colleges and universities

School	Type	Rank	Probit	RSR fitted value	RSR	Hierarchy
B7	Science and Engineering	1	7.241403	1.147851		3
A6	General	2	6.644854	1.017468		3
B6	Science and Engineering	3	6.281552	0.938063		3
A8	Public Security and Law	4	6.036433	0.884490		3
B9	Science and Engineering	5	5.841621	0.841911		2
A1	Medicine	6	5.674490	0.805382		2
B5	Teacher Training	7	5.524401	0.772578		2
B1	Science and Engineering	8	5.385320	0.742181		2
A2	General	9	5.253347	0.713336		2
B3	Science and Engineering	10	5.125661	0.685429		2
A4	Finance and Economics	11	5.000000	0.657964		2
B10	Medicine	12	4.874339	0.630499		2
B4	Science and Engineering	13	4.746653	0.602592		2
B2	General	14	4.614680	0.573747		2
A9	Science and Engineering	15	4.475599	0.543349		2
A7	Medicine	16	4.325510	0.510546		2
A5	Science and Engineering	17	4.158379	0.474017		2
A3	Medicine	18	3.963567	0.431438		1
B8	Art	19	3.718448	0.377864		1
A10	Medicine	20	3.355146	0.298460		1



Discussion

The results of this study show that there are significant multidimensional differences in the emergency management capabilities of local universities in Guangxi in terms of public health emergencies. Specifically, the overall performance of universities in this region is better in the dimensions of monitoring and early warning (C) and emergency response and rescue (D) (mean score > 1.5), reflecting their higher maturity in real-time response mechanisms and basic disposal processes.

It should be emphasized that monitoring and early warning of public health emergencies is not only a key means of timely detection of potential outbreaks and effective containment of proliferation, but also an important path to achieve accurate prevention. In the future, universities with outstanding monitoring and early-warning measures should actively play a radiation-driven role, and provide emergency monitoring and early-warning guidance, equipment and resource sharing, peer-to-peer assistance, and training support for the emergency management departments of other universities during the period of regular management and emergency response ^[16]. In the process of emergency response and rescue, in addition to timely treatment of the injured and control of the scene, attention should be paid to the psychological recovery of students ^[4].

This study also found that three colleges, A10 (undergraduate-medicine), B8 (specialist-art) and A3 (undergraduate-medicine), significantly lagged behind in core emergency management dimensions. A10 lagged behind in the areas of command system (Indicators 2, 3, and 4), preventive preparedness (Indicators 7, 8, and 10–12), and post-event recovery (Indicators 25, 26, 28, 30), highlighting structural deficiencies in its emergency management system. B8 (specialized-art) showed deficiencies in preventive preparedness (Indicators 8, 11, and 12) and post-event recovery (Indicators 25, 30), reflecting a general tendency to neglect emergency management in art colleges. This may stem from the special nature of its student population composition and the non-traditional nature of its teaching mode ^[17].

Medical colleges including A3, A7, A10 and B10 scored low on monitoring and early-warning informatization (Indicators 17–18). This suggests that despite their advantages in professional resources, these have not been effectively transformed into campus early-warning practice. To address this shortcoming, such universities should focus on integrating big data and artificial intelligence technology, upgrading the existing monitoring and early-warning system and strengthening its functions, in order to improve the precision of early warning and the timeliness of intervention ^[18-19].



The paradox that medical universities, despite their clinical strength, rank in the low-to-mid tier should also be interpreted in light of geographical and threat-context factors. The sample institutions differ in location (e.g., the provincial capital of Nanning versus peripheral cities such as Baise and Guilin) and in campus structure (single- versus multi-campus), and Guangxi's hot-humid, multi-ethnic border setting exposes institutions to different hazard profiles. These contextual differences may shape which capabilities an institution prioritises: a university facing frequent infectious-disease pressure may invest differently from one whose principal risks are food safety or heat-related illness. Rather than indicating a uniform weakness, the medical-university result may therefore reflect a tendency to rely on in-house clinical capacity in place of campus-wide management systems—an effect that is likely to be moderated by an institution's prior experience with emergencies and the maturity of its management structures. This interpretation is consistent with our own finding that the gap between medical and non-medical institutions stems more from preventive preparedness and organisational systems than from treatment capacity. Accordingly, the claim that high clinical resources translate into strong campus early warning should be treated with caution.

The RSR assessment found that the overall performance of specialized colleges is better than that of undergraduate colleges: among the top 5 colleges, 3 are specialized colleges (B6, B7, B9) and 2 are undergraduate colleges (A8, A6); while 3 of the last 5 are undergraduate medical colleges (A3, A7, A10). The emergency management capability in Guangxi colleges shows a pattern of “overall superiority of specialized colleges and differentiation of medical colleges,” and the fundamental difference stems from the perfection of preventive preparedness and organizational systems rather than the level of emergency treatment. This phenomenon may also be attributed to the relatively small size of specialized colleges and their shorter management chain, which improves the efficiency of emergency-instruction implementation. This is consistent with an Anhui survey of medical students' emergency management capabilities in public health emergencies ^[20].

Educational authorities can formulate differentiated assessment standards based on the weight distribution to guide resources toward prevention and system construction. Overall, the public health incident management ability of science and engineering, public security and law is better than that of medicine and art. Science and engineering and public security and law continue to lead by virtue of systematic processes and technological rigour, while the medical category tends to be “heavy on rescue and treatment but light on management.” In the future, medical colleges should reconstruct their non-



medical emergency response system through institutional synergy and the transplantation of scientific management templates, and art colleges should develop lightweight visual plans and mobile resource networks.

Conclusion

To summarize, the early-warning capability of medical colleges in Guangxi is weak, and there is an urgent need to promote the transformation of their professional resources into campus emergency management practice and strengthen the application of informationized monitoring. The command system tops the list of weights, indicating that emergency management should be centered on an institutionalized and normalized decision-making mechanism. Specialized colleges perform better overall, and their experience in flat management can provide useful reference for undergraduate colleges. In particular, larger undergraduate universities should consider adapting the flat-management model observed in smaller specialized colleges shortening the chain of command and delegating clearer emergency decision authority to campus-level units so as to reduce bureaucratic delay and accelerate the execution of emergency instructions. The recovery process is generally neglected, and efforts should be made to build a closed-loop management mechanism of “disposal–assessment–optimization” in order to continuously improve the resilience and adaptability of the emergency response system. Taken together, these findings answer the three objectives of the study: the evaluation model integrating the Delphi-derived indicator system with RSR ranking was successfully constructed (Objective 1); it revealed clear, graded capability differences among the 20 universities (Objective 2); and it yields concrete, tiered recommendations that can serve as a reference for enhancing campus emergency management capacity, including in comparable settings beyond Guangxi (Objective 3).

Recommendations

(I) Implement a tiered competency-enhancement strategy to narrow the inter-school gap.

High-capacity colleges (20%, e.g., B7, A8) should build regional emergency-response training bases and provide exercise guidance and technical support to low-capacity colleges. Medium-capacity colleges (65%) should focus on strengthening post-event recovery (Indicators 25–30) and multisectoral collaboration (Indicator 3), and establish inter-campus support twinning mechanisms. Low-capacity colleges (15%, e.g., A10, B8) should be supervised by the education authority and rectify shortcomings in monitoring and early-warning informatization (Indicators 17–18) and plan revision by a deadline.



(II) Systematically reinforce weak links and build a closed management loop.

Implement the mandatory three-step process of “emergency response – summary assessment – plan optimization” (Indicators 25–28), and incorporate the post-incident review into university assessment indicators. Specifically, we recommend that the After Action Review (AAR) be established as a mandatory, scored benchmark within the standard emergency-management assessment criteria for universities, so that the post-event recovery dimension currently the most neglected is routinely evaluated rather than treated as optional. Sign emergency collaboration agreements with local CDCs and tertiary hospitals (Indicator 6), and carry out one joint drill per semester.

(III) Future research directions.

Quantify the impact of the length of the management chain (e.g., flat management of specialized colleges) on the efficiency of emergency response, and explore the application of AI and IoT technology for real-time monitoring in high-risk scenarios such as dormitories and cafeterias (Indicator 18).

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