

Social Health Innovation and Emergency Preparedness in Universities: An Evaluation of Perceived Public Health Crisis Management Capacity in Guangxi, China

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Abstract

This cross-sectional survey study developed and applied a multidimensional framework for evaluating the public health emergency management capacity of higher education institutions (HEIs) in the Guangxi Zhuang Autonomous Region, China. Social health innovation defined here as the coordinated reform of institutional governance, community health partnership and technology adoption provided the conceptual lens for indicator development. A five-dimension, 30-item indicator system was constructed through two rounds of Delphi consultation with seventeen experts (effective response rates 100.00% and 91.67%; expert authority coefficient 0.94). Kendall's coefficient of concordance was in round one and 0.306 in round two (both $p < 0.01$), indicating statistically significant but modest expert agreement. Between February and June 2025, structured questionnaires were distributed by convenience sampling to students and faculty at twenty HEIs, yielding 1,701 valid responses (institutional sample sizes 30–368). Capacity was measured as respondents' perceptions rather than through objective institutional audit. The entropy weight method (EWM) derived data-driven indicator weights reflecting between-institution variability, and the rank sum ratio (RSR) method with Probit-based grading ranked and classified institutions. Management and command system construction (28.19%) and prevention and emergency preparedness (26.63%) carried the largest entropy weights; perceived shortfalls were most pronounced in contingency plan updating, inter-departmental coordination and post-incident evaluation. Descriptively, vocational colleges scored higher overall than undergraduate universities, and science-engineering and public security institutions scored higher than medical and arts institutions; these comparisons were not tested inferentially. Probit grading classified 4 of the 20 institutions (20.00%) as high capacity, 13 (65.00%) as medium and 3 (15.00%) as low. On the basis of these findings the study proposes as an interpretive contribution rather than a validated intervention a social health innovation framework centred on flatter emergency governance, university–community health partnerships and technology-enhanced early warning. For policy, the results indicate that regional education and health authorities should weight institutionalised command mechanisms and preventive preparedness most heavily in HEI assessment standards, and direct targeted support to institutions in the low-capacity tier.

Keywords: Social health innovation, University emergency management, Public health emergencies, Institutional capacity assessment, Guangxi higher education institutions

Introduction

Higher education institutions (HEIs) occupy a distinctive position within the social infrastructure of public health governance, serving simultaneously as sites of concentrated population density, hubs of knowledge production, and microcosms of the communities they serve. When public health emergencies infectious disease outbreaks, food safety incidents, or unexplained mass illnesses arise within campus settings, the consequences extend well beyond institutional boundaries to affect the well-being of surrounding communities and the stability of regional social systems (Chen et al., 2024).

This study adopts social health innovation as its guiding conceptual lens, and defines the construct operationally so that its relationship to the measured indicators is explicit. Drawing on the literature on community-based health governance and institutional resilience, social health innovation is understood here as the coordinated reform of three institutional capabilities: (i) governance restructuring the redesign of decision-making authority, cross-departmental coordination and accountability so that health risks can be managed rapidly and across organisational boundaries; (ii) community engagement the deliberate extension of institutional health capability outward through partnerships with hospitals, disease control agencies and neighbouring communities; and (iii) technology adoption the use of information systems for surveillance, early warning and risk communication (Cao et al., 2020; Heinsohn et al., 2022).

These three components directly informed the five-dimension indicator system used in this study, as summarised in Figure 1. Governance restructuring is represented by the management and command system construction dimension; community engagement and preparedness planning by the prevention and emergency preparedness and the emergency response and rescue dimensions; technology adoption by the monitoring and early warning dimension; and the aftermath recovery dimension captures the learning loop through which all three components are revised after an event. Social health innovation therefore functions in this study as an analytical framework for interpreting institutional capacity profiles. It should be stated at the outset that the construct was not measured as a separate latent variable, and the study does not claim to have empirically validated it.

The Guangxi Zhuang Autonomous Region, located in southern China with a population exceeding fifty million, presents a compelling context for such an investigation. Its subtropical to tropical monsoon climate sustains year-round vector activity and favourable conditions for arboviral and enteric infections, while its extensive land border with Viet Nam and its position on major regional transport corridors generate sustained cross-border population movement a documented pathway for the importation of communicable disease into the region. According to Ministry of Education data for 2024, Guangxi hosts eighty-seven higher education institutions comprising thirty-eight universities and forty-nine colleges, with a combined enrolment of approximately 1.55 million students. Between 2014 and 2016, Guangxi ranked third nationally in reported school-related public health incidents (Weng et al., 2019); this remains the most recent published national comparison of school-based incident rates by province, and more recent provincial surveillance data would strengthen the case further.

The COVID-19 pandemic sharpened the importance of robust emergency response capability in university settings, particularly in economically developing regions with constrained resources and distinctive epidemiological profiles (Cao et al., 2020). Earlier provincial analyses of public health emergencies in Guangxi (Zhizhi et al., 2011) are retained here only as evidence of the pre-pandemic incident baseline, and are no longer used to support claims about the pandemic period itself.

Recent evaluation research has advanced on three fronts, none of which resolves the problem addressed here. First, at the individual level, Wei et al. (2023) constructed a Delphi-based index for assessing personal emergency preparedness during major emerging infectious disease outbreaks, and Chen et al. (2024) evaluated public health emergency management competence and its associated factors among medical college students in southwest China; both measure people rather than institutions. Second, at the national and system level, Wang et al. (2022) evaluated emergency response capability across China and analysed the obstacles to it, while Murphy et al. (2019) quantitatively assessed disaster preparedness and resilience among United States HEIs; these operate above or outside the Chinese institutional context. Third, campus-level risk analysis work such as Dehdashti et al. (2020) documents hazard profiles but does not produce a comparative capacity ranking across institutions.

The research gap addressed by this study is therefore specific: no published work has constructed a multidimensional indicator system and used it to evaluate and comparatively rank public health emergency management capacity across multiple HEIs within a single Chinese province or autonomous region, in a way that accounts for institutional type and disciplinary orientation. Closing this gap matters practically, because without comparative institution-level evidence, education and health authorities cannot target scarce preparedness resources to the institutions that most need them.

Objectives

The study pursued three objectives:

1. To develop a multidimensional framework for evaluating the public health emergency management capacity of higher education institutions in Guangxi.
2. To assess and comparatively rank perceived emergency management capacity across twenty higher education institutions in Guangxi using that framework.
3. To propose, on the basis of the empirical findings, a social health innovation framework for strengthening institutional resilience.

Objectives 1 and 2 are empirical. Objective 3 is an interpretive or output objective: it yields a conceptual proposal derived from the observed capacity profiles, not an intervention that has been tested. Each objective is revisited explicitly in the Conclusion.

Literature Review

The scholarly literature on campus emergency management reveals a marked contrast between developed and developing country contexts. In nations such as the United States, the United Kingdom and Japan, comprehensive full-cycle management systems spanning pre-event warning, active response and post-event recovery have been established through coordinated government and institutional efforts (Huang & Wang, 2020; Zhang, 2022). At the university level, these systems emphasise proactive risk prevention through strengthened emergency regulations, systematic campus risk assessment, regular stockpiling of essential supplies and technical resources, effective risk communication strategies, and institutionalised psychological intervention programmes. Murphy et al. (2019) found, however, that even within this comparatively mature environment, preparedness and resilience vary substantially between institutions, which supports the value of institution-level rather than system-level measurement.

In the Chinese higher education context, emergency management systems continue to face several structural challenges. A central limitation involves the insufficient incorporation of students as active participants in emergency governance, manifested in inadequate cultivation of student awareness and response capabilities, limited institutional mechanisms supporting their engagement, and a tendency toward superficial rather than substantive public health education. A persistent gap between theoretical instruction and practical preparedness — often described as a separation of knowledge from action — further weakens institutional

readiness. At the operational level, existing systems commonly exhibit deficiencies in contingency plan design, implementation effectiveness, post-event recovery processes, and the adequacy of resource and institutional support mechanisms (Xu, 2021; Jiang et al., 2025). Cao et al. (2020) reached a convergent conclusion at national scale, identifying coordination and early-warning weaknesses as the principal constraints on China's public health emergency management during COVID-19.

Methodologically, indicator-system construction in this field has relied heavily on Delphi consultation, typically combined with the Analytic Hierarchy Process for weighting (Wei et al., 2023). Delphi establishes content validity but leaves weights dependent on further expert judgement. The present study departs from this convention by pairing Delphi-derived content with entropy weighting, which derives weights from the dispersion actually observed in the data, and with rank sum ratio analysis, which converts a multi-indicator matrix into a defensible institutional grading. The methodological contribution is therefore the pairing of these techniques with a social health innovation lens at the institutional level, rather than the novelty of the techniques in isolation.

Viewed through the lens of social health innovation, the documented weaknesses represent opportunities for institutional transformation. By reconceptualising emergency management not merely as an administrative function but as a form of social capital development one that strengthens the bonds between universities and their surrounding communities while building collective capacity for health governance institutions can move beyond reactive approaches toward proactive, community-embedded resilience. This theoretical perspective guided the development of the evaluation framework employed in the present study.

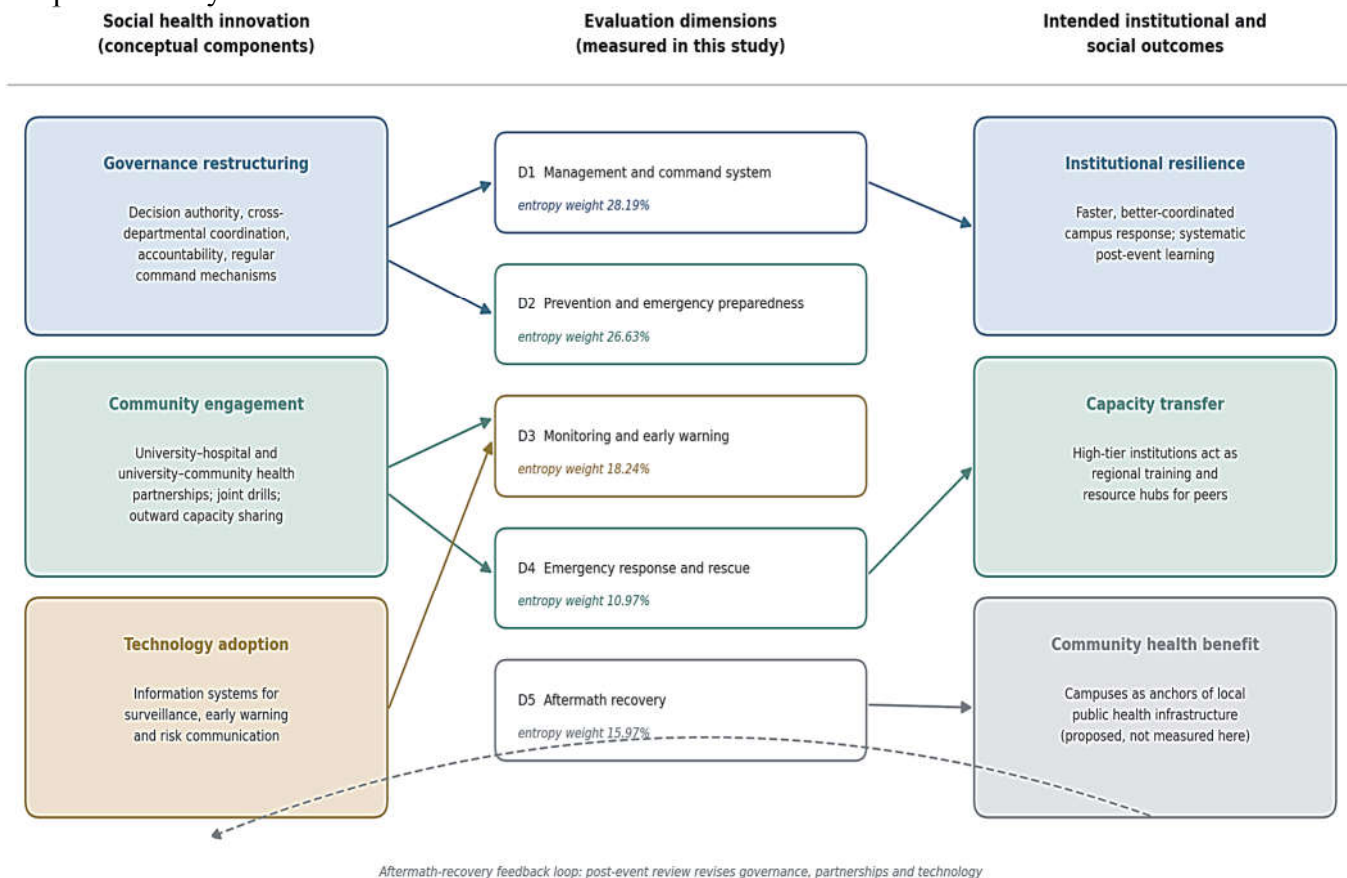


Figure 1 Operationalisation of social health innovation and its mapping onto the five evaluation dimensions. Entropy weights shown are those obtained in this study (Table 3). The community health benefit outcome is proposed rather than measured.

Methodology

Study design and setting

This was a cross-sectional, questionnaire-based study conducted across twenty higher education institutions in the Guangxi Zhuang Autonomous Region between February and June 2025. The sampled institutions comprised ten undergraduate universities (coded A1–A10) and ten vocational colleges (coded B1–B10), representing diverse disciplinary orientations: three comprehensive institutions, eight science and engineering institutions, one teacher training college, one finance and economics institution, five medical and pharmaceutical colleges, one arts institution, and one public security and law institution.

Sampling, participants and justification

A convenience sampling strategy was used. Electronic questionnaires were distributed through the institutional management channels of each participating institution; the survey link was forwarded to students and faculty by a designated coordinator, and participation was voluntary and anonymous. A total of individuals were invited, of whom 1,701 returned valid responses.

Inclusion criteria were: (i) currently enrolled student or actively employed faculty or staff member at one of the twenty institutions at the time of data collection; and (ii) provision of informed consent. Exclusion criteria were: (i) incomplete questionnaires; (ii) responses with uniform answers across all items or with a completion time below the pre-set minimum, which were treated as inattentive; and (iii) respondents who had been enrolled or employed at the institution for less than one semester and were therefore unable to comment on institutional practice.

Convenience sampling was adopted because the twenty institutions differ substantially in size, administrative structure and willingness to distribute external surveys, and no central sampling frame of students and staff across Guangxi HEIs was available to the research team. This strategy permits broad coverage at acceptable cost, but it does not produce a probability sample: respondents who chose to participate may differ systematically from those who did not, particularly in their interest in or exposure to emergency management. The resulting limits on generalisability, and the consequences of the unequal institutional sample sizes, are addressed in the Limitations section.

Ethical considerations

The study protocol was reviewed and approved by 5 . All participants were presented with an information statement describing the purpose of the study, the voluntary and anonymous nature of participation, and their right to withdraw at any point without consequence; electronic informed consent was obtained before the questionnaire could be accessed. No personally identifying information was collected, and institutional identities are reported only in coded form (A1–A10, B1–B10).

Indicator system development (Delphi)

The indicator system was refined through two rounds of Delphi consultation with seventeen domain experts. Effective response rates were 100.00% in round one and 91.67% in round two. The expert authority coefficient was calculated as $Cr = (Ca + Cs) / 2$, where Ca is the judgement basis coefficient and Cs the familiarity coefficient, yielding $Cr = 0.94$, which exceeds the conventional 0.70 threshold for authoritative consultation. Kendall's coefficient of concordance was in round one and $W = 0.306$ ($p < 0.01$) in round two.

The round-two value indicates that agreement among experts, while statistically significant, was modest in magnitude: a W of approximately 0.3 denotes weak-to-moderate concordance rather than strong consensus. This is not unusual in multi-indicator Delphi studies of emergency preparedness: comparable published frameworks in this field have reported Kendall's coefficients in the range of roughly 0.16 to 0.32 but it does mean that the relative ordering of individual indicators should be treated as provisional, and this is reflected in the interpretation offered throughout.

Instrument and psychometric properties

The survey instrument was designed by the research team and comprised two sections. The first collected demographic information: gender, age, educational qualification, institutional role (faculty or student), years of professional experience, and academic title. The second assessed public health emergency management capability using the Delphi-refined indicator system: thirty items across five dimensions: management and command system construction, prevention and emergency preparedness, monitoring and early warning, emergency response and rescue, and aftermath recovery with six items per dimension.

Response scales used either a three-point (0, 1, 2) or a four-point (0, 1, 2, 3) format, with higher scores indicating stronger perceived capability. Because the two formats have unequal ranges, every indicator column was min–max normalised to the interval [0, 1] before entropy weighting and rank assignment, so that four-point items did not exert disproportionate influence on the composite score simply by virtue of their wider raw range.

Content validity was established through the two Delphi rounds. Internal consistency was acceptable, with Cronbach's alpha coefficients for the five dimensions ranging from 0.841 to 0.915. No exploratory or confirmatory factor analysis was conducted, so the five-dimension structure rests on content validity rather than on empirically demonstrated dimensionality; this is acknowledged as a limitation and identified as a priority for future work.

Measurement construct

An important feature of the design should be made explicit. Capacity was not measured by objective institutional audit—for example by inspecting contingency plan documents, verifying stockpile levels, or observing drills. It was measured as the aggregated perception of students and staff regarding the practices of their own institution. The construct is therefore perceived institutional capacity. Perceptions are informative because students and staff are the population on whom emergency arrangements actually operate, and because low perceived capacity is itself a governance problem regardless of what documentation exists. They are nonetheless subject to self-report bias, to differences in respondents' proximity to emergency management functions, and to variation in institutional communication about arrangements that do exist. All findings should be read accordingly.

Analytical workflow

Analyses were conducted in SPSS version 26.0. The workflow proceeded in six steps, presented here in full because the aggregation of individual responses to institution-level scores is central to interpreting the results.

Step 1 Screening. Returned questionnaires were screened against the exclusion criteria above, leaving 1,701 valid responses.

Step 2 Aggregation to institution level. For each institution j and each of the thirty secondary indicators i , the arithmetic mean of all valid respondent scores at that institution was computed. This produced a 20×30 institution-by-indicator matrix, which was the unit of analysis for all subsequent steps. Institutional means were unweighted: every respondent at an

institution contributed equally to that institution's score, and institutions contributed equally to the analysis regardless of how many respondents they supplied.

Step 3 Normalisation. Each of the thirty indicator columns was min–max normalised to $[0, 1]$ to remove the effect of the differing three- and four-point response ranges.

Step 4 Entropy weighting. For each normalised indicator, information entropy e_i was computed and the weight derived as $w_i = (1 - e_i) / \sum(1 - e_i)$. Entropy weights quantify how much an indicator discriminates between institutions: an indicator on which all twenty institutions score similarly carries little information and receives a low weight, while an indicator that spreads institutions widely receives a high weight. They are a property of the observed data distribution and are not a measure of the substantive or theoretical importance of an indicator.

Step 5 Rank sum ratio. Institutions were ranked on each indicator, and the weighted rank sum ratio computed as $WRSR_j = \sum(w_i \times R_{ij}) / m$, where R_{ij} is the rank of institution j on indicator i and m is the number of institutions.

Step 6 Probit grading. $WRSR$ values were converted to cumulative frequencies and Probit values, and the regression $RSR = a + b \times \text{Probit}$ was fitted. Optimal grading on the fitted line partitioned the twenty institutions into high, medium and low capability tiers.

Justification of the analytical methods

The entropy weight method was selected in preference to subjective weighting procedures such as the Analytic Hierarchy Process because expert judgement had already been used once, in the Delphi rounds, to establish which indicators belong in the system. Applying a second layer of expert judgement to set the weights would compound any bias present in the first; entropy weighting instead derives weights from the observed data, and is reproducible from the dataset alone. Its trade-off, addressed above, is that the resulting weights carry no theoretical claim.

The rank sum ratio method was selected in preference to a simple weighted composite index or to TOPSIS for three reasons: it is non-parametric and therefore robust to the ordinal, non-normally distributed scores produced by short response scales; it performs adequately with a small number of evaluation objects, which matters when only twenty institutions are compared; and its Probit-based grading step produces an explicit, reproducible rule for classifying institutions into tiers rather than requiring an arbitrary cut-off (Tian, 1993; SPSSPRO, 2021).

Descriptive performance thresholds are also reported. The 1.5-point threshold applied to items scored on the three-point (0–2) scale corresponds to 75% of the maximum attainable score for that item. Thresholds are used for description only, and no inferential test was applied to threshold crossings.

Results

Respondent characteristics

A total of 1,701 valid questionnaires were obtained from the twenty sampled institutions. Respondent characteristics are summarised in Table 1. Individual institutional samples ranged from 30 to 368 respondents.

Table 1 Characteristics of respondents (n = 1,701)

Characteristic	Category	n	%
Institution type	Undergraduate university	1,079	63.40
	Vocational college	622	36.60
Role	Student	1,254	73.70
	Faculty and staff	447	26.30
Age (years)	≤ 25	-	72.70
	26–45	-	21.40
Highest qualification	Bachelor's degree	-	54.40
Academic title (faculty)	Intermediate	-	44.50
Work experience (faculty)	6–12 years	-	38.90
	≥ 13 years	-	40.00

Note: Male-to-female ratio 1.09:1

Dimension-level scores

In the management and command system dimension, most institutions achieved mean scores above the 1.5-point descriptive threshold on the three-point scale. Three institutions scored below it: A10 (undergraduate, medicine), A3 (undergraduate, medicine) and B10 (vocational, medicine). Institution A10 recorded 0.75 points on the regularity of emergency command meetings, and scored below threshold on inter-departmental coordination and on accountability structures.

In the prevention and emergency preparedness dimension, institutions A10, B8 (vocational, arts) and A3 scored below threshold, specifically on contingency plan updating, staff training provision, and comprehensive preventive measure development.

The monitoring and early warning dimension and the emergency response and rescue dimension produced mean scores above threshold at all twenty institutions. Within the monitoring dimension, however, four institutions A3, A7, A10 and B10, all medical or pharmaceutical recorded the lowest scores in the sample on indicators relating to information technology integration in monitoring systems.

In the aftermath recovery dimension, institutions A10 and B8 scored below threshold on post-event comprehensive assessment, follow-up care, plan optimisation and preventive awareness training.

Entropy weights

Entropy weights for the five primary dimensions are reported in Table 2. Weights reflect the degree to which each dimension discriminated between the twenty institutions in this dataset.

Table 2 Entropy weights of the five primary dimensions

Dimension	Weight (%)	Rank
D1 Management and command system construction	28.19	1
D2 Prevention and emergency preparedness	26.63	2
D3 Monitoring and early warning	18.24	3
D5 Aftermath recovery	15.97	4
D4 Emergency response and rescue	10.97	5
Total	100.00	

Note: Weights are data-derived and express each dimension's discriminating power across the twenty institutions; they are not a ranking of substantive importance.

Across the thirty secondary indicators, weights ranged from 0.76% to 15.01%. The indicator on regular emergency command team meetings carried the highest weight (15.01%), meaning that institutions varied more on this indicator than on any other. The indicator on hospital–university cooperation mechanisms carried the lowest (0.76%), meaning that institutions scored similarly on it.

Institutional ranking and tier classification

Weighted rank sum ratio values and the resulting Probit-based tier classification are reported in Table 4. The five highest-ranked institutions were B7 (vocational, science-engineering), A6 (undergraduate, comprehensive), B6 (vocational, science-engineering), A8 (undergraduate, public security-law) and B9 (vocational, science-engineering). The five lowest-ranked were A10, B8, A3, A5 and A7. Probit grading placed four institutions (20.00% of the twenty institutions evaluated) in the high-capability tier, thirteen (65.00%) in the medium tier and three (15.00%) in the low tier. All percentages refer to institutions, not to respondents.

Table 4 Weighted rank sum ratio, rank and capability tier by institution

Code	Type	Disciplinary orientation	Rank	Tier
B7	Vocational	Science-engineering	1	High
A6	Undergraduate	Comprehensive	2	High
B6	Vocational	Science-engineering	3	High
A8	Undergraduate	Public security-law	4	High
B9	Vocational	Science-engineering	5	Medium
...	...	...	6–15	Medium
A7	Undergraduate	Medicine	16	Medium
A5	Undergraduate	Medicine	17	Medium
A3	Undergraduate	Medicine	18	Low
B8	Vocational	Arts	19	Low
A10	Undergraduate	Medicine	20	Low

Descriptively, three of the five highest-ranked institutions were vocational colleges, and four of the five lowest-ranked were medical or pharmaceutical institutions. No inferential test of the difference between institutional types or between disciplinary orientations was conducted, and these patterns are therefore reported as descriptive observations only.

Discussions

The findings speak to institutional emergency management and to the broader discussion of social health innovation in higher education. Strong scores in the monitoring—early warning and emergency response—rescue dimensions suggest that Guangxi's HEIs have reached a reasonable baseline of perceived reactive capacity. Whether that perceived capacity would translate into effective performance during an actual emergency is a question this design cannot answer, and the distinction matters: respondents were reporting what they believe their institution can do.

Institutions with well-regarded monitoring systems may be well placed to extend expertise outward — sharing resources, providing technical guidance and offering training to neighbouring institutions and community organisations. This is offered as an implication for practice rather than as a finding: no community-level outcome was measured in this study, and the effect of such sharing on regional resilience remains untested (Wei et al., 2023).

The medical institution paradox

The most striking pattern is that medical and pharmaceutical institutions — A3, A7, A10 and B10 — scored lowest on command system governance, preventive preparedness, post-event recovery, and on information technology integration in monitoring. Professional medical expertise, on this evidence, does not automatically translate into perceived campus-level emergency governance. Two explanations are consistent with the data, and the study does not distinguish between them.

The first is substantive: an institutional culture oriented toward clinical treatment may under-invest in systematic administrative management, producing genuine governance gaps. The second is a reporting artefact: respondents at medical institutions have professional training in what good public health practice looks like and may therefore apply a more exacting standard when rating their own institution, depressing scores relative to institutions whose respondents lack that benchmark. This second possibility is a specific vulnerability of perception-based measurement and cannot be excluded here. Distinguishing the two would require either an objective audit component or a calibration of respondent expectations, and is proposed below as a priority for future research.

If the substantive explanation holds, integrated emergency governance models that explicitly bridge clinical competence with administrative management systems drawing on the standardised process approaches observed in high-scoring science and engineering institutions would be the appropriate response (Jia et al., 2024).

Interpreting the entropy weights

Management and command system construction and prevention and emergency preparedness together accounted for 54.82% of the total weight. It is important not to over-read this. Because entropy weights measure dispersion, the correct interpretation is that these two dimensions discriminated most sharply between institutions they are where Guangxi HEIs differ most, and therefore where evaluation and targeted investment can be most efficiently directed. The result does not establish that these dimensions are causally the most consequential for emergency outcomes, although that proposition is consistent with the wider literature on proactive governance (Cao et al., 2020; Wang et al., 2022).

The same caution applies in reverse to the lowest-weighted indicator. Hospital–university cooperation received 0.76% not because such cooperation is unimportant, but because institutions scored uniformly on it in this sample, uniformly undeveloped. A dimension on which all institutions are equally weak is invisible to entropy weighting precisely when it

may most warrant attention. Strengthening university–hospital ties therefore remains a plausible avenue for social health innovation despite its low weight, and this reading is supported by prior work rather than by the weight itself (Zhang, 2022).

Institutional type and organisational structure

Vocational colleges scored higher overall than undergraduate universities. A structural explanation is available and intuitively appealing: shorter management chains, smaller organisational scale and more agile decision-making may facilitate more responsive emergency governance, consistent with organisational theory on flat structures and crisis communication (Hou et al., 2022). This study did not measure management chain length, organisational scale or decision latency, and did not test the association statistically. The structural account is therefore advanced as a hypothesis generated by the data, not as a finding established by it, and testing it directly is proposed below.

Undergraduate universities, particularly those spanning multiple campuses with complex disciplinary portfolios, may nonetheless find value in examining the management practices of high-scoring vocational institutions and adapting relevant elements to their own contexts.

Limitations

Seven limitations qualify these findings.

1. Design. The study is cross-sectional and describes perceived capacity at a single point between February and June 2025. It cannot establish causal relationships, nor track how capacity changes after an incident or a policy intervention.

2. Sampling. Convenience sampling was used and no probability sampling frame was available. Respondents who elected to participate may differ systematically from those who did not, particularly in their engagement with emergency management, which may bias institutional scores in an unknown direction.

3. Measurement. Capacity was measured through respondent perception rather than objective audit. Self-report bias, variation in respondents' proximity to emergency management functions, and differences between institutions in how well existing arrangements are communicated all affect the scores. The medical institution finding is particularly exposed to this limitation, as discussed above.

4. Unequal and small institutional samples. Institutional sample sizes ranged from 30 to 368. Because institutional scores are unweighted means, estimates for institutions with around 30 respondents are considerably less stable than those for institutions with several hundred, yet both contribute equally to the ranking. Conclusions about individual institutions — including A10, A3 and B8 — should be read with the corresponding sample size in view.

5. Weighting method. Entropy weights derive from the dispersion observed in this particular dataset. They would change with a different sample of institutions, and they carry no theoretical claim about which dimensions matter most for emergency outcomes.

6. Absence of inferential testing. Comparisons between vocational and undergraduate institutions, and between disciplinary orientations, are descriptive. No significance tests, confidence intervals or effect sizes are reported, so the possibility that these differences reflect sampling variation cannot be excluded.

7. Generalisability and structure. Findings derive from twenty institutions in one autonomous region and may not transfer to other provinces or to other higher education systems. The five-dimension structure rests on Delphi content validity and has not been confirmed by factor analysis.

Future Research

Five directions follow from these limitations. First, pairing perception-based measurement with an objective audit component document review, stockpile verification, drill observation at a subset of institutions would establish how far perceived capacity tracks demonstrable capacity, and would directly test the reporting-artefact explanation of the medical institution result. Second, applying exploratory and confirmatory factor analysis to the thirty items would test whether the five-dimension structure is empirically supported. Third, collecting organisational variables management chain length, campus count, staffing ratios, decision latency would allow the structural explanation for the vocational college advantage to be tested rather than inferred. Fourth, subgroup analysis by respondent role and by gender, and inferential comparison between institutional types with appropriate adjustment for clustering, would strengthen the comparative claims. Fifth, longitudinal follow-up, or replication in another province, would establish whether the capacity profile identified here is stable and whether it is specific to Guangxi.

Conclusion and suggestions

Each objective is addressed in turn. On the first objective, a multidimensional evaluation framework comprising five dimensions and thirty indicators was developed through two rounds of Delphi consultation, with acceptable internal consistency ($\alpha = 0.841\text{--}0.915$) and an expert authority coefficient of 0.94, though with only modest expert concordance ($W = 0.306$). On the second, the framework was applied to twenty Guangxi HEIs: perceived capacity varied across institutional types, disciplinary orientations and management dimensions; the aftermath recovery dimension was consistently the weakest across the sample; and Probit grading classified four institutions as high capacity, thirteen as medium and three as low. On the third, a social health innovation framework is proposed below on the basis of these findings, as a conceptual and policy proposal rather than a validated intervention.

Recommendations derived directly from the study findings

1. Assessment standards should weight command system governance and preventive preparedness most heavily, because these two dimensions discriminated most sharply between institutions (28.19% and 26.63% of total entropy weight) and are therefore where evaluation is most informative and targeted investment most efficient.

2. The three institutions in the low-capability tier, and specifically A10, A3 and B8, require targeted intervention on the indicators on which they fell below threshold: regularity of emergency command meetings, inter-departmental coordination, accountability structures, contingency plan updating and staff training provision.

3. A mandatory post-event review protocol should be institutionalised across all HEIs. Aftermath recovery was the dimension on which institutions were weakest overall, and A10 and B8 fell below threshold on post-event comprehensive assessment, follow-up care and plan optimisation.

4. Medical and pharmaceutical institutions warrant specific attention to information technology integration in campus monitoring systems, on which A3, A7, A10 and B10 recorded the lowest scores in the sample with the caveat, noted above, that this pattern may partly reflect more exacting self-assessment at these institutions.

Broader policy implications supported by previous literature

The following are consistent with the present findings but rest primarily on prior evidence rather than on what this study measured, and are offered as implications rather than conclusions.

1. High-capability institutions could serve as regional training hubs disseminating practice to lower-performing peers. This study did not evaluate any such transfer mechanism.
2. Formal university–hospital cooperation agreements and regular joint exercises would address an area in which all sampled institutions scored uniformly low, though the benefit of doing so is inferred from prior work (Zhang, 2022) rather than demonstrated here.
3. Technology-enhanced monitoring incorporating artificial intelligence and Internet of Things applications, prioritised for higher-risk campus environments such as dormitories and dining facilities, is supported by the wider disaster informatics literature (Lu et al., 2022; Jia et al., 2024).
4. Where the structural explanation for the vocational college advantage is borne out by future testing, flatter emergency governance structures in large multi-campus universities would follow as a design recommendation.

New knowledge and the effects on society and communities

The study contributes in three respects. First, it provides the first comparative, institution-level evaluation of perceived public health emergency management capacity across multiple HEIs in Guangxi, producing a reproducible ranking and tier classification rather than a single-institution case description. Second, it demonstrates a methodological pairing not previously applied in this domain: entropy weighting and rank sum ratio have each been used in health services evaluation, but their combination for cross-institutional HEI emergency capacity assessment with weights derived from data rather than from a second round of expert judgement is novel to this field, and offers a template that other regions can apply without access to a large expert panel. Third, the finding that vocational colleges scored above undergraduate universities is counter-intuitive relative to the resource-based assumption that better-funded institutions are better prepared, and generates a testable structural hypothesis about organisational form and emergency governance.

The findings have identifiable users. Provincial and municipal education authorities can use the tier classification to target preparedness funding and to set differentiated assessment standards. HEI administrators — particularly directors of student affairs, campus health services and security offices — can use the dimension profiles to locate their own institution's weakest indicators. Regional centres for disease control can use the hospital–university cooperation finding to identify where partnership infrastructure is absent. Accreditation bodies can incorporate the indicator system into institutional review.

Claims about community and regional health benefit should be framed carefully. This study measured campus-level perceptions; it did not measure community health outcomes, and no inference about community resilience can be drawn from its data. The proposition that strengthened HEI preparedness contributes to regional public health infrastructure is an aspiration consistent with the social health innovation framework and with prior literature, and is offered as a direction for future evaluation rather than as a demonstrated effect.

The framework is in principle transferable. Its requirements are modest — an expert panel for content validation, a survey of students and staff, and standard statistical software — and it does not depend on features unique to China. Higher education systems with a comparable mix of institutional types and a similar administrative relationship between institutions and regional health authorities, including those in Southeast Asia, could apply the same procedure, adapting indicator content to local regulatory requirements while retaining the five-dimension structure and the entropy–RSR analytical pipeline.

References

- Cao, Y., Shan, J., Gong, Z., Kuang, J., & Gao, Y. (2020). Status and challenges of public health emergency management in China related to COVID-19. *Frontiers in Public Health*, 8, 250. <https://doi.org/10.3389/fpubh.2020.00250>
- Chen, X., Zhang, M., Bu, Q., Tan, B., & Deng, D. (2024). Evaluation and associated factors of public health emergency management among medical college students in a city in Southwest China: A cross-sectional study. *BMC Medical Education*, 24(1), 314. <https://doi.org/10.1186/s12909-024-05317-1>
- Dehdashti, A., Fatemi, F., Janati, M., Asadi, F., & Belji Kangarloo, M. (2020). Data of risk analysis management in university campuses. *BMC Research Notes*, 13, 554. <https://doi.org/10.1186/s13104-020-05397-4>
- Heinsohn, T., Lange, B., Vanella, P., Rodiah, I., Glöckner, S., Joachim, A., Konrad, M., Ott, J. J., Steinmann, E., Diel, R., Lehrer, C., Rübsamen, N., Schaade, L., Karch, A., Mikolajczyk, R., & Krause, G. (2022). Infection and transmission risks of COVID-19 in schools and their contribution to population infections in Germany: A retrospective observational study using nationwide and regional health and education agency notification data. *PLoS Med*, 19(12), e1003913. <https://doi.org/10.1371/journal.pmed.1003913>
- Hou, S., Zhou, Z., Zuo, Q., Wang, Z., Li, C., Liu, H., Zhang, M., Gao, H., Meng, H., & Xu, M. (2022). Status and influencing factors of emergency management ability of public health emergencies among medical students in Anhui Province. *Occupational Health and Emergency Rescue*, 40(3), 277–281. <https://doi.org/10.16369/j.oher.issn.1007-1326.2022.03.004>
- Huang, Y., & Wang, Y. (2020). Emergency management systems and capacity-building in developed countries: Models, characteristics and useful experiences. *Ningxia Social Sciences*, 2, 90–96.
- Jia, H. X., Jiang, L. F., Wang, C. L., Zhang, J. N., Wei, Y. N., Lu, J. F., Qiu, Y. M., Zhao, J. J., & Ma, B. J. (2024). Establishment and application of infectious disease monitoring, early warning and disposal system. *Chinese Journal of Preventive Medicine*, 58(10), 1620–1624. <https://doi.org/10.3760/cma.j.cn112150-20231206-00407>
- Jiang, H., Feng, S., & She, Y. (2025). Analysis of the current situation of public health emergency response management education and teaching in universities in Guangdong Province. *Health Professions Education*, 43(9), 106–110. <https://doi.org/10.20037/j.issn.1671-1246.2025.09.25>
- Lu, S., Christie, G. A., Nguyen, T. T., Freeman, J. D., & Hsu, E. B. (2022). Applications of artificial intelligence and machine learning in disasters and public health emergencies. *Disaster Medicine and Public Health Preparedness*, 16(4), 1674–1681. <https://doi.org/10.1017/dmp.2021.125>
- Murphy, S. A., Brown, J., Shankar, A., & Lichtveld, M. (2019). A quantitative assessment of institutions of higher education disaster preparedness and resilience. *Journal of Emergency Management*, 17(3), 239–250. <https://doi.org/10.5055/jem.2019.0423>
- SPSSPRO. (2021). *SPSSPRO: Scientific platform serving for statistics professional*. <https://www.spsspro.com>
- Tian, F. (1993). *The rank sum ratio method and its applications*. China Statistics Press.
- Wang, H., Ye, H., Liu, L., & Li, J. (2022). Evaluation and obstacle analysis of emergency response capability in China. *International Journal of Environmental Research and Public Health*, 19(16), 10200. <https://doi.org/10.3390/ijerph191610200>
- Wei, W., Liu, Y., Zhou, N., Tian, M., Xie, L., Watson, R., Dai, F., Chen, Y., & Hu, W. (2023). Constructing an emergency preparedness evaluation index system for public use during major emerging infectious disease outbreaks: A Delphi study. *BMC Public Health*, 23, 1109. <https://doi.org/10.1186/s12889-023-15980-6>
- Weng, X., Wang, R., Wang, X., Li, N., Yu, L., & Zhang, Y. (2019). Epidemiological characteristics of communicable disease related public health emergencies in schools (child care settings) in China, 2014–2016. *Disease Surveillance*, 34(5), 446–450. <https://doi.org/10.3784/j.issn.1003-9961.2019.05.016>



- Xu, G. (2021). *Study on the emergency management mechanism of public health emergencies in Zunyi universities*. (Bachelor's degree dissertation, Zunyi Medical University, China).
- Zhang, L. (2022). Research on the construction of university public health emergency management system based on psychological counseling intervention. *Journal of Healthcare Engineering*, 2022, 2033018. <https://doi.org/10.1155/2022/2033018>
- Zhizhi, F., Gehong, D., & Yuanyuan, W. (2011). Epidemiologic analysis of public health emergencies in Guangxi in 2010. *Chinese Tropical Medicine*, 11(10), 1295–1296. <https://doi.org/10.13604/j.cnki.46-1064/r.2011.10.023>