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# Multi-stakeholder Evaluation of Response Capacity for Major Infectious Disease Epidemic Prevention and Control in Urban Communities: A Cross-sectional Survey in Three Chinese Cities

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**Research Article**

**Keywords:** major infectious diseases, urban communities, response capacity, multi-stakeholder evaluation, associated factors, cross-sectional study

**Posted Date:** November 23rd, 2026

**DOI:** https://doi.org/10.21203/rs.3.rs-11212790/v1

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**Additional Declarations:** No competing interests reported.

# Abstract

**Background:** Urban communities are the first line of defense against major infectious disease epidemics, yet empirical evaluations of community response capacity that include multiple stakeholder groups remain limited. This study evaluated urban community response capacity for major infectious disease prevention and control from a multi-stakeholder perspective and identified its main weaknesses.

**Methods:** Guided by Social Systems Theory and Stakeholder Theory, five stakeholder-specific questionnaires were developed from two established indicator systems. From October 2023 to February 2024, a cross-sectional survey using stratified purposive sampling recruited 983 participants from five stakeholder groups (community organization managers, community organization staff, community health service center managers, community health service center staff, and residents) in 25 communities across three Chinese cities (City D, northeastern China; City G, eastern China; City W, central China); 980 valid questionnaires were analyzed. Group scores are reported as a percentage of the group-specific maximum.

**Results:** Group scores ranged from 77.9% (residents) to 95.1% (community health service center managers). The lowest item-level implementation rate was post-event compensation for requisitioned supplies and labor (16.0%, 4/25); 52.0% (13/25) of community organizations had evaluated their emergency plans, and 52.0% (13/25) of community health service centers had surveyed the incidence of psychological problems. City was associated with infectious disease knowledge ($P = 0.001$) and with cognition, attitude, and behavior ($P = 0.028$) in univariable analysis, but not after adjustment for sociodemographic factors. In multivariable logistic regression (scores dichotomized at or above 80% of the maximum), knowledge was associated with education, occupation, living arrangement, and monthly household income (ORs 1.83–10.87), and cognition, attitude, and behavior with duration of residence and household registration (all $P< 0.05$).

**Conclusions:** A basic coordination framework was present in all 25 communities, but implementation gaps were concentrated in post-event compensation, emergency plan and drill evaluation, and surveys of psychological problem incidence. Future community preparedness may need to prioritize dynamic emergency plan evaluation, dedicated funding, and mental health services, and to target health education toward residents living alone or with lower household income and toward those with shorter residence duration or non-local household registration.


# 1 Background

Major infectious disease epidemics pose persistent threats to global public health security [1]. As a first line of defense in epidemic prevention and control, community response capacity can affect the effectiveness of containment efforts [2]. International evidence indicates the value of community-based approaches in epidemic response [3, 4]; however, multi-stakeholder coordination and resource mobilization remain challenging [5]. Studies in China have examined community governance models or

individual stakeholder groups [6]. A recent study has also constructed emergency response capacity evaluation indicator systems at the county or district level using the Delphi method [7]. At the urban community level, however, evaluations that cover several stakeholder groups and combine objective institution-level indicators with individual-level self-reports are, to our knowledge, still uncommon.

Our research team previously conducted a qualitative study and identified four key elements of the emergency management capacity of community health service centers [8]: surveillance and early warning capacity, encompassing information management, health management, and risk identification and assessment; emergency preparedness capacity, covering the stockpiling of prevention and control equipment and the emergency plan system; emergency response capacity, including emergency response operations, collaborative linkage, and information communication; and recovery and rehabilitation capacity, involving the restoration of residents' physical and mental health and economic recovery. These elements characterize the emergency capacity of primary health care institutions from a full-cycle management perspective and provide a theoretical basis for the selection of evaluation indicators and questionnaire development in this study.

Building on these qualitative findings and guided by Social Systems Theory and Stakeholder Theory [9, 10], this study selected 25 communities in three representative Chinese cities and conducted a comprehensive multi-stakeholder evaluation of collaborative response capacity among five stakeholder groups: community organization managers, community organization staff, community health service center managers, community health service center staff, and community residents. This study aimed to identify weaknesses across the five stakeholder groups, examine factors associated with residents' infectious disease knowledge and cognition, attitude, and behavior, and provide empirical evidence for developing community epidemic prevention and control systems and enhancing response capacity. Specifically, this study addressed three questions: (1) What is the response capacity across the five stakeholder groups? (2) What factors are associated with residents' knowledge and cognition, attitude, and behavior? (3) What are the main weaknesses in urban community response capacity?

## 2 Methods

## 2.1 Study Design

This study used a cross-sectional survey design (October 2023–February 2024) to collect data on response capacity from five stakeholder groups using questionnaires. The survey was informed by a previously published qualitative study [8], whose findings were used to help interpret the quantitative results in the Discussion. This study therefore reports quantitative findings only and does not include newly collected qualitative data.

## 2.2 Theoretical Framework

This study was guided by Social Systems Theory and Stakeholder Theory. The community was regarded as a dynamic system composed of multiple subsystems, including community organizations, community health service centers, and residents. These subsystems complement and constrain one another and are hypothesized to collectively shape the effectiveness of epidemic prevention and control [9]. Stakeholder Theory emphasizes that organizational goal achievement is influenced by multiple stakeholder groups [10]. Accordingly, we selected five stakeholder groups across three levels (community organizations, community health service centers, and residents), including both managerial and staff perspectives from the first two levels and the resident perspective from the third.

## 2.3 Study Participants and Sampling

A two-stage stratified purposive sampling strategy was used. In the first stage, City D in northeastern China, City G in eastern China, and City W in central China were purposively selected as representative cities. In the second stage, 25 urban communities were selected based on feasibility and local coordination: 10 each in City G and City W and 5 in City D. Sample size for the resident questionnaire was estimated using the conventional rule of thumb of at least 10 participants per questionnaire item [11], with an additional 10% to account for invalid responses. For the resident questionnaire (57 items excluding the 18-item community response section used for descriptive purposes only), the estimated minimum sample size was 627; the actual sample of 733 residents exceeded this requirement. For community organizations and community health service centers, managers were the persons officially responsible for epidemic prevention and control at each site, and staff members were selected by convenience sampling from those on duty during the survey period. One manager and four staff members were recruited per site, yielding 125 participants from community organizations (25 managers and 100 staff) and 125 from community health service centers (25 managers and 100 staff). Of the 983 recruited participants, 3 were excluded because of incomplete questionnaires (1 community organization staff and 2 community health service center staff), leaving 980 valid participants for analysis.

The five stakeholder groups were: (1) community organization managers: one manager per community (n = 25); (2) community organization staff: four staff per community (recruited n = 100; valid n = 99); (3) community health service center managers: one manager per community (n = 25); (4) community health service center staff: four staff per community (recruited n = 100; valid n = 98); and (5) community residents (n = 733). For groups 1–4, inclusion criteria were at least 1 year of work experience and provision of informed consent; inability to be contacted or to complete the questionnaire during the survey period was an exclusion criterion. For residents, the sample size followed the same rule of thumb of 10 participants per item, with an additional 10% to account for invalid questionnaires (minimum 627). Inclusion criteria were age ≥ 18 years, at least 1 year of community residence, and provision of informed consent; cognitive or severe sensory impairment that precluded communication was an exclusion criterion. A total of 733 residents were enrolled (City W: 200; City G: 180; City D: 353).

## 2.4 Instruments

Based on two indicator systems previously established by our research team—"collaborative prevention and control for major infectious disease epidemics in urban communities" and "emergency management capacity for major infectious disease epidemics in urban communities"—five stakeholder-specific questionnaires were developed specifically for this study. The construction of the emergency management capacity indicator system has been published elsewhere [12]. The collaborative prevention system was developed through Delphi expert consultation (expert authority coefficient = 0.88; Kendall's W = 0.120–0.250; importance assignment mean = 4.23–5.00; coefficient of variation = 0.00–0.11). Based on the third-level indicators and their connotations, items were screened item by item and self-designed by the research team to form the following five questionnaires. Questionnaire items were developed by the research team based on the third-level indicators of both systems; the indicator-to-item mapping is available from the corresponding author. The English-language versions of all five questionnaires are provided as Additional file 1.

(1) Community organization managers' questionnaire: comprising two parts. The basic information section contains 6 items. The community response section contains 79 items, with a total score of 83. Most items use binary scoring (yes = 1, no = 0); four self-rated items (resource mobilization, scientific command, social donation management, post-event compensation for requisitioned supplies and labor) use a 3-point Likert scale (fully = 2, partially = 1, not at all = 0), and adverse health event occurrence is reverse scored (yes = 0, no = 1).

(2) Community organization staff questionnaire: comprising three parts. The basic information section contains 6 items. The cognition and attitude section contains 13 items, with a total score of 13, using binary scoring (yes = 1, no = 0). Cognition and attitude scores reflect response capacity. The community response section contains 27 additional items, using binary scoring (yes = 1, no = 0).

(3) Community health service center managers' questionnaire: comprising two parts. The basic information section contains 8 items. The center response section contains 41 items, with a total score of 42, using binary scoring, with one 3-point Likert self-rating item (preventive health care capacity; fully = 2, partially = 1, not at all = 0).

(4) Community health service center staff questionnaire: comprising four parts. The basic information section contains 8 items. The infectious disease knowledge section covers six major infectious diseases (plague, cholera, SARS, influenza A, Ebola hemorrhagic fever, COVID-19) and disinfection/isolation knowledge, reduced from 32 to 19 items after pilot testing, with correct answers scoring 1 point (total 19). The cognition and attitude section contains 13 items (total 14); the infectious disease knowledge self-rating item uses a 3-point Likert scale (fully = 2, partially = 1, not at all = 0). The center response section contains 19 items.

(5) Community residents' questionnaire: comprising four parts. The basic information section contains 18 items. The infectious disease knowledge section covers five major infectious diseases (plague, cholera, SARS, influenza A, COVID-19), adapted from the Chinese CDC Public Knowledge and Skills Questionnaire, reduced from 29 to 26 items after pilot testing, with correct answers scoring 1 point (total

26). The cognition, attitude, and behavior section contains 13 items (total 16); three items (infectious disease knowledge self-rating, support for community closure management, satisfaction with community prevention and control) use a 3-point Likert scale (fully/fully support/very satisfied = 2, partially/support/satisfied = 1, not at all/not support/not satisfied = 0). The community response section contains 18 items. The basic information sections were not included in scoring. For staff questionnaires, only the cognition and attitude sections were scored; the community/center response sections were collected for descriptive purposes and were not included in scoring. Residents' response capacity is the sum of knowledge and cognition/attitude/behavior scores (maximum 42). For summary reporting, the group-specific percentage score is the group's mean total score divided by the group's maximum possible score, expressed as a percentage.

## 2.5 Pilot Testing, Reliability and Validity

A pilot survey (July–August 2023) was conducted in three communities, three health service centers, and among 280 residents in two cities in northeastern China (outside the formal sample). Questionnaires were revised and low-discrimination items removed. The Cronbach's α coefficients were 0.834 for the community organization staff questionnaire (subscale α: 0.744–0.807), 0.879 for the community health service center staff questionnaire (subscale α: 0.757–0.882), and 0.886 for the resident questionnaire (subscale α: 0.727–0.922), indicating good internal consistency. Content validity was established through the Delphi expert consultation process used to develop the underlying indicator systems (expert authority coefficient = 0.88; Kendall's coordination coefficients = 0.120–0.250). The managers' questionnaires were based predominantly on objective institutional indicators; data were verified by double independent file review with 100% concordance, and therefore Cronbach's α was not calculated. Construct validity was not assessed by exploratory factor analysis due to the predominantly binary response format; this is acknowledged as a study limitation.

## 2.6 Data Collection and Quality Control

The formal survey (October 2023–February 2024) distributed and collected questionnaires on-site with completeness verification. Data were double-entered using EpiData 3.1 and analyzed with SPSS 23.0. Continuous data are presented as mean ± SD, and categorical data as frequency and proportion. Univariable comparisons used the chi-square test for categorical variables and independent-samples t-tests or one-way ANOVA for continuous variables. Multivariable analysis used binary logistic regression. Statistical significance was set at two-sided $P < 0.05$. For binary logistic regression, variables with $P < 0.05$ in univariable analysis were entered into the multivariable model using the enter method. Residents' infectious disease knowledge and cognition-attitude-behavior scores, as well as staff cognition and attitude scores, were dichotomized into good and poor groups using a score at or above 80% of the maximum as the cutoff, consistent with the definition applied in the univariable analyses (Additional file 2: Table S4). A total of 980 valid responses were included in the final analysis (Section 2.3).

# 3 Results

# 3.1 Response Capacity of Community Organizations and Their Staff

Community organization managers. The 25 community organization managers had a mean age of 43.4 ± 6.2 years and a mean length of service of 14.3 ± 5.2 years; all had participated in epidemic prevention and control. Complete basic information is provided in Additional file 2: Table S1 (Panel A). Among the 79 response items, 45 (57.0%) were fully implemented by all 25 community organizations. Item-level implementation rates are provided in Additional file 2: Table S2 (Panel A). Key weaknesses included low rates of emergency plan evaluation (52.0%, 13/25), emergency drill evaluation (52.0%, 13/25), establishment of dedicated epidemic prevention funds (64.0%, 16/25), early detection and warning capacity (60.0%, 15/25), and accountability enforcement (52.0%, 13/25). The lowest implementation rate was for post-event compensation of requisitioned supplies and labor (16.0%, 4/25). All 25 community organizations reported participation by the community management organization, the community health service organization, and community social organizations (25/25). The total score was 74.44 ± 4.90 out of 83. Mean scores by city were 74.90 ± 5.74 in City W, 74.60 ± 2.70 in City D, and 73.90 ± 5.22 in City G (Table 1; see also Additional file 2: Table S5, Panel B).

Community organization staff. Of the 100 recruited community organization staff members, 99 provided valid questionnaires (99/100). Their mean age was 36.5 ± 7.3 years, and 96.0% (95/99) had participated in epidemic prevention and control. Baseline characteristics are in Additional file 2: Table S1 (Panel A). The total cognition and attitude score was 12.29 ± 1.39 out of 13. Several items reached the highest agreement (99.0%, 98/99), including recognition of the need for community health education activities; the lowest proportion was for "clearly knowing the time limits for reporting infectious disease epidemic information" (72.7%, 72/99). The proportion with a score at or above 80% of the maximum was 94.9% (37/39) in City W, 95.0% (38/40) in City G, and 85.0% (17/20) in City D ($P = 0.361$). Sex, age, education, and other sociodemographic factors were not significantly associated with cognition and attitude scores (all $P > 0.05$). Item-level data are provided in Additional file 2: Table S3 (Panel A), and complete univariable analysis in Additional file 2: Table S4 (Panel A).

Table 1
Response capacity scores among five stakeholder groups (mean ± SD)

| Stakeholder group (maximum score) | City W | City G | City D | Total |
|---|---|---|---|---|
| Community organization managers (83) | 74.90 ± 5.74 | 73.90 ± 5.22 | 74.60 ± 2.70 | 74.44 ± 4.90 |
| Community organization staff (13) | 12.38 ± 1.60 | 12.38 ± 0.98 | 11.95 ± 1.64 | 12.29 ± 1.39 |
| Community health service center managers (42) | 39.60 ± 1.84 | 40.50 ± 1.08 | 39.60 ± 1.14 | 39.96 ± 1.46 |
| Community health service center staff (33) | 26.93 ± 3.46 | 27.80 ± 3.88 | 26.83 ± 4.30 | 27.27 ± 3.78 |
| Community residents (42) | 33.49 ± 5.19 | 33.34 ± 5.19 | 31.95 ± 6.44 | 32.71 ± 5.80 |

*Note: Values are descriptive; no formal statistical test was performed for city comparisons due to the small number of institutions per city (n = 5–10). Full data are provided in Additional file 2: Table S5 (Panel B).*

## 3.2 Response Capacity of Community Health Service Centers and Their Staff

Community health service center managers. The 25 managers had a mean age of 41.8 ± 8.7 years; nursing was the most common professional background (64.0%, 16/25). Baseline characteristics are in Additional file 2: Table S1 (Panel B). Of the 41 response items, 24 (58.5%) were fully implemented by all 25 centers. The total score was 39.96 ± 1.46 out of 42. Item-level implementation rates are provided in Additional file 2: Table S2 (Panel B); between-city item-level comparisons are provided in Additional file 2: Table S5 (Panel D).

*Community health service center staff. Of the 100 recruited community health service center staff, 98 provided valid questionnaires (98/100). Nursing was the most common professional background (65.3%, 64/98). Complete basic information is provided in Additional file 2: Table S1 (Panel B). The total response capacity score was 27.27 ± 3.78 out of 33, comprising infectious disease knowledge (14.67 ± 3.30 out of 19) and cognition/attitude (12.59 ± 1.75 out of 14). The item with the lowest correct response rate was the disinfection scope of contaminated floors (49.0%, 48/98; Additional file 2: Table S3, Panel B). Among center staff, 32.7% (32/98) reported that their center conducted surveys of the incidence of psychological problems. No sociodemographic factor was significantly associated with infectious disease knowledge or cognition and attitude among center staff (all P > 0.05; Additional file 2: Table S4, Panel A).*

## 3.3 Response Capacity of Community Residents and Associated Factors

The 733 residents had a mean age of 47.4 ± 12.4 years. Baseline characteristics are in Additional file 2: Table S1 (Panel C). The total response capacity score was 32.71 ± 5.80 out of 42, comprising infectious disease knowledge (18.72 ± 5.06 out of 26) and cognition/attitude/behavior (13.99 ± 1.76 out of 16). The

item with the highest correct response rate was "avoiding crowded places as an effective measure to prevent COVID-19" (93.6%, 686/733), while the item with the lowest correct response rate was "blood is not a transmission route of cholera" (27.4%, 201/733; Additional file 2: Table S3, Panel C).

In univariable analysis, city was associated with both infectious disease knowledge ($P = 0.001$) and cognition, attitude, and behavior ($P = 0.028$), but these associations were not significant in the multivariable model. Key findings of multivariable logistic regression are shown in Table 2. Infectious disease knowledge was independently associated with education level, occupation, living arrangement, and monthly household income. Cognition, attitude, and behavior were independently associated with duration of residence and household registration (all $P < 0.05$). Complete univariable analysis and logistic regression results are provided in Additional file 2: Table S4 (Panels B–D).

Table 2
Logistic regression analysis of factors associated with response capacity among community residents

| Dependent variable | Independent variable (reference group) | OR (95% CI) | P |
|---|---|---|---|
| Infectious disease knowledge | Education: Junior college (vs. junior high school or below) | 1.830 (1.007–3.325) | 0.047 |
| | Education: Undergraduate (vs. junior high school or below) | 2.084 (1.070–4.058) | 0.031 |
| | Occupation: Health professional and technical personnel (vs. managers of government agencies, Party organizations, enterprises, and public institutions) | 4.334 (1.225–15.332) | 0.023 |
| | Occupation: Currently enrolled students (vs. managers of government agencies, Party organizations, enterprises, and public institutions) | 10.871 (2.033–58.127) | 0.005 |
| | Living arrangement: Living with spouse/children (vs. living alone) | 4.950 (1.271–19.274) | 0.021 |
| | Living arrangement: Living with elders (vs. living alone) | 9.421 (1.681–52.792) | 0.011 |
| | Monthly household income: 5,000–9,999 CNY (vs. <2,000 CNY) | 2.611 (1.013–6.730) | 0.047 |
| | Monthly household income: 10,000–19,999 CNY (vs. <2,000 CNY) | 3.341 (1.259–8.864) | 0.015 |
| Cognition, attitude, and behavior | Duration of residence: 6–10 years (vs. <1 year) | 3.788 (1.100–13.041) | 0.035 |
| | Duration of residence: >10 years (vs. <1 year) | 5.440 (1.677–17.650) | 0.005 |
| | Household registration: Nonlocal (vs. local) | 0.390 (0.217–0.699) | 0.002 |

*Note: Only variables that were significant at the variable level (Wald test) are shown, together with the categories that reached P < 0.05 within them. Categories reaching P < 0.05 within variables that were not significant overall (political affiliation for knowledge; age for cognition, attitude, and behavior) and the complete regression results are provided in Additional file 2: Table S4 (Panels C–D).*

# 3.4 Response Capacity Across the Seven Dimensions of the Indicator Systems

Response capacity was summarized across the seven first-level dimensions of the two underlying indicator systems (collaborative prevention and control; emergency management capacity), using the item-level data presented in Additional file 2: Tables S2 and S5. For the 25 community organization managers (79 items), the proportion of items fully implemented by all 25 communities ranged from 36.4% (Monitoring and Evaluation, 4/11) to 80.0% (Health Services, 4/5); Planning and Coordination reached 78.6% (11/14), Risk Management reached 40.0% (2/5), whereas Prevention and Emergency Preparedness, Monitoring/Early Warning and Information Management, and Resource Support each reached only 50.0–53.3%. The lowest item-level rates were post-event compensation for requisitioned supplies and labor (Resource Support; 16.0%, 4/25), emergency plan effectiveness evaluation (Prevention and Emergency Preparedness; 52.0%, 13/25), emergency drill effectiveness evaluation (Prevention and Emergency Preparedness; 52.0%, 13/25), accountability enforcement (Monitoring and Evaluation; 52.0%, 13/25), early detection and warning (Monitoring, Early Warning and Information Management; 60.0%, 15/25), and dedicated epidemic prevention funds (Resource Support; 64.0%, 16/25).

For the 25 community health service center managers (41 items), the proportion of items fully implemented ranged from 16.7% (Monitoring and Evaluation, 1/6) to 100.0% (Prevention and Emergency Preparedness, 2/2). At the item level, early detection and warning was reported by 96.0% (24/25) of centers and application of big-data information technology by 80.0% (20/25), whereas the lowest rate was for surveys of the incidence of psychological problems in the community (52.0%, 13/25; Monitoring and Evaluation).

## 4 Discussion

# 4.1 Basic Effectiveness and Strengths of Multi-stakeholder Collaboration in Community Epidemic Prevention and Control

Coordination components were present in all surveyed communities, whereas plan evaluation and mental health services remained underdeveloped: all 25 community organizations reported participation by the community management organization, the community health service organization, and community social organizations (25/25, with no variation across sites). From the perspective of Social Systems Theory, the three subsystems (community organizations, community health service centers, and residents) are conceptually complementary [9]; in this sample, measured capacity varied across the five stakeholder groups (77.9%–95.1% of the group-specific maximum), although the scales were not directly comparable. The mechanisms of multi-stakeholder collaboration require further clarification.

# 4.2 Community Organizations: High Coordination but Limited Plan Evaluation

Community organizations, serving as a bridge between government and residents, showed high implementation rates for coordination-related items (e.g., multi-organizational participation, 25/25). Emergency plans were formulated by all 25 organizations, but their effectiveness was evaluated by only 52.0% (13/25); early detection and warning was reported by 60.0% (15/25), and dedicated funding by 64.0% (16/25). Qualitative interviews from our prior study [8] offered mechanistic explanations: staff acknowledged that "relevant emergency plans have been formulated" (participant P6) and that "at least one emergency drill is conducted annually" (participant P7), but they also acknowledged that the effectiveness of these efforts needed improvement. Institutional design, resource mobilization authority during emergencies [13], and dynamic emergency plan evaluation should be considered.

## 4.3 Community Health Service Centers: Professional Strengths and Service Gaps

As primary health care institutions, 96.0% (24/25) of community health service centers reported conducting early detection and warning of outbreaks, whereas 60.0% (15/25) of community organizations reported that their community could perform the same function. However, their service provision also showed gaps: only 52.0% (13/25) conducted psychological problem incidence surveys, indicating that this task was not yet routine in most centers. This finding is consistent with prior reports highlighting the general neglect of psychological support in primary care settings [14]. Qualitative interviews from our prior study [8] provided direct evidence: one interviewee stated, "There are no professional psychological counselors, but we will give residents the contact information of higher-level hospitals or institutions with psychological counseling, and suggest that those with psychological problems seek professional consultation" (participant P12), indicating that community-level mental health services remain at the referral level and have not been internalized as a routine function. Another interviewee noted that "there are few personnel with relevant qualifications, making implementation rather difficult" (participant P2), suggesting that human resource constraints may contribute to this gap. These findings suggest that psychological assessment and counseling should become routine rather than referral-based functions in community health service centers.

## 4.4 Community Residents: Factors Associated with Knowledge and with Cognition, Attitude, and Behavior

Building on qualitative insights [8], residents scored 18.72 ± 5.06 out of 26 on infectious disease knowledge and 13.99 ± 1.76 out of 16 on cognition, attitude, and behavior. The knowledge item least often answered correctly concerned a less common disease (blood as a transmission route of cholera, 27.4%, 201/733). Comparable knowledge gaps among community residents have been reported elsewhere [15, 16].

Infectious disease knowledge was associated with education, occupation, living arrangement, and income, although the pattern was not monotonic, consistent with prior studies [15, 16], whereas residence duration and household registration were associated with residents' cognition, attitude, and

behavior; whether this reflects community attachment cannot be determined from these data. Furthermore, although big data platforms have been applied, "data are incomplete and information updates are delayed" [8], which may affect the timeliness of information reaching residents.

Health education might be prioritized for groups with lower knowledge scores in this sample (those living alone or with lower household income), while interventions to improve cognition, attitude, and behavior might target residents with non-local household registration or shorter duration of residence; the effectiveness of targeted strategies needs prospective evaluation. The wide confidence interval for the student subgroup (OR = 10.87, 95% CI: 2.03–58.13) suggests a limited sample size in this occupational category; these findings should be interpreted with caution and verified in future studies with larger student samples.

## 4.5 Multi-stakeholder Assessment, Inter-city Differences, and Methodological Implications

Including five stakeholder groups offered a broader perspective on community response capacity than single-source assessments. From a Stakeholder Theory perspective [10], different stakeholder groups may perceive service delivery differently due to their distinct roles and vantage points: managers focus on institutional implementation, while staff and residents experience frontline service delivery. This multi-stakeholder design enables comparison across stakeholder groups. For example, managers and staff of the same community health service centers differed substantially in reporting whether surveys of psychological problem incidence were conducted (52.0% [13/25] vs 32.7% [32/98]); the two denominators differ (institutions vs. individuals), so this comparison is descriptive only and warrants formal concordance analysis in future work. The methodological implication is that future assessments of community emergency response capacity should incorporate multiple stakeholder perspectives to cross-check institutional reports against staff and resident experiences.

City was associated with both infectious disease knowledge ($P = 0.001$) and cognition, attitude, and behavior ($P = 0.028$) in univariable analysis, but neither association remained significant after adjustment for sociodemographic factors ($P = 0.161$ and $P = 0.997$, respectively; Additional file 2: Table S4, Panels C–D). Inter-city differences therefore appeared to be explained by differences in sociodemographic composition, such as education, income, and occupational distribution, rather than to differences in the response system itself. Because only 5–10 institutions were sampled per city, city-level comparisons in this study had limited power and should be re-examined in larger samples.

## 4.6 Implications for Community-Based Preparedness

The multi-stakeholder coordination framework assessed here had one clear strength and three consistent gaps. Its strength lies in the presence of a multi-stakeholder coordination structure in every surveyed community. Its weaknesses were the low rate of emergency plan evaluation (52.0%, 13/25), the limited availability of dedicated epidemic prevention funds (64.0%, 16/25), and the low rate of surveys on the incidence of psychological problems (52.0%, 13/25). Big-data information technology was applied by

80.0% (20/25) of community health service centers, and qualitative interviews indicated that data quality remained a concern [8]. Qualitative findings also indicated insufficient human resources and limited emergency professional competency in community health service centers [8], which is consistent with the low rate of psychological problem incidence surveys in these centers; the weak early detection and warning reported by community organizations (60.0%, 15/25) was a separate gap and may reflect differences in professional capacity at the community organization level. Institutional design for settings with a comparable community-based primary health care structure may therefore need to address three areas: emergency plan management, dedicated funding [13], and mental health services [14].

## 4.7 Limitations and Future Directions

Several limitations should be acknowledged. First, all manager-level item proportions are based on 25 institutions (a difference of one institution corresponds to 4.0 percentage points), and most questionnaire items used a binary response format, which may have limited the ability to detect subtle differences in capacity. Self-reported items may also be subject to social desirability bias. Second, constrained by purposive sampling, this study included only 25 communities across three cities with a relatively small manager sample, potentially reducing statistical power for subgroup analyses; nonsignificant results should be interpreted with caution. Third, the cross-sectional design precludes causal inference. Fourth, the survey was conducted after the epidemic transition phase, and some responses may have been affected by recall bias. Finally, although the supporting qualitative study provided useful mechanistic explanations for this study, the time interval between qualitative and quantitative data collection [8] may have affected the integration of prior qualitative findings.

Future research should use probability sampling in more cities, track capacity longitudinally, and collect qualitative and quantitative data concurrently.

# 5 Conclusions

This study provides a multi-stakeholder assessment of urban community response capacity for major infectious disease prevention and control in three Chinese cities. Although a basic prevention and control framework has been established, with coordination structures reported by all 25 communities, the largest implementation gaps in community organizations were post-event compensation (16.0%, 4/25), emergency plan evaluation (52.0%, 13/25), and emergency drill evaluation (52.0%, 13/25), while in community health service centers the lowest rate was for psychological problem incidence surveys (52.0%, 13/25). Knowledge was associated with education, occupation, living arrangement, and household income, whereas cognition, attitude, and behavior were associated with duration of residence and household registration. These findings suggest that future community epidemic preparedness may need to prioritize dynamic emergency plan evaluation, dedicated funding, and mental health service provision, while targeting health education toward residents living alone or with lower household income, and interventions on cognition, attitude, and behavior toward residents with shorter residence duration or non-local household registration. Future work could construct an institution-level capacity index from the

item-level data and track it longitudinally, with qualitative and quantitative components collected concurrently.

## Declarations

# Ethics approval and consent to participate

This study was reviewed by the Ethics Committee of Zhongshan Hospital Affiliated to Dalian University. As this study was part of a National Social Science Fund project and did not involve clinical data or biological specimens from patients, the committee determined that a formal ethics approval number was not required. The study was conducted in accordance with the Declaration of Helsinki. All participants provided written informed consent prior to their involvement. The research team ensured that all collected information was used exclusively for scientific analysis, and strict confidentiality measures were implemented to protect participants' personal data in compliance with relevant data protection regulations.

# Consent for publication

Not applicable.

# Authors' information

All the authors are affiliated with the School of Nursing at Dalian University, which is located in Dalian City, Liaoning Province, China.

# Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available because they contain information that could compromise participant privacy. De-identified data are available from the corresponding author on reasonable request, subject to approval by the Institutional Review Board of Dalian University.

# Competing interests

The authors declare no competing interests.

# Funding

This research is funded by the National Social Science Fund of China (Grant No. 20BSH046).

# Authors' contributions

X.G. drafted the manuscript. J.Y. collected quantitative survey data. K.Z. contributed to the qualitative study that informed this research. N.C. developed and validated the questionnaires. W.L. designed the study and contributed to data analysis. L.A. supervised the overall research quality and served as the corresponding author. All authors read and approved the final manuscript.

# Acknowledgements

We sincerely thank all the experts involved in this study.

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