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Enhancing community health services through a health needs assessment approach during the COVID-19 pandemic in Eastern Thailand

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Abstract

Background The COVID-19 pandemic placed sustained pressure on primary healthcare systems and highlighted the need for context-specific evidence to guide service planning. Health Needs Assessment (HNA) provides a structured, evidence-based approach to identifying priority health problems, community needs, and healthcare system improvement requirements, particularly during public health emergencies.

Methods This study applied a sequential exploratory mixed-methods HNA in Eastern Thailand. A community-based quantitative survey was conducted among 940 residents to identify priority health problems, health needs, and barriers to accessing healthcare services. In-depth qualitative interviews were conducted with 20 primary healthcare providers to contextualize survey findings and explore system-level perspectives. Quantitative data were analyzed descriptively, and qualitative data were analyzed thematically.

Results COVID-19 was the most frequently reported primary health concern among community residents (311/940, 33.1%), followed by hypertension (124/940, 13.2%). Community health needs emphasized infectious disease prevention, chronic disease screening, physical activity promotion, and dietary improvement. Barriers to healthcare access included concerns related to infection risk, service availability, and logistical constraints. Qualitative findings highlighted the importance of service continuity, emergency preparedness, proactive community outreach, and strengthened health information systems. While community residents focused primarily on practical access-related needs, healthcare providers emphasized service organization and system capacity strengthening.

Conclusions This study integrates community and healthcare provider perspectives to identify priority health concerns and healthcare system needs. The findings generate context-specific, policy-relevant evidence to support primary care planning and health service improvement. These findings underscore the value of the HNA approach as an evidence-based framework for responsive community health planning.

Keywords Health needs assessment, Community health services, Health promotion, Disease prevention, Health policy

1 Introduction

The COVID-19 pandemic has placed sustained pressure on health systems worldwide, including Thailand since its first case in January 2020 [1]. The government implemented strict measures like lockdowns, travel restrictions, and quarantine, keeping initial cases low. However, multiple waves followed: the second in December 2020, the third in April 2021 (Alpha variant), the fourth in June 2021 (Delta variant), and the fifth in December 2021 (Omicron variant). Each wave prompted stricter measures, including targeted lockdowns, travel bans, and intensified vaccination campaigns, prioritizing healthcare workers. Public health campaigns promoted hygiene, mask-wearing, and social distancing. From October 1, 2022, COVID-19 was declared a monitored disease [2].

Thailand's healthcare system, overseen by the Ministry of Public Health (MOPH), is organized into three levels: primary care focusing on prevention and basic services, secondary care provided mainly by district hospitals with outpatient and inpatient services, and tertiary care for complex conditions. Universal access is provided through schemes like the Universal Coverage Scheme (UCS), with the private sector offering supplementary services. Traditional medicine is also integrated, reflecting a holistic approach. However, the pandemic highlighted challenges, especially in rural areas [3].

Several tools are commonly used for community health planning, such as community diagnosis, rapid community assessments, participatory approaches, and program-planning models [4]. Community diagnosis and rapid assessments are effective for describing local health problems and capturing immediate community perceptions during emergencies, while program-planning models are useful for mapping behavioral and environmental determinants and designing interventions. However, these approaches may not systematically integrate service gap analysis, priority-setting, and feasibility considerations across multiple types of needs.

The Health Needs Assessment (HNA) framework provides a structured, evidence-informed process that integrates perceived, expressed, normative, and comparative needs, linking health problems to current service capacity, access barriers, and prioritized improvement actions [5]. During the COVID-19 pandemic, several countries conducted needs assessments that collectively examined domains such as basic needs, healthcare access, psychosocial and emotional well-being, occupational challenges, and communication needs [6, 7]. Nevertheless, community-level HNA evidence from Thailand remains limited, particularly from the eastern region.

Eastern Thailand represents a strategic economic and cross-border area characterized by rapid industrialization, tourism, agricultural production, and substantial internal and migrant workforce mobility. These dynamics can intensify communicable disease risks, increase the burden of non-communicable diseases (NCDs) associated with urbanization and occupational exposures, and generate heterogeneous barriers to healthcare access across coastal, forested, and border provinces. The region's shared border with Cambodia and its diverse geographic contexts further underscore the need for context-specific primary care planning and emergency preparedness.

By integrating quantitative and qualitative data from both community residents and healthcare providers, HNA provides a systematic pathway from situation analysis to feasible service and policy recommendations to support responsive primary care planning during and beyond public health emergencies. Therefore, this study applied an HNA-guided sequential exploratory mixed-methods approach to (1) identify priority health problems during the COVID-19 pandemic; (2) assess community health needs and barriers to accessing healthcare services; and (3) determine key healthcare system improvement needs to inform feasible strategies for strengthening primary care and community health services in Eastern Thailand.

2 Methods

2.1 Study design and settings

This study employed a sequential exploratory mixed-methods design conducted between July and September 2021 during Thailand's fourth wave of the COVID-19 pandemic. The qualitative component (July–August 2021) informed the development of the quantitative questionnaire, which was subsequently administered in the community survey (August–September 2021). The study was conducted in eight provinces in Eastern Thailand (Chonburi, Rayong, Chanthaburi, Trat, Samut Prakan, Chachoengsao, Prachinburi, and Sa Kaeo).These provinces form part of Health Region 6. Thailand has divided 13 health regions to provide better quality medical services to citizens in these regions and increase efficiency.

2.2 Health needs assessment process

This study applied the HNA framework as a structure to guide data collection, analysis, and interpretation [5]. The HNA process comprised four interrelated stages: (1) identification of priority health problems, (2) assessment of community health needs and barriers to accessing healthcare services, (3) planning of healthcare system improvement strategies, and (4) translation of findings into action-oriented policy directions. The qualitative and quantitative components jointly informed the identification and assessment stages. Qualitative interviews with primary healthcare providers provided contextual insights into prevailing health problems, service delivery constraints, and perceived system needs, while the community survey captured population-level priorities, access experiences, and expressed health needs. Findings from these stages were synthesized and subsequently discussed with relevant stakeholders to support the planning and action stages, ensuring that the results were directly linked to feasible and context-appropriate service and policy implications.

2.3 Qualitative study, participants, and data collection

Healthcare providers were recruited using purposive sampling to capture diverse primary care perspectives across the eight provinces. Eligible participants were staff working in primary care units (PCUs) in Health Region 6 with at least five years of experience in their current area and roles related to healthcare service delivery and community health management. Health Region 6 comprises 790 PCUs across the eight provinces. A total of 20 healthcare providers were selected from PCUs serving the same community settings as those included in the quantitative survey to ensure alignment between provider perspectives and community-level data. These included directors of subdistrict

health promotion hospitals (n = 11), nurses (n = 4), and public health professionals (n = 5). Interviews were conducted online via Google Meet by the lead author due to COVID-19 restrictions. A semi-structured interview guide aligned with the HNA framework was used to explore local health problems, current services, perceived needs, barriers, and feasible improvement strategies [5]. Interviews were audio-recorded with permission and professionally transcribed into Microsoft Word. Thematic analysis involved data coding and theme identification and categorization based on the needs assessment framework.

2.4 Quantitative study, sample size, sampling, instrument, and data collection

The minimum sample size for the community survey was calculated using a population-based formula with a 95% confidence level (z = 1.96) and a margin of error of 0.05 [8]. The required sample was 769; to account for non-response, the target sample was increased by approximately 10%. A total of 947 residents responded to the survey; after excluding incomplete responses, 940 participants were included in the final analysis.

Multistage sampling was used to select study sites and participants. First, 16 districts (two per province) were selected from the eight provinces. Within each selected district, subdistricts were selected, and a systematic sampling approach was applied to recruit eligible adult residents from community lists, using a random start and a fixed sampling interval. Eligibility criteria were (a) aged ≥ 18 years, (b) residing in the area for at least one year, (c) able to communicate in Thai, and (d) willing to participate. Responses with substantial missing information or participants who withdrew were excluded.

A self-administered questionnaire was newly developed by the research team based on the HNA framework and informed by themes generated from the qualitative interviews. The instrument comprised 17 items across five domains: (1) personal information, (2) perceived health problems, (3) access to health services and barriers, (4) health promotion and screening needs, and (5) suggested approaches for improving the health service system. Content validity was assessed by three experts (including representatives from the National Health Security Office Region 6 and an independent academic), yielding an item-objective congruence (IOC) index of 0.67. Reliability was supported by pilot testing with 30 participants (Cronbach's $\alpha = 0.86$).

Data were collected primarily using an online questionnaire (Google Forms via QR code) to enable contactless participation during the pandemic. Paper-based questionnaires were also made available through trained village health volunteers (VHVs) to include residents with limited internet access; in practice, one respondent completed a paper-based form.

2.5 Statistical analysis

Quantitative data were analyzed using Microsoft Excel. Descriptive statistics were used to summarize participants' characteristics and survey responses, reported as frequencies and percentages for categorical variables and as mean ± standard deviation (including minimum and maximum) for continuous variables. Qualitative data were analyzed using Braun and Clarke's six-step thematic analysis [9]. Two researchers independently coded the transcripts manually using Microsoft Word and Excel-based matrices. The coding process involved familiarization with transcripts, generating initial codes, searching for candidate themes, reviewing themes, defining and naming themes, and producing the

final thematic report. Coding discrepancies were discussed and resolved by consensus, with iterative refinement of the coding framework to enhance credibility and dependability. The thematic analysis involved coding the data, identifying themes, and categorizing based on the needs assessment framework (health problems, current healthcare services, health needs, and healthcare system development).

2.6 Action plan development

Following analysis, the findings were discussed with stakeholders from the National Health Commission (NHC) under the National Health Security Office (NHSO) Rayong Branch (Region 6) to translate priorities and identified barriers into practical directions for service improvement and local health policy action planning.

3 Results

In this sequential exploratory mixed-methods study, qualitative findings were used to contextualize and complement the quantitative survey results, allowing integration of community and provider perspectives across key thematic domains.

3.1 Demographic characteristics of healthcare providers and community residents

A total of twenty healthcare providers participated in the qualitative interviews. The mean age of providers was 51.0 ± 5.09 years (range 42–59 years), and the mean duration of work experience in their current positions was 13.65 ± 5.95 years (range 5–25 years). All participants held at least a bachelor's degree and were actively involved in primary healthcare service delivery and community health management.

For the quantitative component, 947 community residents responded to the survey (946 online and one paper-based questionnaire). After data cleaning and exclusion of incomplete responses, 940 respondents were included in the final analysis. Most respondents were female (640/940, 68.1%), with a mean age of 47.4 ± 13.2 years. The largest occupational group was general laborers, followed by business owners, agricultural workers, housewives or students, and government officials (Table 1).

Table 1 Demographic characteristics among participants in this study ($n = 940$)

Variables	*n*	Percentage
Gender		
Male	300	31.9
Female	640	68.1
Age (years)		
18–24	47	5.0
25–45	366	38.9
46–59	353	37.6
≥60	174	18.5
Mean ± S.D. (47.4 ± 13.2)		
Occupation		
Government official	126	13.4
Agricultural workers	152	16.2
Business	164	17.4
General labor	284	30.2
Housewife/student	214	22.8

3.2 Identification of health priorities

3.2.1 Health problem priorities

Quantitative survey results indicated that COVID-19 was the most frequently reported primary health concern (311/940, 33.1%), followed by hypertension (124/940, 13.2%). Other commonly reported concerns included musculoskeletal problems and additional chronic conditions. These findings reflect the coexistence of acute infectious disease threats and persistent non-communicable disease burdens within the community.

Qualitative interviews supported these findings, with healthcare providers emphasizing the continued burden of chronic diseases alongside the need for preparedness and response capacity during the COVID-19 pandemic. Providers also highlighted occupational and environmental health issues specific to the eastern region, including agricultural chemical exposure.

Healthcare provider [SC004] stated: *"The health problems of the people in the area seem to be like elsewhere, encountering COVID-19 and chronic diseases in the population. Diabetes and hypertension are the most frequently encountered diseases, while some chemical residue issues in agriculture also exist due to fruit cultivation in the area."*

Across the identified health priorities, healthcare providers and community residents shared common concerns regarding infectious disease prevention and the burden of non-communicable diseases. However, community residents emphasized practical access-related concerns, whereas healthcare providers focused on system-level service organization and capacity constraints.

3.2.2 Health needs of the community

The community respondents expressed specific requirements for health promotion initiatives, which included promoting physical activities, encouraging healthier dietary habits, conducting community disease screenings, preventing infectious diseases, and enhancing overall well-being within the community (Fig. 1). Furthermore, there was an emphasis on improving the cleanliness of homes, advocating against smoking, promoting sobriety from alcohol, ensuring safe workplaces, and addressing road safety concerns, as shown in Fig. 1A. Regarding the health screening needs, participants highlighted requirements for various screenings, including COVID-19 screening; specific disease screening, such as cancer; blood lipid level testing; blood pressure level testing,

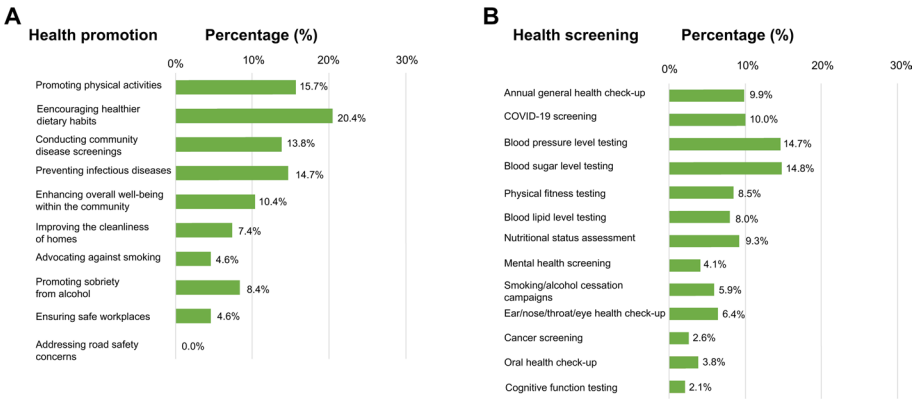

Fig. 1 Health needs assessment among community residents in Eastern Thailand during the COVID-19 pandemic ($n = 940$). **A** Health promotion needs and (**B**) health screening needs. Items are presented in descending order according to the proportion of respondents indicating each need

blood sugar level testing; smoking/alcohol cessation campaigns; physical fitness testing; cognitive function testing; oral health check-up; annual general health check-up; mental health screening; ear/nose/throat/eye health check-up; and nutritional status assessment, as shown in Fig. 1B.

Healthcare providers highlighted the population's evolving health needs, aligning with past and present contexts. Key priorities included comprehensive and emergency medical services, disease screening, public health emergency preparedness, and leveraging information technology to enhance healthcare quality.

Healthcare provider [SC001] stated: *"Community members still have health behaviors that can lead to preventable diseases. Therefore, if you ask what kind of healthcare service the community needs, the answer would be that it is necessary to change health behaviors. Currently, communication often occurs through line application groups, and this trend has increased during the COVID-19 pandemic."*

Healthcare provider [SC009] stated: *"The development of healthcare services should focus on raising public awareness of self-healthcare. We must live with COVID-19 for a long time, so we need to develop services alongside support systems and enhance readiness for emergency medical services to respond to potential crises in the area."*

Taken together, community residents expressed strong needs for preventive and health promotion activities, including infectious disease prevention, physical activity promotion, dietary improvement, and community disease screening. In contrast, healthcare providers emphasized broader service-related needs, such as comprehensive medical services, emergency preparedness, and structured prevention programs to address both acute and chronic conditions. Mental health screening was identified as a perceived need based on community and provider perspectives, rather than as a measure of diagnosed mental health conditions.

3.3 Analysis of current healthcare services

3.3.1 The current healthcare services

Residents primarily described healthcare services in terms of those they directly accessed, such as outpatient care, disease screening, and health promotion activities. Healthcare providers, however, described a wider range of services, including proactive community outreach, family doctor team services, emergency medical care, and coordination with village health volunteers to maintain service delivery during the pandemic.

The perspective from healthcare providers highlights that individuals in each area choose healthcare services based on their entitlements and the severity of their conditions. Before the COVID-19 pandemic, family doctor teams, including hospital doctors and village health volunteers (VHVs), provided proactive community care to reduce crowding during the pandemic. Healthcare services now include proactive community screenings and risk assessments, alongside reactive facility-based care.

Healthcare provider [SC010] stated: *" People in this area choose healthcare services based on their healthcare entitlements. Currently, family doctor teams are being organized, including doctors from hospitals. We work together with village health volunteers to go out and take care the patients in the community. We are developing primary healthcare services and have set up chronic disease clinics, which have seen an increase in patient visits during the COVID-19 pandemic due to the need for hospitals to reduce congestion."*

Healthcare provider [SC011] stated: *"We offer both reactive and proactive healthcare services. Reactive services involve providing comprehensive care. On the other hand, proactive services focus on long-term care and home visits. We have outreach vehicles and village health volunteers who assist in communicating information within the community."*

During the pandemic, community residents reported multiple sources of health information. The most common sources of information were online social media platforms (63.5%), village health volunteers (56.7%), family members (45.2%), healthcare providers (44.2%), television (33.7%), friends (32.7%), hospitals (31.7%), newspapers (24.0%), radio broadcasts (15.4%), and educational organizations (13.5%), respectively.

3.3.2 Barriers to accessing healthcare services

About 76.0% of community residents (714 out of 940 individuals) reported being able to access health services from both public and private healthcare facilities in their area. In contrast, about 24.0% of participants (226 out of 940 individuals) reported difficulties accessing healthcare services. Among those with limited access to healthcare, the distribution of reported barriers is presented in Table 2. Whereas, healthcare providers emphasized operational barriers, including workforce shortages, increased workload, disruptions to routine screening services, and challenges in service coordination during periods of high demand.

3.4 Assessment of healthcare system improvement needs

3.4.1 Need for quality service improvement

A total of 595 out of 940 community residents responded and were analyzed for this section. About 87.5% of respondents (348 out of 595 individuals) expressed satisfaction with the effectiveness of the current development and implementation of the community health system. However, the remaining 12.5% of respondents (247 out of 595 individuals) suggested scopes for healthcare system improvement. These suggestions focused on enhancing disease prevention and screening in the community. These responses are summarized in Table 3.

Healthcare providers emphasized the importance of community-based disease prevention and enhanced healthcare services. This involves delivering health services in the community through digital technology.

Table 2 Access healthcare services of participants and the reasons during the COVID-19 pandemic ($n = 940$)

Variables	*n*	Percentage
Can access healthcare services		
Yes	714	76.0
No	226	24.0
The reason that cannot access healthcare services		
Fear	64	28.3
Financial constraints	48	21.3
Transportation issues	48	21.3
Lack of healthcare entitlements	26	11.5
Personal beliefs	15	6.6
Unfamiliarity with healthcare providers	10	4.4
Lack of channels to contact	10	4.4
Concerns about crowded facilities	5	2.2
Total	226	

Table 3 Suggestions for improvement of health system ($n = 247$)

Scope for improvement of health system	*n*	Percentage
Enhancing disease prevention and screening in the community	93	37.7
Improving the quality and accessibility of healthcare services	74	29.9
Promoting healthy behaviors	41	16.6
Effectively communicating health information	34	13.8
Enhancing environmental sanitation	3	1.2
Fostering increased community engagement and networking	2	0.8

Healthcare provider [SC012] stated: *"To develop the healthcare system, we should utilize healthcare technology and communication technology. However, we must design the health information system carefully, avoiding an excessive number of programs."*

Healthcare provider [SC003] stated: *"The healthcare system should focus on delivering quality services that are prompt and responsive to the community's health needs. This requires the analysis of health information to make informed decisions."*

Overall, community residents highlighted the need for improved accessibility, shorter waiting times, and more regular screening and prevention activities. Healthcare providers focused on improving service quality through better system organization, enhanced health information systems, strengthened referral mechanisms, and improved emergency preparedness to ensure continuity and quality of care.

3.4.2 Development of the healthcare workforce

There is a need to expand and fortify the healthcare workforce to adequately meet the quantity and quality requirements. It is imperative to ensure that resources are sufficient to provide equipment and medications accordingly. Key aspects of this endeavor include health workforce development, strengthening the health network, fostering community participation, and establishing a robust bond between healthcare providers and the community. Once collaboration is established, community engagement can be effectively implemented.

Healthcare provider [SC018] stated: *"For a well-developed healthcare system that caters to the community's needs, we must plan to expand and enhance the workforce to meet the quantity and quality needed. If resources are sufficient, we should also provide equipment and medications accordingly."*

Healthcare provider [SC020] stated: *"The goal of healthcare system development is to work in a health network. We cannot work alone. We aim to foster community participation and establish a strong bond between us and the community. Once collaboration is in place, we can achieve great results together. Currently, we are practicing community isolation for COVID-19, and everyone is contributing fully. We want to see this spirit continue."*

3.5 Action plan for health policy

3.5.1 Key strategies

The action plan for health policy highlights key strategies for improving healthcare service and emergency preparedness in Thailand. First, enhance community healthcare access through online health platforms, improved referral systems, and optimized emergency services, addressing barriers like fear, financial constraints, and transportation. Second, adopt a network-based approach to tackle communicable and non-communicable diseases, integrating facility- and community-based interventions. Third, prioritize

robust health information systems for evidence-based decision-making, embracing digital technology for healthcare delivery and data sharing.

4 Discussion

This study applied an HNA framework to examine community health priorities, access barriers, and system-level improvement needs for primary healthcare in Eastern Thailand during the COVID-19 pandemic. By integrating perspectives from community residents and primary healthcare providers, this study extends the application of HNA beyond priority identification to demonstrate how community- and provider-derived data can be systematically translated into implementation-oriented policy directions during a public health crisis. Although data were collected in 2021, the findings remain relevant because they reflect persistent structural and organizational characteristics of primary care delivery rather than time-specific epidemiological conditions.

At the identify stage, the findings revealed a dual configuration of health priorities, with communities emphasizing infectious disease preparedness alongside sustained needs for prevention, screening, and continuity of care for NCDs. This pattern is consistent with studies from Vietnam and Malaysia [10], and from a scoping review including the United States, Canada, the United Kingdom, Portugal, Georgia, South Africa, Thailand, Mexico, India, Kenya, Guatemala, and Saudi Arabia [11], which reported that chronic disease management and health promotion remained central priorities even during acute public health emergencies. Evidence from Indonesia and the Philippines further indicates that disruptions to routine NCD services during crises disproportionately affect rural and socioeconomically disadvantaged populations [12, 13]. These findings underscore that NCD prevention and continuity of care represent enduring community health priorities that must be protected during periods of system stress.

The assess stage clarified why the availability of primary care services did not consistently translate into equitable utilization. Participants reported overlapping access barriers, including financial constraints, transportation difficulties, and fear of infection. Similar access challenges have been documented in Malaysia, Laos, Vietnam, and Indonesia, where geographic distance, out-of-pocket costs, uneven healthcare workforce distribution, and concerns about facility safety reduced healthcare utilization during the pandemic [14–17]. While fear of COVID-19 exposure was context-specific, it illustrates a broader mechanism through which perceived risk suppresses service use during emergencies. These findings suggest that access barriers operate primarily at the system level and require coordinated policy and service delivery responses rather than individual-level behavior change alone.

During the plan stage, both community members and healthcare providers emphasized the importance of sustaining and strengthening routine health promotion and screening activities, which are core functions of Thailand's primary care system. Gaps were identified in the coverage, consistency, and follow-up of existing screening services, particularly for NCDs, oral health, and mental health. Importantly, reported mental health needs should be interpreted as expressed demand for services rather than estimates of population prevalence. Regional evidence suggests that prolonged public health emergencies are associated with increased psychosocial stress in communities and burnout among frontline healthcare workers [18, 19]. Within the HNA framework, expressed mental health needs may therefore function as early indicators of broader system stress,

highlighting the value of integrating feasible psychosocial screening and referral mechanisms into routine primary care as part of health system resilience.

Digital health tools emerged as enabling mechanisms within the planning process. Participants described the use of online platforms, social media, and community networks to support communication, follow-up, and service coordination. In Thailand, the Line application and telemedicine facilitated interaction among patients, VHVs, and healthcare providers during periods of restricted mobility [20, 21]. However, regional policy analysis cautions that digital transformation may exacerbate health inequities if digital access, literacy, and governance are not adequately addressed. In this context, digital health should be understood not merely as a technological innovation but as a boundary-spanning mechanism that links community outreach, service coordination, and health system governance. The implication of this study is therefore not to replace existing service models with digital solutions, but to embed low-barrier digital tools into routine primary care processes while maintaining parallel offline options.

The act stage represents the translation of identified priorities and assessed gaps into implementation-oriented directions rather than evaluated outcomes. The proposed health policy action plan focuses on strengthening healthcare access and emergency preparedness at the community level. Key strategies include expanding community healthcare delivery through online platforms, strengthened referral pathways, and optimized emergency services; adopting a network-based approach to disease management through integrated facility- and community-based interventions; and strengthening health information systems to support data-driven decision-making and digital health services. These initiatives, planned for implementation during 2023–2027, align with the National Health Security Office's Strategic Goal 2, which emphasizes ensuring equitable and accessible public health services for the population [22]. Importantly, these actions are not proposed as standalone interventions but as components of an iterative HNA cycle that allows monitoring, adaptation, and refinement over time.

The continued relevance of these findings beyond the COVID-19 pandemic lies in their focus on structural system capacity rather than crisis-specific conditions. By operationalizing the identify–assess–plan–act cycle, this study provides a pragmatic and transferable HNA model for linking community-identified needs to actionable primary care strategies. Although situated in Eastern Thailand, the findings offer transferable insights for other middle-income countries with strong primary care systems and community health workforces facing similar challenges in balancing routine care and emergency response.

This study has several limitations. First, the qualitative component included only primary care providers, and perspectives from secondary and tertiary care were not captured. Future studies should broaden stakeholder representation across care levels to strengthen system-level insights. Second, although sociodemographic data were collected, the quantitative analysis was descriptive and did not examine associations between sociodemographic characteristics and identified health priorities or access barriers. Future studies should incorporate inferential analyses to better understand how population characteristics influence health needs and healthcare utilization. Additionally, reliance on online surveys may have introduced selection bias and limited participation among individuals with low digital access. Mixed-mode recruitment strategies, targeted outreach through community networks and VHVs, and stratified sampling

should be considered in future HNA cycles to improve representativeness. Third, despite the large sample size, the findings may not fully represent all population subgroups in Eastern Thailand; probability-based sampling and weighting could enhance generalizability. Fourth, the quantitative analysis was descriptive, limiting the assessment of associations between participant characteristics, access barriers, and prioritized needs. Incorporating inferential analyses in future studies could provide more granular and actionable insights. Finally, as data were collected during a specific phase of the COVID-19 pandemic in 2021, some priorities may have evolved. Nonetheless, the identified structural access barriers and the continued need for integrated prevention, screening, and NCD services suggest that several recommendations remain relevant. Periodic HNA cycles are therefore recommended to monitor changing community priorities and refine primary care strategies over time.

5 Conclusions

This HNA-guided mixed-methods study provides actionable evidence to strengthen community health services in Eastern Thailand during the COVID-19 pandemic (2021). The findings highlight concurrent priorities for infectious disease preparedness and sustained NCD prevention and management, alongside persistent access gaps that can widen inequities during crises. Policy and local governance should therefore prioritize equity-focused access support for vulnerable and rural groups, institutionalize community-based prevention and integrated screening within primary care, and strengthen implementation through VHVs and streamlined health information systems. Digital health should be positioned as the optimization of practical tools already used in the community, supported by digital literacy and user-centered system design to avoid program overload. Embedding periodic HNA cycles into routine planning can improve service resilience and continuity of care beyond COVID-19. Although the findings are context-specific, the HNA-guided mixed-methods approach demonstrated in this study is potentially transferable to other low- and middle-income country settings with comparable primary care structures and community health volunteer systems.

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Author contributions
Conceptualization, Design of the study, Data acquisition and analysis, interpretation of data, Draft the manuscript: W.J., PH.J.; Data curation, Reviewing, Editing: W.J., W.C., K.P., M.Y., PH.J.; Final approval of the version to published: W.J., PH.J. M.Y. All the authors have read and agreed to the published version of the manuscript.

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Data availability
The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
This study was approved by the Human Ethics Committees of Burapha University (IRB1-059/2564, June 2021) in compliance with the Declaration of Helsinki. Participants provided informed consent, either on paper or electronically for online participation, after the research objectives and procedures had been explained. Data were analyzed anonymously. Participation was voluntary, and participants could refuse to answer any question or withdraw at any time without consequences. Confidentiality was ensured by assigning unique study codes, removing identifying information from interview transcripts, and storing data on password-protected devices accessible only to the research team. Any quotations used in the manuscript were de-identified, and all findings were reported at the group level. Informed consent was obtained from all participants. For online respondents, electronic consent was provided prior to accessing

the questionnaire. Participants were informed of their right to withdraw at any time without consequences, and all data were anonymized.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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