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Assessing healthcare status and challenges in border regions: insights from Tak and Mae Hong Son provinces, Thailand – a mixed-method approach

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Abstract

Background Thailand's Tak and Mae Hong Son (MHS) provinces, bordering Myanmar, are critical entry points for individuals seeking employment or healthcare. The COVID-19 pandemic and Myanmar's political instability have significantly impacted the health and performance of border-area health systems. This analysis examines the current state of the health sector, border health challenges resulting from cross-border movement, and identifies key gaps through data from health organizations and interviews in Tak and MHS provinces.

Methods A mixed-method situational analysis was conducted, incorporating documentary analysis (quantitative health facility data, national reports, and online survey data) and key informant interviews in five districts: Umpang, Mae Ramat, and Tha Song Yang (TSY) in Tak province, and Mueang and Pang Mapha in MHS province. A purposive sample of 42 participants, including community health workers and service providers, was interviewed on-site. Thematic analysis was used to interpret patterns within the interview data.

Results The non-Thai population makes up 20–30% of Tak and MHS provinces, with varying compositions across districts. Umpang has a high number of hill tribe ethnic minorities, TSY sees many cross-border patients, Mae Ramat has a large migrant worker population, and Mueang and Pang Mapha host people displaced by conflict. Between 2020 and 2023, malaria cases surged in Umpang and TSY, while TB incidence spiked in TSY, with non-Thais being 2–3 times more affected than Thais. This puts significant financial pressure on local health systems, as many non-Thais, including cross-border Myanmar nationals, lack health insurance, limiting access to subsidized healthcare. Additionally, resource shortages and insufficient healthcare staff further strain border health management. To bridge these gaps, many non-governmental organizations actively work to support healthcare services in Tak province. Addressing these challenges requires coordinated efforts to ensure equitable healthcare access and sustainable resource allocation in border regions.

Conclusion The study highlights significant health challenges in Tak and MHS provinces, particularly in districts with high non-Thai populations. Diseases like malaria and TB are more prevalent in these areas, straining local health

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systems. Financial and staffing challenges underscore the need for proactive government support and cross-sector collaboration to improve health equity in these culturally diverse border communities.

Key messages Tak and MHS provinces face significant healthcare challenges due to a large non-Thai population, particularly Myanmar nationals, who frequently seek care due to conflict and instability. Informal border crossings and lack of health insurance coverage for undocumented migrants strain local health systems. There are barriers to Thailand's Social Security Scheme (SSS) and Migrant Health Insurance Scheme (MHIS) for non-Thais, including limited awareness and employer reluctance. Border hospitals are overwhelmed with rising costs, unpaid treatment, and staffing shortages. NGOs play a vital role in providing essential services and disease control. To improve healthcare, stronger collaboration between health authorities, NGOs, and better funding and workforce support are essential.

Keywords Health service, Health facilities, Border health, Population movement

Introduction

The increasing trend of cross-border migration in recent years has attracted significant attention in many countries, with international migrants rising from 2.8% of the global population in 2000 to 3.6% in 2020 – a 62% increase from 173 million to 281 million [1]. This rising trend underscores the need to reorient health policies to better protect the health of migrants [2]. The World Health Organization (WHO)'s Global Action Plan on promoting the health of refugees and migrants (2019–2030) also emphasizes universal health coverage for refugees and migrants [3].

Thailand is in the heart of the Indochina Peninsula, sharing over 5,000 km of borders with Cambodia, Lao PDR, Myanmar, and Malaysia. In particular, Myanmar has the longest border with Thailand at 2,401 km and the largest population [4]. Tak and Mae Hong Son (MHS) provinces are located in the northernmost part of Thailand on the Thai-Myanmar border. Tak is administratively divided into nine districts, five of which (namely, Mae Sot, Mae Ramat, Phop Phra, Tha Song Yang (TSY) and Umphang) share a 533 km land and river border with Kayin State in Myanmar. MHS is administratively divided into seven districts and shares a 483 km land border with Kayin, Kayah, and Shan States in Myanmar along the Thongchai Mountains, Salween River, and Moei River. As of May 2024, about 60% of Myanmar refugees in Thailand are accommodated in three refugee camps in Tak [5] and approximately 30% in four refugee camps in MHS [5, 6].

Despite the British-established border between Myanmar and Thailand in the 1880s [7], cross-border movement in search of commerce and health services remains integral to daily life for those who have long lived in these border areas. Since the 1980s, Thailand's economic development, demand for low-skilled labor, coupled with its high minimum wage and geographical proximity have driven an influx of Myanmar migrant workers [8]. The establishment of special economic zones (SEZs) in Tak province has further stimulated the influx of Myanmar migrant workers, including long-term, seasonal, and temporary workers [9]. Border towns in Thailand's Tak and MHS provinces serve as key gateways for migrants seeking jobs or medical services [9, 10]. Currently, migrant workers constitute approximately 7% of Thailand's population, 75% of whom are Myanmar migrant workers [11].

In addition, many Myanmar civilians fled to Thailand due to conflicts between the Myanmar military and ethnic armed groups in the 1970s and 1980s. After the Myanmar military coup in 2021, the "People's Defense Force (PDF)" was created to resist the military coup, and the border area became unstable [12]. The population of nine camps along the Thai-Myanmar border increased by 31% from January 2020 to the end of December 2024, reaching 106,454 [13]. Tak and MHS provinces, bordering the most conflict-stricken areas of Myanmar, currently host approximately 90% of Myanmar refugees living in camps as of 2024 [5]. Cross-border movement through informal channels across Tak province has increased, particularly in Mae Sot, Mae Ramat, Phop Phra, TSY and Umpang districts. The number of illegal immigrants also increased significantly from 23% in 2021 to 50% in 2023. Tak province had the highest proportion of Myanmar nationals in an irregular situation (75%) compared to other states [14]. The geographical conditions for border crossing along the Thai-Myanmar border and the proximity to conflict zones in Myanmar have influenced the composition of non-Thais, which varies somewhat from region to region [7], resulting in somewhat different public health challenges across regions.

To solve the border health issues, the Ministry of Public Health (MOPH), Thailand has introduced the Border Health Problem Solving and Development Plan Version 1 (2007–2011) [15], which aims to provide access to quality primary healthcare, establish effective disease surveillance systems, and promote multi-sectoral engagement, including collaboration with neighboring countries. This was followed by Version 2 (2012–2014) [16], which details strategies for collaborative border health operations. In 2016, the Strategy and Planning Department of MOPH developed the Border Health Strategic Plan [17], consisting of three strategies: (i) Friends (building friendly relations); (ii) Share (exchange and cooperation);

and (iii) Strong (effective management system), including plans to support SEZs, followed by the Border Health Development Master Plan and Operational Plan 2022–2027. The District Health System (DHS) in border areas integrates health and social services to enhance the quality of life for both Thais and non-Thais residing in border areas, guided by the MOPH.

The health insurance to improve their access to affordable healthcare for non-Thai nationals includes (i) Social Security Scheme (SSS) managed by the Ministry of Labor for non-Thai nationals in formal employment sector, (ii) Fund #99 for stateless persons who are certified by the Cabinet to reside permanently in Thailand and hold documents marked as "non-Thai nationals," and (iii) MOPH Migrant Health Insurance Scheme (MHIS) for non-Thai nationals who are not included in any insurance scheme. Additionally, the MOPH is working with the WHO to develop a health insurance system for non-Thai nationals (HINT) [18]. The HINT system aims to register individuals with real-time identity and rights issues and approve rights within five minutes compared to the previous one to two weeks and connect to the financial data hub system to facilitate refund decisions for hospitals within 24 h and fund transfers within 15 days. The development includes the 30 Thai baht (Gold Card) policy and the Border and Special Area Health System under the 2024 policy of the MOPH. Providing real-time registration for individuals with identity and rights issues and improving access to services for specific population groups are among the 13 policies of MOPH's 100-day Quick Win initiative. But it still does not apply to all types of foreigners, so undocumented migrants are not eligible.

Recent data [19] indicates a sharp resurgence of malaria in Myanmar, with cases increasing from 8,000 in 2019–2020 to 32,000 in 2022, particularly in Kayin state, which shares a border with Mae Sot district in Tak province. This is likely linked to Myanmar nationals fleeing the 2021 military coup, many of whom moved to mountainous areas highly prone to malaria. This means that limited access to health services in these areas not only heightened the rise of disease transmission but also increase the burden on health systems and epidemic risk management in Thailand's border areas. Despite these challenges, there is a lack of up-to-date information on health issues and healthcare services in border areas following the COVID-19 pandemic.

This study aims to investigate current border health system management and existing support programs for marginalized population through interviews and data collected from health institutions in Tak and MHS provinces. This situation analysis is a crucial first step before implementing interventions to strengthen health systems for both Thais and non-Thais in border areas. The insights gained from this study can also be valuable for researchers and policymakers, providing an understanding of the complex relationship between cross-border movement and public health challenges.

Materials and methods

Study design and data collection

This study employed a mixed-method approach, combining qualitative and quantitative data collection methods to understand diverse contextual insights at both the macro and micro levels. Data was collected from 20 January to 17 February 2024 in three districts of Tak province (Mae Ramat, TSY, and Umphang) that received financial aid from the Japan International Cooperation Agency (JICA) and Mueang and Pang Mapha districts of MHS province (Supplementary Figure F1-2). There are still concerns about infectious diseases like dengue fever, malaria, elephantiasis, and emerging illnesses along the Thai-Myanmar border. Several challenges hinder effective healthcare: (1) Difficulty identifying and collecting data on non-Thai individuals, limiting health assessments; (2) Language barriers due to insufficient personnel training; (3) Legal and budget constraints on hiring interpreters; (4) Increased workload for public health officials, restricting service access; (5) Financial strain on health units, as many cross-border populations have low incomes; and (6) A complex, unclear healthcare infrastructure along the border. These issues complicate disease control and the overall healthcare response in the region.

Quantitative data sources included the Health Data Center (HDC) [20], district-level service records, national reports, and online surveys (Supplementary Table S1). The HDC is a dataset that exports data from all levels of health departments (hospitals and health centers) to create standardized reports. Additional data from the National Statistical Office of Thailand and Provincial Statistical Offices in Tak and MHS covered household demographics, socio-economic status, employment, migration, health facilities, and welfare information. The data focused on key areas essential to health system performance, including governance, human resources (health workforce), service delivery, financing, and health information systems.

Qualitative data was collected through in-depth interviews and observations. Key informants for in-depth interviews were purposively selected based on their roles and responsibilities within the MOPH's Primary Care Contracting Unit (CUP) model. The CUP is a district-level organizational framework for healthcare services involving district health offices, district hospitals, Tambon (subdistrict) Health Promoting Hospital (THPH), and community health centers. Table 1 shows key informants who participated in the study. Each interview lasted around 60 min, guided by open-ended questions

Table 1 Key informants in the study sites ($n=42$)

Province	District	Subdistrict	Provincial Public Health Office	District Public Health Office	Subdistrict Administrative Organization	District Hospital	Health Promoting Hospital	Community Health Center	Total
Tak	Umphang	Umphang		2	1	4†		1	8
		MoKo			1		1		2
		Mae Chan				1	1		2
	Mae Ramat	Mae Ramat		1		4†			5
		Mae Charao				1			1
		Khane Chue					2	1	3
	Tha Song Yang	Mae Tan		2		2			4
		Mae La			1		2		3
		Tha Song Yang			1		2		3
		Mae Song					1		1
Mae Hong Son	Muang	Chong Kham	2			2		1	5
		Hui Pha						1	1
		Pang Mu					1		1
		Mok cham Pae		1			1		2
	Pang Mapha	So Pong				1			1
Total									42

† Hospital director, epidemiologist, border health personnel, and health promotion nurse were included

on topics such as facility management structure, human resources, budget allocation, patient referral, follow-up management, engagement and coordination of public and private sector networks, and international non-governmental organizations (NGOs) working in border health. The researchers also conducted observation at border checkpoints and natural routes such as river and mountain passes. This approach allowed for an in-depth understanding of the environmental conditions, social contexts, and geographical factors related to cross-border movement.

Data analysis

To effectively handle the data from the study, we used triangulation methods that included cross-checking information from multiple sources to reduce bias in data collection and analysis. For example, triangulation may involve combining qualitative interviews with quantitative surveys using multiple data sources. This verification process through triangulation ensures a more comprehensive analysis and enhances the accuracy and consistency of the data obtained and the reliability of the conclusions drawn from the study.

Ethical consideration

The research obtained ethics approval from "the Mahidol University Ethical Committee (No: 2024/014.2401)". The research team requested permission for data collection from local authorities and arranged appointments to explain the project. The research team verbally informed the interviewees about the data collection process and addressed ethical considerations, including maintaining confidentiality and ensuring that personal information would not be disclosed without consent.

Results

Demographics of Non-Thai population

"Non-Thais" in this study refer to individuals with or without the Ministry of Interior registration (i.e., 13-digit identification number), including ethnic minorities residing in Thailand, excluding civil war migrants living in temporary shelters and refugee camp.

Officials from the Mae Ramat District public health office describe the different groups of non-Thai individuals living and working in Thailand as follows:

> *"A significant portion consists of migrant workers from Myanmar. Many are employed in agriculture, construction, manufacturing, and domestic services, filling essential labor shortages in Thailand. However, they often face precarious working conditions, lack legal protections, and have limited access to healthcare and social services. Another major group includes refugees and displaced persons who have fled Myanmar due to ongoing conflict and persecution. These individuals primarily reside in camps along the Thai-Myanmar border, where they rely on humanitarian aid and NGO support for survival. Their legal status is uncertain, making it difficult to access employment, healthcare, or education outside the camps. Stateless individuals, many from ethnic minority groups, struggle with restricted access to education, healthcare, and legal employment. Without proper documentation, they cannot access for-*

mal healthcare services, leaving them vulnerable to untreated illnesses and preventable diseases. Some turn to cross-border medical services, but even that is not always accessible due to financial constraints and legal barriers. In urban areas, another segment of the non-Thai population includes expatriates, who contribute to various industries such as education, technology, and business. Unlike migrant workers and refugees, expatriates generally have better access to healthcare and legal employment, but they may still face challenges related to language barriers and insurance coverage."

Officials from the TSY District public health office describe, how does cross-border healthcare impact Thailand's healthcare system?

"Many people from Myanmar, particularly from border areas with limited medical services, enter Thailand to seek treatment. These cross-border visitors include day laborers, traders, and residents of conflict-affected regions who require urgent care for injuries, infectious diseases, maternal health, and vaccinations. Thai border hospitals play a crucial role in providing emergency and primary healthcare to both Thai and non-Thai residents. However, they face multiple challenges, including: Language barriers, making communication between healthcare workers and patients difficult. Lack of formal identification, preventing proper medical documentation and follow-up care. Financial burden, as many patients cannot afford treatment, leading to unpaid hospital costs. Healthcare workforce shortages, placing additional strain on already overwhelmed medical facilities. There is a need for policy improvements, including clearer guidelines for cross-border healthcare cooperation and expanded interpreter services in hospitals. Strengthening partnerships between government agencies, NGOs, and international organizations could also help address the funding and workforce challenges faced by border healthcare facilities.

A high percentage of the non-Thai population

According to MOPH data in 2023, the non-Thai population makes up 20.7% of Tak's total population (143,156 out of 691,714): 14.8% in Mae Ramat, 25.8% in TSY, and 34.2% in Umphang districts (Supplementary Table S1).

The border control areas in MHS are designated for cargo-only trade, prohibiting individuals' crossings due to ongoing conflicts between Myanmar military and ethnic armed groups, along with the continued influx of refugees. However, Myanmar nationals crossing the informal natural border to seek employment or healthcare in Tak. This increase is driven by political and economic instability in Myanmar. Many prefer Thai healthcare facilities due to availability and accessibility, and high trust in the quality of care provided.

Officials from the Mae Ramat District public health office reported as follows:

"Due to the political situation, traveling back to Thailand for labor employment has become increasingly inconvenient since they returned to Myanmar during COVID-19. This has led to increased illegal border crossing through the natural routes (i.e., over land or water). ……Crossing through this (natural border crossing) point is closer, costing about 20 baht to cross by boat. Most of the Myanmar patients who come here primarily use boats for crossing or, if it is the dry season and the river level is low, they walk across or hire motorbikes. Visiting a Thai doctor through this route is more convenient for them. After seeing the doctor, they can cross back immediately. Some even bring their children here to get vaccinated, thinking that the quality of the medicine is superior. ……However, if someone is seriously ill and doesn't have money for a private clinic, sympathetic officials (in Thai hospitals) coordinate with charitable organizations to obtain free treatment."

The composition of non-Thai patients varies across the study areas. According to the data obtained, in the Umpang district, nearly half of the patients are ethnic minorities without a Thai ID who have lived there for a long time and approximately one in five patients is a Myanmar national. In the TSY district, many Myanmar nationals cross the river for healthcare services, while Mae Ramat district, a SEZ, has a large number of migrant workers (Supplementary Table S2–4).

Shared ethnic ties between border villages of the two countries

The practice of living as neighboring communities and sharing ethnic ties in Thailand-Myanmar border areas existed before the British establishment of a formal border in the 1880s. This practice remains strong today, not only in the health sector but also in areas like education. Under Thailand's "Education for All" policy, children without legal status and Myanmar children residing in border areas can study in Thai schools. Thus, in some districts of Tak and MHS, Myanmar students cross the border every day to attend school.

Health officials in the border areas of Tak Province explained the reason as follows:

"If there were no borderline, the residents on both sides would view each other as siblings, knowing

each other completely. When they practice traditional rites or ceremonies, the cross-border communities still find a way to participate together. The joint celebration makes us feel like we are still together, and we don't feel any different – in that sense, the international borderline feels too abstract."

"The sense of siblinghood and being of the same ethnicity still exists. In places like TSY and Mae Ramat Districts, the feeling (of connection between the border areas of Thailand and Myanmar) remains the same because, you see, when the Moei River is dry, you can walk right across to the other country. It is not as dramatic as a vast natural border. Even in Umpang District, there is no river border, and walking around, you wouldn't even know where (which country) you are in."

The health insurance fund for Non-Thai migrants

Thailand's Social Security Scheme (SSS) extends coverage to non-Thai employees, providing essential benefits under the Social Security Act. These include healthcare, maternity care, child allowances, unemployment benefits, disability support, pensions, and compensation for work-related injuries or diseases. Non-Thai employees, primarily migrant workers from Myanmar, Cambodia, and Laos, must be legally employed and registered to qualify for SSF enrollment. Contributions are shared among employees, employers, and the government. However, barriers persist, such as limited awareness, challenges in registration for undocumented workers, and employers' reluctance to enroll migrants. Many non-Thai employees rely on out-of-pocket payments, leaving them vulnerable in emergencies.

Health officials in the border areas of Tak explained the Barriers to the SSS for non-Thai employees as follows:

"Non-Thai employees face several barriers to accessing Thailand's SSS. A primary challenge is limited awareness among migrants and employers about the benefits and registration process. Many employers are reluctant to enroll migrant workers due to perceived administrative burdens or costs, particularly for those on short-term contracts. Undocumented workers are excluded, as legal employment and proper documentation are prerequisites for SSF eligibility. Accessing health services through SSS is challenging for non-Thai employees due to limited awareness, language barriers, and complex registration processes. Undocumented workers are excluded, and some employers avoid enrollment to reduce costs. These issues leave many migrants without reliable healthcare support or social security coverage."

MHIS for Non-Thai Migrants in Thailand addresses healthcare access for migrant workers, undocumented individuals, and their dependents. Established by the MOPH, it offers an alternative to state insurance schemes for those without Thai citizenship or a 13-digit ID number. The fund provides essential health services, including preventive care, treatment for communicable diseases, maternal health, and vaccinations. However, challenges persist, such as financial barriers, limited awareness, lack of access to registration points, and concerns about compliance. Many migrants remain uninsured (Supplementary Table S5). Myanmar nationals enrolled in health insurance other than social security in Tak and Mae Hong Son provinces were small (22,753 in Tak and 1,416 in MHS). Strengthening enrollment processes, lowering costs, and enhancing employer participation can improve the fund's impact, benefiting both migrants and Thailand's public health system.

Key informants who work as public health officers in the study areas had the following observations about access to health insurance, including healthcare services:

"Firstly, some individuals lack the ability to pay for or purchase health insurance cards and, secondly, even if individuals are capable of purchasing health insurance cards, many participating healthcare facilities refuse to sell them. Some healthcare facilities perceive health insurance card prices as 'not worthwhile,' and fear the financial burden they may impose. Thirdly, individuals without 13-digit Thai identification number face obstacles to accessing state health insurance schemes. Lastly, if employers assist in purchasing health insurance for foreign workers, provided by the MOPH, the workers may not fulfill their work obligations during the period of eligibility, as there are no contractual obligations."

In TSY hospital, according to the information from public health personnel, the number of non-Thai patients has increased by approximately 20% per year (accounting for more than half of non-Thai patients, including inpatients and outpatients), resulting in an annual budget deficit of 10–20 million baht. Due to the lack of medical personnel on the Myanmar side, particularly for childbirth, many Myanmar nationals rely on Thai hospitals, requiring an expenditure of 10,000 baht (approximately 300 USD) per person. According to the information from TSY hospital, the hospital manages an average of 1,000 births annually but faces shortages in medical equipment, such as vital sign monitors and infant incubators. Thus, the hospital seeks additional government funding and contributions from the private sector. However, both resources and services remain insufficient to meet the growing needs (Table 2).

Table 2 In-patient and out-patient service and expenses for non-Thais in Tak and Mae Hong son provinces

	Out-patient visits			In-patient service		
	2021	2022	2023	2021	2022	2023
Tak Province						
Mae Ramat Hospital						
Times	161,257	174,625	160,004	8,886	9,529	9,895
Total cost (baht)	6,857,096	8,716,469	7,447,381	11,485,171	20,898,552	12,357,960
Total payment collected (baht)	5,106,974	4,588,180	5,898,662	6,085,261	10,239,162	7,447,381
Cost of waived fees	1,750,116	4,128,505	1,515,407	5,399,910	10,659,391	4,910,579
Umphang subdistrict						
Times	46,537	79,424	72,136	2,374	2,910	3,908
Total cost (baht)	11,413,990	3,178,470	320,798	1,529,336	224,815	438,150
Total payment collected (baht)	286,087	235,146	296,630	106,528	117,550	96,718
Cost of waived fees	11,127,903	2,943,324	24,168	1,422,808	107,265	341,432
Tha Song Yang District						
Times	39,212	66,958	55,744	1,774	2,499	2,355
Total cost (baht)	5,513,859	5,203,905	5,686,960	1,599,605	2,098,753	1,329,074
Total payment collected (baht)	2,302,450	2,912,009	4,472,458	753,954	600,787	611,538
Cost of waived fees	3,211,409	2,291,896	1,214,502	845,651	1,497,966	717,536
Mae Hong Son Province						
Times	-	169,768	115,132	-	4,621	4,293
Total cost (baht)	-	79,896,089	59,419,121	-	81,083,804	62,244,624
Total payment collected (baht)	-	5,639,136	10,283,680	-	5,440,235	7,726,144
Cost of waived fees	-	74,256,961	49,135,450	-	75,643,569	54,518,480
Sri Sangwan Regional Hospital						
Times	-	79,028	49,848	-	2,609	2,005
Total cost (baht)	-	36,471,148	25,515,609	-	48,078,021	34,782,302
Total payment collected (baht)	-	1,862,985	2,294,829	-	3,042,009	3,642,425
Cost of waived fees	-	34,608,171	23,220,788	-	45,036,012	31,139,877
Pang Mapha Hospital						
Times	-	25,945	16,393	-	515	564
Total cost (baht)	-	9,229,388	7,538,160	-	3,790,671	4,165,327
Total payment collected (baht)	-	914,344	1,100,828	-	257,529	346,630
Cost of waived fees	-	8,315,044	6,437,332	-	3,533,142	3,818,697

As of December 24, 2024, at 18:35 UTC, the exchange rate is approximately 1 USD = 34.1417 THB

In Umphang, conflicts between the Myanmar military and ethnic armed groups have led to an increase in the number of non-Thais seeking medical services. In the first nine months of fiscal year 2023, Umpang hospital has allocated 40 million baht to treat non-Thai patients who cannot afford medical expenses. The hospital has relatively sufficient medical equipment, but the budget for treating non-Thai patients is insufficient. It relies on donations, which fluctuate yearly, to cover the shortfall. The hospital is also running a project to solicit donations of surplus drugs to treat non-Thai patients.

In MHS, unpaid treatment costs for non-Thais during the COVID-19 pandemic in 2022 amounted to 74 million baht for outpatient care and 75 million baht for inpatient care. During the pandemic, the government's COVID-19 fund managed and covered these to some extent. In 2023, as COVID-19 cases decreased, unpaid treatment costs for non-Thais reduced to 50 million baht and 54 million baht for outpatients and inpatients, respectively. However, since the government fund for COVID-19 has been discontinued, these unpaid costs remain a significant financial burden for hospitals. At Pang Mapha hospital, non-Thai patients often present with severe conditions requiring hospitalization or referral to Sri Sangwan regional hospital. Each year, the Pang Mapha hospital accumulates 3–4 million baht in unpaid inpatient costs and 6 million baht in unpaid outpatient costs from non-Thai patients. Sri Sangwan regional hospital treats around 2,000 inpatients and 40–50 thousand outpatients annually, with approximately 50% of both Thais and non-Thais lacking national health insurance. In 2023, the hospital received 85 million baht from the Gold Card scheme. However, after deducting 87 million baht for staff salaries, no funds remain for patient services, resulting in an immediate deficit. While the hospital received 1.4 million baht from Social Security, some of this must be calculated as an additional 10 million baht per year that must be paid to hospitals in Chiang Mai province

when a patient is referred from the hospital. An additional 10 million baht needs to be accounted for foreign patients. Staffing shortages further exacerbate the situation, given its location in a border area. In instances of staff transfers or retirements, the hospitals must often recruit replacements using their budget, adding to the ongoing financial challenges.

Health facilities

At the central level, the MOPH sets national health policies, regulations, and standards. However, provincial health offices have the autonomy to adapt and implement these policies in ways that meet local needs. These offices oversee a network of provincial and district hospitals, health centers, and clinics, ensuring that healthcare services reach all population groups.

The provincial health system manages a network of provincial and district hospitals, healthcare centers, and clinics, which provide both primary and specialized care. These facilities address both routine healthcare needs and public health challenges, such as infectious disease control, maternal and child health, and chronic disease management. Additionally, provincial health offices collaborate with local governments and community organizations to implement health initiatives to ensure emergency preparedness. The provincial health system plays a key role in achieving universal health coverage and reducing health disparities across the country.

The district healthcare system plays a crucial role, especially in border regions. However, the system faces unique challenges, including a higher concentration of migrant populations, limited infrastructure, and geographical isolation. The district healthcare system manages public health threats such as communicable diseases, as well as preventive care, vaccination programs, and maternal-child health services (Supplement table S6 –7).

Currently, public health facilities in border areas provide emergency and basic healthcare to all individuals, regardless of nationality or legal status. Healthcare workers are also committed to helping every individual access treatment or vaccination, regardless of legal status.

> *"The current security threat is primarily a matter of health and infectious diseases. In Tak Province, there is significant instability, not only due to COVID-19 but also other infectious diseases like malaria. A healthcare system must address these problems to ensure everyone can access health services without exorbitant costs. If residents on the opposite side neglect diseases like malaria, mosquitoes can cross the border and infect Thais, leading to recurring outbreaks on both sides. Similarly, diseases like tuberculosis can spread through the air. Therefore, a cross-border approach to public health is crucial from a humanitarian perspective and a means of controlling infectious diseases. The most recent example is COVID-19, which we have been able to control through policies that genuinely assist everyone, ensuring that anyone, regardless of their legal status, receives treatment or even crosses over to receive vaccination." (Director of Umphang Hospital).*

NGOs play a pivotal role, providing healthcare and humanitarian aid in areas where local governments have limited reach or capacity. For example, the Shoklo Malaria Research Unit (SMRU) and Mae Tao Clinic are offering primary care, maternal and child health services, treatment for infectious diseases like malaria, tuberculosis (TB), and HIV/AIDS. The "TB Village" in Mae Ramat district, run by SMRU, provides free TB treatment to patients and free accommodation and meals within the facility to the patients' families to ensure that they complete their treatment successfully. Furthermore, NGOs in border areas advocate for the rights of displaced populations, offering legal aid and protection from exploitation, human trafficking, and abuse. They also support education and vocational training programs, particularly for children and youth in refugee camps. Interviews with public health officials and NGOs in Mae Sot district revealed that through cross-border health initiatives and collaborations, these NGOs facilitate knowledge exchange and resource-sharing between Thailand and Myanmar, strengthening health systems and addressing shared public health challenges in the region. Additionally, some NGOs run mobile health units and provide training to community health workers (Table 3).

Issues and challenges on health in the border areas

Tak and MHS face a range of significant health challenges, many of which are linked to their proximity to the Myanmar border and the large migrant populations in the region. First, Infectious Diseases: Both provinces experience a high prevalence of infectious diseases such as malaria, TB, dengue fever, and HIV/AIDS. The movement of people between Thailand and Myanmar, combined with poor healthcare access, creates conditions conducive to disease transmission. Malaria, in particular, remains a major concern, especially in rural and border areas. Second, Maternal and Child Health (MCH): Access to maternal and child healthcare is limited, leading to higher rates of maternal and infant mortality. Many women and children in remote areas have inadequate access to prenatal care, skilled birth attendants, and vaccination programs. Malnutrition is also a significant issue, further contributing to poor health outcomes. Third, Mental Health: Mental health problems are widespread, especially among migrant workers and refugees

Table 3 Healthcare provision and referral system for non-Thai population in the border areas of Thailand

Province	**Tak**			**MHS**	
District	**Umphang**	**Mae Ramat**	**(TSY)**	**Muang**	**Pang Mapha**
Healthcare provision for Myanmar people	• There are social support networks that assist many Myanmar patients: for example, the MTC provides health counseling and medical services and acts as a liaison between hospitals in Thailand and Myanmar • Some NGOs, such as SMRU, provide healthcare with an emphasis on maternal-child health and infectious diseases (mainly Malaria and TB) for marginalized populations living on both sides of the Thai-Myanmar border • Medical institutions provide services to Thai and Myanmar patients, ensuring convenience for medical service recipients: For example, vaccinations used to be given at MTC and SMRU. Now they can be provided at a local HPH close to the service recipient's home.			• Thai public health agencies are implementing collaborative projects involving medical professionals from both countries to increase the effectiveness of joint efforts: these benefit patients crossing the border to Thailand to receive treatment.	
Referral system	• Referring patients in the Thai-Myanmar border area occurs through formal and informal channels. • Patients in Myanmar can request an ambulance to pick them up and transfer them to a hospital on the Thai side (formal process), OR they can walk or drive to a temporary border crossing point and be transferred to a hospital through relatives on the Thai side (informal process). • Mae Sot Hospital, a provincial hospital in Tak Province, treats patients transferred from Umpang Hospital, TSY Hospital, and Mae Ramat Hospital. Due to the increase in non-Thai patients, the burden of treatment costs and overcrowding in these hospitals is increasing.				
Health insurance	• Foreign migrant workers legally employed in Thailand are entitled to purchase health insurance, and the coverage period is the period stated on the border crossing card. • Daily workers are not provided with health insurance but can still access health care services at a reasonable cost.			• Health insurance is not sold, but medical treatment is accessible conveniently and the treatment costs are not high	
Cooperation with NGOs	• The Border Health Office of Tak Province collaborates with public and private sector organizations, including district health offices and hospitals in the five border districts. • International (non)governmental organizations such as SMRU, ARC, PU-AMI, Solidarities, JICA, and PPAT operate under the Thailand MOPH supervision. • NGOs working for non-Thais in Thailand include SMRU, IRC, IOM, MTC, etc. • NGOs working in foreign communities near the border area include SMRU, IRC, BHF, BPHWT, BMA, CPI, and MTC. • Kawthoolei Hospital in Myanmar, opposite the TSY subdistrict, is managed by many support organizations, such as CPI, MSF, SMRU, ATH, KLF, etc. Also, the hospital is in partnership with Thailand's TSY Hospital for patient referral, disease outbreak control, immunization programs, and infrastructure upgrade and renovation and with Ta Re Poe Kwee Hospital, Myanmar for patient referral, disease outbreak control, and immunization programs			• NGOs working for non-Thais in Thailand include IRC and IOM	

TSY Tha Song Yang, *ATH* The Atupa Transnational Healthcare, *BPHWT* Back Pack Health Workers Team, *BHF* Borderland Health Foundation, *BMA* Burma Medical Association, *CPI* Community Partners International, *HPH* Health Promoting Hospital, *IRC* International Rescue Committee, *IOM* International Organization for Migration, *KDHW* Karen Department of Health and Welfare, *KLF* Kaw Lah Foundation, *MTC* Mae Tao Clinic; *MSF* Médecins Sans Frontières, *MOPH* Ministry of Public Health, *PU-AMI* Premiere Urgence - Aide Medicale Internationale, *PPAT* Planned Parenthood Association of Thailand, *SMRU* Malaria Research Unit, *SATREPS* Science And Technology Research Partnership for Sustainable development

from Myanmar who face trauma, displacement, and living in difficult conditions. There is a lack of mental health services, which exacerbates the situation. Lastly, Cross-Border Health: Both provinces have large numbers of undocumented migrants who lack access to healthcare services due to legal and financial barriers. Many are at risk of exploitation and poor living conditions, which further contribute to health issues.

Regarding MCH services, data indicates high rates of undernutrition and low immunization coverage, especially in mountainous and remote areas. There is an urgent need for infrastructure investments, such as cold chain transport for vaccines and nutritional supplies. Additionally, support for vaccines under the Expanded Program on Immunization (EPI) in schools is critical, particularly for cold storage systems in areas with large stateless populations. In the three border districts of Tak, at least 40–50% of primary school students are non-Thai citizens. While Thai healthcare personnel provide EPI to all students in these districts, they are unable to receive reimbursement for vaccinations given to non-Thai students.

Crude birth rates in both Tak and MHS are higher than the national and regional averages (Supplementary Table S7). However, both provinces also experience higher-than-average under-5 mortality rates (10.0 for MHS and 11.7 for Tak) and infant mortality rates (8.7 for MHS and 8.5 for Tak). In terms of maternal and child health, Tak faces ongoing challenges with low full immunization rates and high undernutrition rates. Additionally, Tak has significantly lower rates of education completion, health insurance coverage, and literacy compared to national standards. We also obtained information through interviews that many Myanmar nationals are turning to Thai hospitals for childbirth due to insufficient manpower and resources in Myanmar's hospitals to ensure safe deliveries. In addition to maternal care, respiratory infections, malaria, dengue fever, and acute childhood respiratory infections are prevalent among Myanmar patients. These health challenges underscore the need for improved healthcare infrastructure and access for both Thai and migrant populations in the region.

In 2023, the top five diseases with the highest morbidity rates were identified, with diarrhea being the most prevalent across all areas (Supplementary Table S8). Malaria ranked as the third most common disease in the TSY and Umpang districts. Between 2020 and 2023, there was a noticeable increase in malaria cases across three districts of Tak province, particularly among non-Thais in Umpang and TSY districts (Supplementary Table S9). In Umpang, malaria cases rose steadily across all subdistricts, with the most significant increase occurring in the Moko subdistrict, which is located near the land border and features flat terrain (Supplementary Figure F3). This subdistrict showed a particularly sharp rise in cases. Based on the analysis of malaria surveillance and monitoring data from the Umphang District Public Health Office, among both Thai and non-Thai populations, Plasmodium vivax was the most common malaria strain, accounting for 3.5 times more cases than Plasmodium falciparum. For TB, the incidence rate (per 100,000 people) in Mae Ramat district has decreased over time, while in TSY district, it has seen a slight increase, particularly among non-Thais. In Mae Ramat district, the incidence of hemorrhagic fever per 100,000 people was 364.0 in 2018 and 545.7 in 2019. During the COVID-19 pandemic, this rate dropped to 165.1 in 2020 and 45.7 in 2021. However, it began to rise again, reaching 313.1 in 2022 and 795.2 in 2023, with the increase being most pronounced among Thais (Supplementary Table S10).

To manage epidemics, the Thai and Myanmar governments are developing the "Twin Village/Hospital" system, a collaborative framework aimed at improving healthcare access for residents in border areas. This system includes a surveillance network to monitor diseases and public health emergencies in these regions. It is supported by a diverse community-based workforce, which includes migrant health volunteers (MHVs), community health workers (CHWs), village health volunteers (VHVs), and malaria outpost workers.

"The spread of important infectious diseases along the Thai-Myanmar border needs constant vigilance. .... Preparedness measures for disease outbreaks include robust border area surveillance, prevention, and control systems, effective cross-border information exchange networks, Surveillance and Rapid Response Teams (SRRT) that operate efficiently, and joint disease investigations between Thailand and Myanmar. There are comprehensive plans for preventing and controlling important infectious diseases in the border areas through collaboration with relevant agencies. There is a push for coordination and cooperation between the border provinces of Thailand and Myanmar for early warning and surveillance of key infectious diseases."
(A senior public health official in TSY district)

"Formal checkpoints cannot control diseases that occur with the movement of people across the border. Moreover, there are many natural border crossing opportunities along the Thai-Myanmar border where people can cross back and forth daily or periodically. Therefore, a community surveillance system needs to be established with technical support and supervision from local Tambon Health Promotion Hospitals (THPH), Village Health Volunteers (VHV), and Migrant Health Volunteers (MHV). They can work with communities to conduct surveillance and facilitate access to quality healthcare services. The issue of collecting fees from patients crossing the border is still a human rights issue that requires attention. Although hospitals sometimes receive donations, it is not a sustainable solution."
(A physician at TSY hospital)

"The demarcation of the border is used for internal governance within each country in politics, economy, and the exercise of democratic power by both nations. However, that collaboration does not formally include public health. Healthcare providers in cross-border zones view public health as a field that cannot be divided by territorial boundaries. The occurrence of diseases and illnesses in the population of one country can directly affect the population of the neighboring country, particularly in terms of infectious disease control and prevention. Therefore, healthcare officials in Thailand have implemented

various projects to improve the quality of life for the border communities of Myanmar. Examples include the Village Health Volunteer (VHV) project, a collaboration between Thai VHV and MHW from Myanmar, and the Royal Health Pavilion Project in the border area of Umpang district."
(A doctor in a border hospital)

The location of the "Twin Village/Hospital" system is shown in Supplementary Figure F4. Under the "Twin Village/Hospital" system, Thai and Myanmar volunteers work collaboratively via Thai IT systems (mobile phones) and a network of Thai and Myanmar volunteer health workers. Their responsibilities include monitoring epidemics, health risks, and outbreaks in three districts of Tak province and adjacent areas in Myanmar, covering 16 communities. However, many MHWs and MHVs are not formally recognized and receive no compensation, limiting their effectiveness and making their roles unsustainable. For example, Myanmar VHVs with other responsibilities, such as agriculture or farming, may be unable to perform disease control tasks effectively as they do not receive any compensation or benefits such as social security are provided in Thailand (e.g., 1,000 baht per month).

Health facilities in border areas are also facing several challenges, especially limited budget and human resources. The Thai government's budget allocation does not cover treatment for non-Thai patients and assigns medical staff based solely on the registered Thai population. However, ongoing conflict in Myanmar has increased the demand for public health support in border areas, placing a heavy burden on Thai provincial governments, which lack sufficient funds to manage this increased demand. According to the 2021 Public Health Resources Report, health workers in Tak and MHS, including doctors, pharmacists, and specialist nurses, are serving more patients than the national average due to the rising non-Thai population in border areas (Supplementary Table S11). It may indicate that the collapse of Myanmar's health system due to political instability has further overburdened Thai health workers.

Discussion

Our study looked at the current status of health and healthcare in Thailand's provinces (Tak and MHS) bordering Myanmar. In MHS, where stricter border control is enforced, infectious diseases, such as malaria and TB, are significantly lower than in Tak. Districts in Tak face a high burden of infectious diseases, particularly in areas with high levels of stateless (e.g., Umpang) and cross-border patients (e.g., TSY). This supports the hypothesis that cross-border movement may contribute to the transmission of infectious diseases since a notably higher rate was observed among non-Thais, particularly in Umpang and TSY districts. This trend may imply that the increased influx of non-Thais may be associated with the increased malaria incidence partly due to the political instability after the military coup in 2021 in Myanmar [9, 21, 22].

A study using district-level data from Tak [24] found a contrasting result that increased migration was associated with increased respiratory infectious diseases and decreased vaccine-preventable diseases but had no effect on vector-borne diseases such as malaria. The difference may stem from the fact that the previous study used data from 77 provinces over multiple periods (2016–2021), while our data focused on two provinces, Tak and MHS during or after COVID-19. The two provinces are one of the six provinces with the highest number of malaria cases in Thailand with Tak alone accounting for 50% of cases among six provinces [23]. It may be explained that malaria incidence in more remote areas of the Thailand-Myanmar border has increased significantly in recent years, likely related to the closure of health services and lack of anti-malarial drugs in Myanmar. Further research should be followed to confirm it.

In addition, even though the incidence of pulmonary TB has decreased in the Mae Ramat district, the incidence has increased in the TSY district, particularly among non-Thais. The lower incidence in Mae Ramat district may be associated with TB prevention and treatment activities run by SMRU. The SMRU pays for all expenses related to TB treatment, including free accommodation and meals for vulnerable populations; some patients may choose to return to their home country or other areas before completing all treatment. TB requires treatment for 3–6 months, and malaria requires medication for 14 days and frequent blood tests to confirm full recovery. If patients do not receive or adhere to treatment regimens, they may not fully take their medications, which may result in incomplete recovery or the development of drug resistance. This poses a health threat to all border communities in Myanmar and Thailand. Therefore, for diseases requiring long-term medications, such as pulmonary TB and HIV, cross-border healthcare systems remain a challenge, including disease data management, coordinated disease control and prevention plans, and efforts to secure continuous treatment monitoring systems. The Thai government also has implemented initiatives to enhance border health service systems, including the International Public Health Operational Network, the Border Public Health Operational Network, and the Health Dam, as well as prevention and treatment programs on communicable diseases, such as HIV/AIDS, tuberculosis, and malaria along the border. However, due to a lack of policy support and insufficient budget allocation, the implementation has failed to achieve its strategic goals fully. In addition, political instability in Myanmar

has significantly hindered the implementation of Twin Village/Hospital and has rendered all efforts in vain.

As a measure for effective disease control, screening and control measures for diseases are required before non-Thais enter the country. All migrant workers entering through the legal mechanism of One Stop Service (OSS) or Bilateral Memorandum of Understanding (MOU) must pass a health screening for serious communicable diseases. However, non-Thais engaged in agriculture and other activities are not screened for diseases before arrival, and disease control measures in temporary shelters for migrants in some border towns are limited.

In the hilly and remote areas of Tak province, where undernutrition is high and immunization rates are low, infrastructure investments, such as refrigerated transportation for vaccines are needed. Essential health technologies including drugs and diagnostic tools for tuberculosis and malaria, can help community workers identify active cases and provide timely treatment. Due to frequent accidents and transportation issues caused by the mountainous terrain and financial constraints of MHS, MHS hospitals must be equipped with medical supplies and technologies to handle emergencies and serious injuries. Furthermore, more sustained efforts are needed to provide health services to ethnic minorities living in geographically isolated areas such as mountainous terrain or remote areas with limited access to services, through mobile public health services, adaptive communication, and ongoing outreach to foreign residents.

Despite the Thai government's efforts to provide health insurance to minorities, according to the Ministry of Labor, only 57% (39% from SSS and 18% MHIS respectively) of non-Thai migrants across Thailand has health insurance. Approximately 43% are not covered by the national health insurance system. This is consistent with a recent study on health insurance coverage of migrant workers in Tak [24], reporting that 30–40% of illegal migrants currently living in migrant communities in border areas do not have health insurance. Consequently, government hospitals in border areas continue to bear the financial burden of healthcare for this group. To increase expanded health insurance coverage for undocumented immigrants and children, the MOPH, in collaboration with the Ministry of Labor, will need to be more proactive in recruiting immigrants into the insurance system and will need continued policy support to expand immigrant-friendly services [25, 26]. Meanwhile, our study has raised concerns about internal constraints such as excessive workload and lack of human resources, as shown in several studies [27, 28]. Culturally sensitive health care, such as providing interpretation services, is recognized as an effective means of improving the health status of immigrants [29]. Tak and MHS are making efforts to increase the use of health services by non-Thais by hiring ethnic minorities in hospitals and provincial health offices. The culturally sensitive health care will also reduce the workload of health care providers and facilitate the use of health services through communication with non-Thais. Inclusive improved health system design that includes immigrants regardless of their immigration status should be considered, along with cross-sectoral policy coordination, including accelerating nationality verification for undocumented migrants [30].

It is evident that local and international NGOs have been supporting to improve access to essential health services at the border areas. These supports include recruiting CHW, establishing mobile clinics for migrant worker communities, bilingual (mainly Thai and Burmese) signage and information at health facilities, and workplace outreach services. NGOs such as SMRU, which runs MCH projects, malaria control and treatment, and TB prevention and treatment activities in Phop Phra, Mae Sot, and Mae Ramat in Tak, play a key role [31]. Recent studies have shown that Thailand's central and provincial administrations have upgraded their MHV mechanisms for cross-border disease prevention to be more systematic and formal to promote health security along borders [32, 33]. However, there is a concern that the budget sustainability issue of the interim budget al.location process for project implementation may limit the use of this model. The lack of regular staff and responsible departments in the area and a health information management system that provides a comprehensive picture of the entire country also hinder its efficient implementation. Geographic factors, political instability in Myanmar, access to health services, individual beliefs, socio-cultural conditions along the border, and the network of NGOs involved in the referral of patients between the two countries all contribute to the complexity and challenges of border health management. Collaborative efforts among government agencies, NGOs, and community workers in the region will enhance the effectiveness of border health services.

This study, to the best of our knowledge, is the first to apply a mix methods approach to understand the dynamics of the healthcare status along the Myanmar-Thailand border. This innovative approach in the Thai context takes into account the perspectives of all relevant stakeholders to explore the key factors influencing access to health service. The findings reveal that the healthcare along the border faces significant challenges, including issues related to access, resources, disease control, and humanitarian support. However, there are several limitations. First, migrants were not included as participants, and future research incorporating their views as beneficiaries could offer valuable insights. Additionally, other non-Thai populations, such as stateless individuals, expatriates, and refugees, were not considered in the study. As

each group faces distinct challenges, caution should be exercised when interpreting findings for other non-Thai populations. Lastly, political and economic factors were not addressed, as the focus of this systems approach was primarily on public health.

Conclusion

This study highlights the health challenges in Thailand's border regions, particularly in Tak and MHS provinces. Poor health conditions, such as malaria and TB, were more pronounced in Tak, particularly in districts with high levels of cross-border patients and migrants. Since many of them lack health insurance and have limited access to subsidized public health services, this situation places a financial and administrative burden on local health systems in the Tak and MHS provinces. Given Myanmar's political instability and the unique sociocultural diversity in the border region, continued support from the Thai government, including through collaborative efforts with local and international NGOs and the Myanmar government, is essential for mobile outreach public health services, effective disease surveillance, and data management to address health issues in border areas and promote health equity in diverse cultural communities.

Abbreviations

DHS	District Health System
HDC	Health Data Center
MCH	Maternal and Child Health
MHIS	Migrant Health Insurance Scheme
MHS	Mae Hong Son Province
MHV	Migrant Health Volunteers
MOPH	Ministry of Public Health
OSS	One Stop Service
PDF	People's Defense Force
SEZ	special economic zones
SSS	Social Security Scheme
SRRT	Surveillance and Rapid Response Teams
THPH	Tambon Health Promotion Hospitals
TSY	Tha Song Yang district
VHV	Village Health Volunteers

Supplementary Information

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Supplementary Material 1.

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Authors' contributions

BT and MT developed the study, and BT and SAH were involved in data collection and equally drafted the manuscript. CST and MT reviewed it critically for important intellectual content. SAH, MT, CST, and BT have read, edited, and approved the final version of the manuscript for publication.

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Data availability

All data generated or analyzed for this study are presented in the manuscript.

Declarations

Ethics approval and consent to participate

The research received ethics approval from the Human Research Ethics Committee at Mahidol University (approval certificate no. 2024/014.2401). The study adhered to the ethical principles outlined in the Declaration of Helsinki for medical research involving human participants. Prior to participation, the study's objectives, procedures, and participants' rights—including confidentiality and the ability to withdraw without any consequences—were clearly explained. Informed consent was obtained using a detailed consent form. All collected data were anonymized and treated with strict confidentiality, ensuring their use solely for research purposes. This process safeguarded the rights and privacy of participants throughout the study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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