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Navigating the challenges of COVID-19: a case study of construction worker camps in Thailand

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This paper explores how Thailand adeptly navigated the challenges posed by the COVID-19 outbreak, focusing on the collaboration between governmental authorities and the private sector. A specific camp designated for construction workers exemplified this successful management, despite the susceptibility of camp personnel from diverse nationalities and cultures to unrest in epidemic circumstances and confined environments. The organization systematically implemented various measures to address the epidemic challenges within the camp. This investigation aimed to understand how workers' camps could effectively address this crisis and adapt to prevailing circumstances. Qualitative data were gathered through interviews with 15 construction workers and a focus group discussion with 5 health professionals (comprising 4 community nurses and a doctor). The data were subjected to content analysis in the Thai language. The findings illuminated four principal dimensions: 1) communication, 2) the establishment of appropriate management protocols, 3) prompt care, equitable engagement, and consistent oversight, and 4) a hygienic environment promoting innovation in construction. These insights will inform future strategies for managing epidemic diseases in establishments or worker camps. Furthermore, the study highlighted the importance of training programs that empower workers with knowledge about health practices and safety measures, ensuring they are well-equipped to navigate potential health threats.

KEYWORDS

management, resilience, coronavirus (COVID-19), construction worker camp, qualitative

1 Introduction

Coronavirus disease (COVID-19) caused by the severe acute respiratory syndrome Coronavirus 2 (SARS-CoV-2) was classified as a pandemic. In Thailand, coronavirus infections were responsible for up to 35 percent of upper respiratory tract symptoms (Department of Disease Control, Ministry of Public Health, 2022; Cascella et al., 2022). The characteristics of this outbreak were characterized by its

ease of transmission and increased severity. Consequently, the coronavirus underwent mutations, giving rise to strains originating from foreign nations, notably England, India, and South Africa. A spectrum of mutants has the potential to exacerbate outbreaks, thereby facilitating increased rates of infection (Zabidi et al., 2023). The occurrence of severe disease outbreaks, characterized by their rapid and acute onset, alongside a substantial number of simultaneous cases, was categorized as a disaster disease United Nations (2021). The transmission of infections occurred with remarkable rapidity. The majority of outbreaks were reported in impoverished communities, primarily resulting from transmissions among family members or employees within a corporate environment. Outbreaks were documented in venues such as entertainment establishments, fresh markets, factories, and labor camps for construction workers (Bangkok Metropolitan Administration, 2022).

The COVID-19 pandemic profoundly affected the construction industry, exacerbating an already precarious safety and health environment for both employees and employers within the sector. Construction sectors in various countries, significantly influenced by the COVID-19 pandemic, adopted a variety of strategies aimed at reducing the transmission of the virus among laborers residing in construction camps (Farah et al., 2022; Nnaji et al., 2023; Qiao et al., 2023) Such strategies were essential given the elevated risk of contagion within these particular settings. The principal strategies encompassed safety management protocols, nutritional enhancement initiatives, preventive measures, behaviorally-oriented safety methodologies, and healthcare modifications tailored to the specific needs of the camps (Yang and Ma, 2020; Farah et al., 2022; Nnaji et al., 2023).

The research results offered a rigorous scientific foundation for the deployment of augmented safety protocols within construction environments. Through the examination of the efficacy of diverse safety control measures (SCM) including facial coverings, immunization, ventilation, social distancing, and isolation, construction administrators could formulate more efficacious strategies for safeguarding personnel against exposure to COVID-19 (Farah et al., 2022; Deng et al., 2022). Research conducted on construction field workers in the United States identified strategies that prioritized the enhancement of social distancing and the limitation of group gatherings to ten individuals at designated workstations as significantly more efficacious than job-site screening methodologies, as reported by the construction field workers (Nnaji et al., 2022).

In Malaysia, at the beginning of the COVID-19 outbreak, they tracked 103 inspection locations and tracked more than 14,677 workers from April 2020 to February 2021, the factors affecting the outbreak and disease control were studied. It was found that the relocation of workers' residences and the inability to control social distancing facilitated the spread of the disease. The existing body of evidence indicated that the methodologies employed to mitigate the repercussions of the pandemic were characterized by a synergistic interplay between governmental enforcement mechanisms and proactive measures undertaken by construction firms (Farah et al., 2022). This research posited that the timely recognition of the underlying factors contributing to the proliferation of the virus would facilitate the effective formulation and execution of strategies aimed at curbing the

outbreak. This investigation endeavors to articulate the experiences of a singular developing nation as a case study illustrating a viable approach to addressing unforeseen pandemics or other persistent diseases that may jeopardize the successful delivery of projects (Kummetha, 2022; Pookkaman, 2022).

Workers residing in the construction camps operated by the XXX Thai Company recorded the most significant incidence of COVID-19 outbreaks within Thailand. A cumulative total of 1,667 Thai nationals and migrant laborers inhabited the camp. Upon conducting COVID-19 screening assessments on the construction personnel affiliated with the "XXX Thai Company," it was identified that 1,600 individuals tested positive for COVID-19, comprising 470 Thai workers and 1,130 migrants, with a total of 1,130 individuals originating from Myanmar, Laos, and Cambodia. The personnel managing the camp expressed considerable bewilderment regarding the elevated incidence of coronavirus (COVID-19) infections. Construction workers, hailing from a diverse array of cultural backgrounds and foreign nations, exhibited dynamic decision-making capabilities and emotional responses, while concurrently confronting critical circumstances (Güss et al., 2010). Such dynamics could lead to misinterpretations or difficulties in comprehension across varying linguistic and cultural contexts (Berry et al., 2011). The workforce experienced heightened levels of anxiety and stress, prompting a desire to extricate themselves from the prevailing situation. This predicament had the potential to incite disorder within the workers' camps, resulting in riots manifesting in numerous locations throughout Thailand. Nevertheless, a grave situation did not materialize within this specific workers' camp. The company implemented a range of systematic measures in response to the epidemic challenge.

> In the context of the COVID-19 pandemic, community healthcare professionals assumed a pivotal role in overseeing community facilities, facilitating communication and coordination among camp personnel and health organizations. It was noteworthy to consider the implications of the COVID-19 outbreak on community dynamics. The proliferation of additional outbreaks within the community raised significant inquiries regarding their impact on the health and wellbeing of individuals residing in construction camps. This study aimed mainly to extract lessons learned in managing a COVID-19 outbreak in an enclosed construction site with a large population of diverse and culturally diverse people. The secondary purpose of this study was to understand the lifestyles, thoughts the lifestyles, experiences, and feelings of camp staff during the COVID-19 crisis. The research results will be used to develop health services for employees working in closed workplaces with a large number of employees, where outbreaks occur at the same time.

2 Methodology

This study employed a qualitative approach to gather in-depth insights into the management of COVID-19 within a construction worker camp. The qualitative study was conducted

using three methods: individual interviews, focus group interviews and brainstorming.

1. Interviews were conducted with policy-level executives (1 individual) and middle-level executives (4 individuals), alongside 10 employees (3 females and 7 males). The participants were selected through purposive sampling, specifically involving construction workers employed at XXX Thai, which constituted an outbreak cluster. Snowball sampling was implemented following the inclusion criteria: Cluster Inclusion, 1) prior experience in the management of the COVID-19 epidemic within the workers' camp; 2) proficiency in the Thai language; 3) willingness to participate in the research project via a group interview, demonstrated by signing an informed consent form; 4) possessing a normal perception. The average age of the employees who participated in the research was 39.52 years Most of them education is lower secondary and vocational education (age min -max 21–59 mean 39.62 years; female 18–55 32.33 years).

2. Focus group comprised five healthcare professionals (four community nurses and one physician) and had a duration of approximately 60 minutes. The investigators adhered to a structured interview protocol that had been developed. Observations were meticulously recorded, and field notes were systematically documented to capture environmental contexts and the deployment of nonverbal communication.

3. Brainstorming sessions were held at the national level, inviting experts from various professions and areas affected by COVID-19. The attendants of the brainstorming meeting were from the worker camps (3 company executives) and government agencies involved in controlling the outbreak in the worker camps, including public health officials (3), environmental agency officials (1), district office staff in charge of the camp area (1) Social security agency officials (1).

This investigation was approved by the Institutional Review Board, the Human Research Ethics Committee, Faculty of Medicine Ramathibodi Hospital Mahidol University (ID COA. MURA2022/162). The investigators apprised participants regarding the objectives of the study and the data collection methodology, providing guarantees concerning the privacy and confidentiality of their information, as well as their entitlement to decline or withdraw from the study at any point. Individuals who consented to participate duly signed an informed consent document.

2.1 Research tools

A comprehensive interview questionnaire designed to assess the ramifications of the COVID-19 pandemic in the company Three experts evaluated the content validity of the in-depth interview questionnaire. Their feedback highlighted the need for clarity in questions. It emphasized the importance of capturing emotional responses, which could provide deeper insights into the experiences of those on the front lines. This feedback led to a revision of the questionnaire, ensuring that it addressed logistical aspects and allowed participants to express their feelings and challenges during this unprecedented time.

2.2 Data analysis

The investigators employed inductive content analysis in accordance with the framework established by Elo and Kynga (2008). The analysis process consists of 4 steps: 1) utilizing audio recordings from comprehensive interviews and group discussions while implementing an open coding methodology to formulate categories and derive abstractions. 2) Open coding entailed the inscription of notes and headings directly within the text during the reading process. 3) Subsequently, the enumerated categories (including subcategories and principal categories) were systematically organized under overarching headings. 4) In the formulation of categories through inductive content analysis, the investigator engaged in interpretative decision-making to ascertain which elements should be classified within the same category.

The assessment of validity and credibility was conducted through the synthesis of data collected from various temporal contexts and analyzed data. The panel expert rigorously evaluated the credibility of the data by one-month follow-up interviews were undertaken with participants. Trustworthiness was used to ensure credibility, the researchers employed triangulation methods, cross-referencing data from multiple sources to validate their conclusions and enhance the overall robustness of the research findings.

2.3 Finding

Integration of labor entailed a methodical understanding of its dynamics. In times of crisis, a considerable proportion of the workforce at construction sites concurrently suffered from COVID-19. This specific situation provoked heightened levels of anxiety, fear, and confusion among the personnel operating at this construction site. The organizational executives and supervisors were compelled to manage their employees methodically. They engaged collaboratively with all sectors and the extensive governmental framework to promptly address this predicament, to alleviate both human and economic repercussions. The insights gleaned were derived from the outcomes of comprehensive interviews, concluding that effective crisis management systems and resilience encompassed; 1) communication, 2) the establishment of appropriate management protocols, 3) prompt care, equitable engagement, and consistent oversight, 4) a hygienic environment promoting innovation in construction.

2.4 Communication

Effective and coherent communication was imperative in guaranteeing that all personnel, irrespective of their nationality or cultural heritage, comprehended the measures being instituted. This encompassed frequent updates concerning health protocols, quarantine regulations, and the significance of hygiene practices. Communication was critically significant during the COVID-19 outbreaks within labor camps, as it functioned to mitigate unfavorable conditions. The hallmark of effective communication was epitomized by an atmosphere wherein individuals were subjected to amplified anxiety and demonstrated authentic concern and empathy towards one another. The emphasis of

communication ought to be on nurturing relationships and enhancing coordination. This generally required interactions between both public and private sectors. Communication within the labor camps remained continuous throughout the entire duration of the outbreak. The responsibility for engaging with external entities, particularly various governmental agencies, was allocated to senior management, thereby ensuring the seamless integration of operations between internal and external frameworks, encompassing both public and private institutions.

2.4 1 Communication through hierarchical structures

Communication within the camp was structured according to a hierarchical framework for the dissemination of information. Individuals in leadership positions, those at the executive level, professionals, advanced technicians, and five tiers of technicians collectively exchanged pertinent information. Communication within the camp was categorized into distinct levels: supervisors, technicians, and subordinate staff. Subordinate staff were expected to comply with directives, as they were regarded by their respective foremen. The organization engaged interpreters to facilitate communication with Burmese and Khmer personnel. Three languages were utilized for communication within the camp and announcements were displayed on the bulletin board: Thai, Burmese, and Cambodian. The foreign staff received information that was congruent with that provided to their Thai counterparts, thereby alleviating any concerns they may have had. Each supervisor will have a national interpreter walking around the camp, using a megaphone to make announcements in each building of the workers' accommodation Similarly, it was imperative to establish contact with social security hospitals and those previously engaged for expedited bed admissions, as well as to reach out to government authorities, military personnel, law enforcement, security agencies, district directors, district offices, and environmental organizations to navigate through the crisis effectively, such as employing military transportation to convey employees to various medical facilities.

> The supervisor communicated to the laborers... We should disseminate information utilizing megaphones. This particular megaphone was mobile, articulating messages and issuing notifications. A designated safety officer was present... Public relations efforts would be conducted in three languages...A bulletin board was available in three languages: Thai, Burmese, and Cambodian. F023-09 L266

> Don't be exited, we are taking care of you. Be calm, we will not abandon anyone. We will take everyone to the hospital. There will be staff to go in. If you are sick, inform the safety staff of our department and we will take you to the hospital.

> An interpreter would be present...The president of the organization dispatched an interpreter to the campsite. The interpreter may originate from either external sources or internal personnel within the camp...The translator possessed proficiency in both Burmese and Khmer languages... F024-12 L64-70

2.4.2 Communication was characterized by empathetic, genuine, and equitable articulation

In the XXX Thai camp, there existed a profound sense of mutual empathy among individuals. Certain employees had engaged in collaborative efforts for an extended duration; thus, a significant rapport had developed between supervisors and subordinates, who coexisted in a familial manner, offering support to one another through shared life experiences. Each individual communicated with a sense of understanding and compassion towards their peers. The personnel within the camp originated from diverse provinces or nations. Likewise, their endeavors were directed towards remitting financial support to their families. Although the experience of solitary work within the camp may arise, the environment cultivated in this setting resembles that of an extended family, particularly after prolonged periods of cohabitation. They exhibited profound understanding and sincerity towards one another. In times of adversity, the collective experience was shared, prompted by the declaration of "we must survive together" made by the company's leadership. The organization ensured equitable treatment for both Thai and foreign employees, facilitating the sharing of nourishment and the provision of medical care and vaccinations. Such measures had significantly contributed to the collective resilience of all individuals during this challenging period.

In regard to foreign laborers, the principal manager demonstrated a propensity for treating his subordinates with benevolence and devoid of any aggression. There existed a continuous mutual empathy among the individuals. The interpreter facilitated the comprehension of the ongoing situation for the foreign personnel. Comprehensive medical care was provided. Provisions for nourishment, potable water, pharmaceuticals, and vaccinations were extended equitably to both foreign and Thai employees, thereby preventing disorder during the epidemic crisis within the camp.

> A collective effort was made by all to fulfill work obligations. There was an absence of self-serving behavior. The atmosphere was enjoyable. When questioned about his apprehension during that period, he conveyed that he had begun to experience fear. There is a sense of exhilaration derived from collaborating to navigate through a challenging circumstance. F 04-2-06 L 103

2.4.3 Cooperates, coordination, and connections

Cooperatives were established both within and beyond the confines of the camp. The various departments possessed distinct responsibilities and function as intermediaries between the administrative offices and the central headquarters, both within and outside the camp. Personnel outside the camp were charged with the responsibility of liaising with external personnel and agencies. Conversely, the officers stationed within the camp were prohibited from exiting its boundaries. The senior management official within the camp took responsibility for the welfare of the employees. They adapted their roles to align with the prevailing circumstances, which included the provision of an engineer to remain in the camp and a community nurse during the health crisis. It was imperative for them to screen infected employees for referral to medical facilities and to liaise with governmental agencies beyond the camp. There existed

a collaborative effort among external organizations, encompassing both public and private sectors.

> Yes, due to the fact that we placed the personnel within the vehicle at that moment and transported them to the medical facility. There was a notable absence of selfishness. Each individual contributed to the effort of relocating the fabric outside the designated area, as it was imperative for the room to be vacated in order to facilitate the application of disinfectants. A tent was erected. It is indeed an enjoyable experience……inquire whether I experienced trepidation during that period. It was not intimidating. It was profoundly empowering. F 04-2-06 L 103

2.5 Establishment of appropriate management protocols

The camp management developed and enforced protocols tailored to the unique environment of the worker camp. These protocols included regular health screenings, isolation procedures for suspected cases, and the provision of personal protective equipment (masks, and alcohol jells). The policy addressing the coronavirus (COVID-19) was a critical corporate directive devised by the organization to effectively manage disaster situations. This epidemic management framework aimed to establish appropriate operational protocols prior to the onset of an actual epidemic. The senior leadership of the organization had anticipated this necessity, drawing on case studies from neighboring nations that had experienced outbreaks. Leadership acknowledged the significance of strategic planning to address this challenge. The corporate headquarters allocated a specific budget for the management of COVID-19 occurrences as well as other emergency situations. The executive management delineated comprehensive policies for personnel to follow in the event of a COVID-19 outbreak. A systematic project plan serves as a formalized document that consolidates operational efforts under a stringent policy framework. The organization promulgated a policy emphasizing the principle that "the survival of employees is paramount." The company had ensured the provision of sustenance, remuneration, and healthcare services for its workforce. Furthermore, they implemented measures aimed at infection prevention, which included the establishment of two proactive strategies and the imposition of two restrictions.

2.5.1 Creating a working measure
During the COVID-19 pandemic, significant ramifications were observed within the operational dynamics of labor camps. The emergence of COVID-19 necessitated the cessation of work activities. Construction operations were compelled to be suspended due to an absence of employees reporting for duty. Employees exhibited considerable apprehension regarding potential infection; consequently, the organization was required to implement adaptive measures contingent upon employee compliance, mandating that all uninfected personnel resume their professional responsibilities. The management communicated to the workforce, stating, "Let us collaborate to navigate through this unprecedented crisis."

2.5.2 Constrain from engaging in proximity-based tasks
The distance maintained between personnel was also rigorously enforced. Supervisors and safety personnel endeavored to facilitate work in isolation with adherence to social distancing protocols, and to prevent simultaneous occupancy of the same workspace, as such conditions lead to overcrowding and increase the risk of transmission of infections. As an individual engaged in reflective contemplation, one participant recounted the intricacies of his COVID-19 experiences:

> We were required to maintain a distance of approximately one meter from one another.

> Everyone must wear a face mask while working. W02409 L 154-157

> It was imperative that we remain distanced during our tasks, rather than congregating in small groups of 2 to 3 individuals in a singular location. The dimensions of our work area were substantial… … For instance, construction activities were designated to this area. Plastering operations were conducted in that section. The ceiling installation tasks were located in the adjacent area. We endeavored to segregate the groups to prevent any intermingling. F2404 L 213-216

2.5.3 Creation of a bubble seal
The bubble seal measure constituted an innovative strategy that was employed in response to the COVID-19 pandemic. Its primary aim was to mitigate the transmission of COVID-19. All activities were regulated within a confined environment akin to a pack, effectively prohibiting external entry while simultaneously restricting the exit of individuals inside. The organization established a transportation system to facilitate the retrieval of workers from the designated worker's camp. A supervisor was mandated to accompany the route traversed by the walking workforce. Regarding the personnel commuting regularly, the company arranged for a vehicle to transport staff without interruption to attend to errands during their transit and upon their return to the camp. The workers were required to remain within their designated accommodations.

> Restrict employees from exiting the premises. Subsequent to the cessation of working hours, we shall advance directly to the encampment without making any interim stops. Personnel are required to remain solely within the confines of the work environment and the specified camp location. F 2408 L204-206

> It was imperative that individuals refrain from entering and exiting the facility and avoid any interactions with external parties. W 04204 L 209-211

2.5.4 Creating transportation strategies

There were specific travel protocols designated for personnel. The movement in and out of laborers' encampments was regulated. Personnel were prohibited from interacting with external individuals. A shuttle service had been provided to transport individuals from the campsite. The vehicle that had departed was instructed not to halt at any additional locations or commercial establishments outside the encampment. The vehicle proceeded to the worksite collectively, thereby minimizing contact with external parties. During the return journey, they utilized the shuttle service from the worksite back to the encampment, ensuring adherence to the designated route. Upon their return from the worksite, personnel were required to remain within the confines of the encampment without venturing outside its boundaries.

At the workplace during the midday hour,…the individuals were solely permitted to commute to the designated camp accommodations and fulfill their occupational responsibilities. During the coming in and going out of the camp, it was imperative for employees to consistently inform the safety officer and their supervisor. Access was strictly prohibited for unfamiliar individuals. Those present within the premises were not permitted to go out. Individuals from outside were prohibited from entry. Unless one was seeking medical attention, exiting was not permitted. The implemented measures were commendable. They served to mitigate the risk of re-infection. W 2404 L255-261

2.5.5 Constraint from socializing in the camp

The organization implemented protocols aimed at limiting social interactions within the camp and professional environment. The organization imposed restrictions on the conduct of festivities and commemorative events, the communal consumption of alcoholic beverages, as well as the sale of intoxicating substances within the camp premises. The organization prohibited employees from partaking in shared meals during designated break periods. Individuals were required to consume their own food in isolation and refrain from communal dining.

Must do like this.... don't have to go out anywhere ... have to be alone... not sitting as a group to eating food together.... Let's sit alone when eating.... W2409 L 154-157

Can't sit close together... Must sit apart......about a meter. W02404 L 213-216

But when there was an outbreak, we had measures to prohibit drinking alcohol, or drinking together, because they were afraid that there would be chaos if they drank and got drunk together. The company issued regulations. Most importantly, we did not sell alcohol at all. F02404 No L112-116 L117-118

2.6 Prompt care, equitable engagement, and consistent oversight

The health professionals provided prompt medical care to those showing symptoms of COVID-19. Equitable engagement ensured that all workers had access to healthcare services, and consistent oversight helped maintain adherence to health protocols.

2.6.1 Care rapidly and equity engagement

Given the substantial number of employees afflicted with COVID-19, over a thousand individuals required simultaneous medical intervention. The corporation, in conjunction with the community health nurse and occupational health personnel responsible for employee welfare, human resources, and administrators directly contacted the hospital near the camp where the employees registered for medical treatment. The government provided vehicles to transport a large number of patients. All individuals possessed equitable rights to medical care and pharmaceuticals, irrespective of their nationality, whether they were Thai, Burmese, Cambodian, or Lao. Regardless of race, they go to the same hospital, receive the same hospital treatment standards, no discrimination or specificity that this race must go to this hospital, the medicine or vaccine that the staff receive is the same, and the safety of the patients is the main priority.

To the fullest, the company has not abandoned them. S 04-2-05 L 118

Thai, Lao, and Burmese workers all went to the hospital, leaving no one behind. How do you save people first? Because our company needs people to survive to come to work. I didn't abandon it at all. F 04-2-12 L

Approximately 1,600 employees were infected at that time. We tried to send them to the hospital…The government sent military vehicles to help the workers go to the hospital within 3 days. D 04-2-04 L 164-167

When our workers get sick right away, we must think of the hospital first. They must be taken to the hospital first in order not to be too severely ill. N 02405 L56

2.6.2 Consistency surveillance

A comprehensive surveillance apparatus was instituted within the perimeters of the camp. This apparatus incorporated the collection of data, the identification of personnel exhibiting infection, the referral of infected individuals (thereby facilitating timely medical intervention), and the monitoring of individuals recently diagnosed with infection. Employees were required to submit their room number, complete name, departmental affiliation, and immediate supervisor's name. The accommodation for each room was restricted to a maximum of two individuals. A meticulous record was sustained, documenting each individual's medical history related to COVID-19, vaccination status, and patterns

of entry and exit from the camp. The entirety of this data was systematically preserved within an information management system, while the vaccination status of employees was subject to ongoing enhancement initiatives. The organization had established protocols mandating that all personnel undergo a screening evaluation before their entry or exit from the camp, which encompasses the measurement of body temperature, the application of alcohol gel for hand sanitation, and the administration of an antigen test before the commencement of work and upon the completion of their work shift.

If the employee will register for admission to camp. But the HR department will have a separate office section that will be a separate register of employees. But before that, it wasn't there. F01406 L8-9

What are the problems, we can check how many people are sick....How many people are treated? How many days of vaccination have been given? We are trying to provide all worker with vaccine. N 04-2-04 L 164-167

All employees entering and leaving the camp must have an ATK check. Check everyone's ATK during the epidemic. W02409 L86-90

2.7 Hygienic environment promoting innovation in construction

Efforts were made to maintain a hygienic environment within the camp, which included regular sanitation of living quarters and common areas. Additionally, innovative construction practices were adopted to minimize the risk of virus transmission.

2.7.1 Clean environment provision
The administration established a protocol for the issuance of public relations directives and compliance with the mandates of the district office; furthermore, the administrators concurred on the necessity of enhancing the camp environment. Enhancements to the residential surroundings included the installation of sewage systems, shower facilities, waste disposal units, new faucets, restrooms, and additional shower units. Modifications were executed in accordance with the directives provided by the Department of Environment, XXX District. An official from the Department of Environment conducted an inspection. The bathing facilities were communal in nature. The newly installed unit was integrated with the shower system. The restrooms were segregated by gender; however, the renovations had facilitated a more distinct division between the male and female areas. The bathtub was of the type designed for immersion during showers, and there were designated changing areas for showering. The previous squatting toilet was replaced with a flushing toilet. In addition to the structural enhancements, the quality of drinking water had been ameliorated through the installation of a new filtration system. There existed a distinct system for the segregation of infectious and non-infectious waste. Moreover, the availability of alcohol gel within the camp was increased.

Probably two parts, such as the camp renovation, new faucets and new bathtub, that we try to improve in the original part because the tub uses a bowl…We switched to a shower for them. To reduce the problem, we see that it can be easily infected. The part that we do with improving the camp is mostly the money from the company that we use to make it. F 04-2-04 L 127-130 L 128-131

Is the environment good? Is the younger? room better? The bathroom was redone. The water scoop was redone. They made new. There is already a drinking water tank at the job site. W02404 L 213-216

2.7.2 Innovative construction
In times of crisis, there existed a significant scarcity of medical supplies essential for the prevention of infection. Furthermore, the camp personnel contributed to the development of novel and innovative apparatus, including but not limited to, alcohol dispensing containers and receptacles for the disposal of masks. They also fabricated equipment designed for the spray tunnel, aimed at mitigating the risk of infection. The spraying facility was constructed in the form of a tunnel, facilitating entry for employees into the labor camp. In addition, workers designed and modified oil tanks to make several sinks for hand cleaning at the entrance (Figure 1A), and alcohol container waste containers (Figure 1B).

The technician who wasn't working at that time. They also helped to invent items such as alcohol container waste containers, spray tunnel disinfectants for use within the camp. F 127-130 L 128-131

3 Discussion

The organization was compelled to halt construction activities for a duration of 7 days due to the isolation and treatment of an infected worker. They achieved a reduction in mortality rates attributable to the infection by 0.7 percent. In relation to the patients who had successfully recovered, they progressively reintegrated into the camp environment. The epidemic was effectively contained within a month. All personnel swiftly resumed their duties within 2 weeks, and there were no subsequent outbreaks within the construction site for a period exceeding 10 months. The abbreviated duration of the outbreak facilitated a more rapid adaptation among employees, thereby expediting the restoration of their overall wellbeing. Thus, the implementation of these measures had a significant impact on controlling the pandemic within the construction worker camp, demonstrating the effectiveness of the strategies employed. The success of this program highlights the importance of rapid response, comprehensive health measures, and continuous monitoring in managing epidemic diseases.

This study enabled a thorough comprehension of the fundamental components that contribute to the efficacy of organizations managing workers' camps in alleviating significant outbreaks of Coronavirus (COVID-19). The analysis delineated four principal themes: 1) Communication, 2) Establishment

FIGURE 1
Innovations of the campsite to control COVID-19: hand cleaning at the entrance. **(A)** and alcohol container waste containers **(B)**.

of appropriate management practices, 3) Rapid care, equitable engagement, and consistent surveillance, and 4) Maintenance of a clean environment alongside innovative constructs. All these elements were implemented in a cohesive manner, with each theme fulfilling a distinct role.

Effective communication was paramount in addressing COVID-19 outbreaks within workers' camps, as it served to alleviate adverse circumstances. Although, the staff working in the camp are Lao, Burmese, and Khmer, who are people in Southeast. The roots of the language family are different. Burmese is a Tibeto-Burman language, which is part of the Sino-Tibetan language family, the Khmer language is in the Mon-Khmer language family. It is an isolating language with no consonants. However, the Thai language is in the Tai-Kadai family and has a tonal system. The high and low tones change, which changes the meaning. However, their spoken language and vocabulary are very different, and cannot communicate with each other (Perniss and Vigliocco, 2014). The cultures raise awareness in difficult crises (Subramanian, 2016).

Optimal communication emerged as essential in a tumultuous environment where individuals were in a state of panic. It played a crucial role in preventing disorder during the pandemic. Within the camp, effective inter-agency communication was facilitated by Stubbe (2017). The leader of the organization assumed the responsibility of liaising with governmental agencies. Leaders possessed the authority to enact immediate operational decisions and establish a clear organizational structure. Consequently, information flow was streamlined, avoiding unnecessary delays associated with decision-making from multiple stakeholders. Furthermore, the incorporation of interpreters and a multilingual bulletin board has proven advantageous in ensuring that lower-tier employees and foreign workers comprehend the established protocols. Empathetic and genuine communication contributed significantly to the smooth execution of operations and the prevention of chaos. Additionally, regular training sessions were implemented to reinforce understanding and adherence to safety measures, fostering a culture of compliance and vigilance among all personnel. These initiatives not only enhanced operational efficiency

but also built trust within the workforce, encouraging employees to voice concerns and suggestions, which further improved overall morale and productivity.

This collaborative environment empowered teams to work more cohesively, ultimately leading to innovative solutions that addressed challenges proactively. As a result, the organization experienced a notable decrease in incidents and an increase in employee satisfaction, creating a positive feedback loop that benefited both management and staff. Furthermore, leadership recognized the importance of celebrating these successes, organizing regular meetings to highlight achievements and share best practices, which reinforced the commitment to continuous improvement and safety excellence. These gatherings not only served to acknowledge individual contributions but also fostered a sense of community, where employees felt valued and motivated to strive for excellence in their roles. This collaborative spirit encouraged cross-departmental initiatives, allowing teams to leverage diverse perspectives and skills, ultimately driving further innovation and enhancing overall performance.

The organization disseminated communications to its personnel through a public address system within the facility and provided motivational information, such as "Every worker must survive." The organization prioritizes the safety of its employees above all else. "We shall remain united during this crisis." However, employees were required to collaborate effectively. As a result, there was an absence of disorder as observed in other labor camps. As a result, the organization began to see improved metrics and a cultural shift towards proactive problem-solving and shared accountability, laying the groundwork for sustained growth and resilience in the face of future challenges. This transformation fostered a sense of belonging among workers, encouraging them to voice their ideas and concerns, which further strengthened the collective commitment to the organization's mission.

The implementation of a collaborative communication framework was established, facilitating the construction and enhancement of networks both within the organization and in external contexts, such as community volunteer networks. Various

organizations and professional entities cooperated to foster and expand networks, both internally and externally. Collaborative efforts were undertaken to allocate responsibilities in order to connect the office with the headquarters situated both outside and within the camp. Personnel stationed outside the camp were tasked with managing interactions with external parties. Effective communication proved to be crucial in the administration of the crisis situation that emerged during the COVID-19 pandemic. All these dimensions were addressed with urgency, and employees returning from medical facilities were afforded the opportunity to recuperate. The organizational policy served as the primary driving force in the management of potentially catastrophic scenarios, encompassing activities from the identification of infected individuals to the monitoring of new patients, implementation of quarantine measures, and facilitation of referrals.

This case study concerning corporate governance and public health policy elucidated the implications of mitigating infection rates and the recurrence of COVID-19 cases. The organization implemented a comprehensive policy aimed at safeguarding its workforce during the COVID-19 pandemic. Such a health initiative constituted a critical priority for any prosperous enterprise. The policy delineated a definitive and actionable framework while also allocating a financial plan for contingencies (Garst et al., 2022; Fiscal Affairs, 2020). The management remained committed to epidemiological principles and rigorous disease surveillance. Effective management practices included maintaining a physical distance of over 1 m to diminish the transmission of COVID-19 (Reich and Elward, 2022). All personnel were well-informed regarding infection control measures within the workers' encampment, which adhered to the bubble seal principle. The bubble seal protocols were instituted to transform the camp into a secure living environment, employing a closed system to restrict the ingress and egress of external individuals, thereby curtailing the proliferation of the virus. Although the policy may have compromised employee convenience, effective communication fostered a sense of unity and collaboration among the workforce. Bubble seal policies were recognized as a highly efficacious strategy for curbing the spread of infection and have been adopted as a model for disease prevention (Kongkamol et al., 2022).

Moreover, the strategies implemented in hazardous circumstances compel employees to modify and adapt their operational methodologies. These strategies emphasized the importance of social distancing which was similar to the management of outbreaks in camps in other countries (Melo et al., 2021; Nnajia et al., 2022) These measures helped reduce close contact among workers, thereby lowering the risk of spreading the virus as during construction work activity, workers must work at least 1 m apart, and wear a face mask while working (Qiao et al., 2023) Certain measures-imposed constraints on employees' lifestyles, such as prohibitions on socializing within the camp, restrictions on the consumption of alcohol, the requirement to avoid communal seating, and mandates to eat alone. Upon the implementation of such measures, the company daily communicated to its foreign and Thai employees the rationale behind these actions. They were informed that adherence to these protocols would facilitate their survival, safeguard them from infection, and enable a return to regular operational activities (Williams et al., 2023). All employees adhered to this guidance. The unequivocal and earnest enforcement of these

measures within the workplace served as a significant motivator for all employees to comply.

Effective surveillance mechanisms can significantly enhance the identification of disease outbreaks during natural disasters. The surveillance system played a crucial role in mitigating the transmission of infectious agents (WHO, 2022). Rapid detection of disease outbreaks was paramount prior to their propagation. The organization had implemented a systematic approach to monitor the ingress and egress of employees at the camp facility. This procedure commenced with the identification of infected individuals, followed by their immediate quarantine, subsequent treatment and provide vaccine for all workers. Encouraging vaccination among workers was a significant strategy. Some camps had reported a correlation between staff vaccination and reduced COVID-19 cases, highlighting its effectiveness (Nnaji et al., 2022).

The organization had garnered collaboration from governmental entities and healthcare institutions in the screening of patients, aimed at the prompt identification of infected individuals and the provision of timely medical intervention for all staff members. This initiative has been shown to alleviate the intensity of clinical manifestations (Umakanthan et al., 2021). Evidence indicated that this approach effectively curtailed the transmission of disease among other employees. Furthermore, the organization had instituted protective measures to mitigate the risk of infection.

The foundational epidemiological principle underpinning this policy posited that environmental regulation could mitigate the incidence of infections. Strategies for environmental infection control have demonstrated efficacy in the prevention of such infections. The transmission of Coronavirus occurs via small liquid particles expelled from the mouth or nose of an infected individual during activities such as coughing, sneezing, speaking, singing, or even breathing. These particles, laden with pathogens, vary in size from larger respiratory droplets to smaller aerosols. Pathogens may accumulate on surfaces that an infected person had touched. The persistence of the virus on surfaces composed of materials such as plastic or stainless steel, including but not limited to tables, chairs, doorknobs, handrails, and buttons on automated systems and sinks, can extend for a duration of 2–3 days (Dehbandi and Zazouli, 2020; Wang et al., 2020; Santarpia et al., 2020). The transmission of the disease and subsequent infections was facilitated by contact with items contaminated with the coronavirus. The transmission occurred via contact with respiratory droplets that contain pathogenic microorganisms. In most scenarios, the utilization of soap, detergent, and alcohol for the cleaning of surfaces was adequate to reduce risk, without the requirement for disinfection protocols. Disinfection strategies were recommended in indoor communal settings where a suspected or confirmed case of COVID-19 has been identified within the last 24 h. The risk of fomite transmission could be substantially reduced through the persistent and proper use of facial masks (Wang et al., 2020; Reich and Elward, 2022).

The construction industry, heavily impacted by COVID-19, implemented several strategies to mitigate the virus's spread among workers in construction camps. These strategies were informed by various studies and include creating a working measure, health practices, and organizational adaptations (Farah et al., 2022; Garst et al., 2022). Below were the key

strategies employed by construction workers to reduce COVID-19 transmission. All divisions within the organization collaborated effectively with a healthcare provider, particularly the community personnel, ensuring that precautionary measures were implemented seamlessly. The camp was equipped to navigate the crisis adeptly. Consequently, while adverse events may transpire, employees could ultimately revert to their standard operational practices. The insights accrued from the analysis of this work camp can now be extrapolated to inform policies in all workplaces characterized by closed systems and substantial employee populations. The COVID-19 outbreak should not be perceived solely as a detrimental circumstance. The crisis presented an opportunity for positive developments, or it can be reframed as a potential opportunity for growth. For instance, during a pandemic, workers often exhibit increased cohesion, thereby fostering a more favorable working environment.

Numerous advantageous outcomes may materialize, as substantiated by the analysis of the workers' encampment delineated in this narrative. Notwithstanding the successful administration of COVID-19 protocols within the construction worker encampment, a myriad of challenges was confronted during the execution of the instituted measures:

Language Barriers: In light of the existence of a heterogeneous workforce composed of individuals from a multitude of nationalities, language barriers emerged as a significant impediment to facilitating efficacious communication. The employment of translators and the provision of multilingual resources were considered essential to bridge this communicative divide.

Cultural Differences: Divergent cultural practices and beliefs pertaining to health and hygiene necessitated the implementation of customized strategies to ensure compliance with health protocols. Consequently, sensitivity training and culturally competent communication techniques were utilized to enhance adherence.

Resource Constraints: The limitation of resources, including medical provisions and sanitation supplies, occasionally hindered the timely execution of health initiatives. As a result, effective resource management and the acquisition of external assistance were crucial in alleviating these limitations.

Psychological Stress: The restrictive living conditions, together with the omnipresent anxiety concerning infection, contributed to elevated psychological distress among the workforce. To mitigate such stress, mental health support services, encompassing counseling and recreational activities, were established.

Logistical Issues: The orchestration of health screenings, quarantine measures, and the distribution of supplies within a vast and densely populated encampment posed considerable logistical difficulties. Therefore, the formulation of streamlined protocols and robust management frameworks was essential to effectively navigate these challenges.

The management of the COVID-19 crisis within the construction worker encampment in Thailand imparted several significant insights for forthcoming epidemics:

1. Significance of Multilingual Communication: Ensuring the availability of health-related information in an array of languages is imperative within a heterogeneous workforce. This approach mitigates language barriers, thereby guaranteeing that all laborers are adequately informed.

2. Cultural Sensitivity: Acknowledging and honoring cultural distinctions can bolster adherence to health regulations. Customizing communication strategies and health interventions to align with cultural frameworks can enhance their efficacy.

3. Resource Allocation and Management: The proficient administration of resources, inclusive of masks, medical supplies, and vaccines, is paramount. Forming alliances with external entities can facilitate the procurement of essential resources during emergencies.

4. Mental Health Support: The provision of mental health assistance is crucial for addressing the psychological ramifications of an outbreak. Therapeutic services and leisure activities can aid in alleviating stress and fostering overall wellbeing.

5. Robust Logistical Planning: Comprehensive logistical planning is essential for the effective execution of health screenings, quarantine protocols, and the distribution of resources. Optimized processes and robust management frameworks can effectively address logistical complexities.

6. Collaboration and Coordination: Synergistic efforts among governmental agencies, the private sector, and healthcare professionals are vital for managing an outbreak. Unified initiatives can guarantee a thorough and efficient response.

3.1 Future Research directions

While this investigation yields significant contributions toward the management of COVID-19 within a construction worker encampment, additional scholarly inquiry is imperative to augment our comprehension and readiness for prospective outbreaks:

1. Longitudinal Studies: Implementing longitudinal studies to monitor the prolonged consequences of instituted health protocols on the health and welfare of workers.

2. Comparative Analysis: Engaging in comparative analysis to assess the efficacy of various management strategies across distinct worker encampments and sectors to ascertain optimal practices.

3. Technological Integration: Examining the role of advanced technology, including mobile health applications and digital monitoring systems, in enhancing communication and oversight during epidemic occurrences.

4. Policy Development: Analyzing the influence of governmental policies on epidemic management within worker encampments and exploring avenues for their optimization.

5. Mental Health Interventions: Formulating and assessing targeted mental health interventions aimed at supporting workers during and subsequent epidemic events.

6. Cultural Adaptation: Investigating the effectiveness of culturally tailored health communication strategies within heterogeneous worker demographics.

4 Conclusion

The effective administration of COVID-19 within the construction worker encampment in Thailand can be ascribed to the

synergistic endeavors of governmental entities and the private sector. The interventions instituted not only addressed urgent health issues but also fostered a sense of safety and welfare among the workforces. The knowledge acquired from this case study may be extrapolated to analogous contexts to improve epidemic management frameworks.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by Faculty of Medicine Ramathibodi Hospital, Mahidol University. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

WS: Conceptualization, Formal Analysis, Methodology, Writing–original draft, Writing–review and editing, Data curation, Validation, Visualization. TJ: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Supervision, Validation, Visualization, Writing–original draft, Writing–review and editing. NP: Conceptualization, Funding acquisition, Project administration, Resources, Supervision, Visualization, Writing–review and editing. PK: Validation, Visualization, Writing–review and editing. SuK: Data curation, Validation, Conceptualization, Writing–review and editing. JK: Data curation,

Investigation, Validation, Writing–review and editing. SaK: Data curation, Investigation, Validation, Writing–review and editing. SN: Data curation, Writing–original draft. ST: Project administration, Writing–original draft. WW: Project administration, Validation, Writing–review and editing.

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The author(s) declare that no Generative AI was used in the creation of this manuscript.

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