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Community-based response to the COVID-19 pandemic: case study of a home isolation centre using flexible surge capacity



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ABSTRACT

Objectives: Coronavirus disease 2019 (COVID-19) has consumed many available resources within contingency plans, necessitating new capacity surges and novel approaches. This study aimed to explore the possibility of implementing the concept of flexible surge capacity to reduce the burden on hospitals by focussing on community resources to develop home isolation centres in Bangkok, Thailand.

Study design: A qualitative study consisted of observational and semi-structured interview data.

Methods: The development and activities of home isolation centres were observed, and interviews were conducted with leaders and operational workforces. Data were deductively analysed and categorised based on the practical elements necessary in disaster and emergency management.

Results: Data were categorised into the seven collaborative elements of the major incident medical management and support model. The command-and-control category demonstrated four subcategories: (1) coordination and collaboration; (2) staff engagement; (3) responsibility clarification; and (4) sustainability. Safety presented two subcategories: (1) patients' information privacy and treatment; and (2) personnel safety and privacy. Communication showed internal and external communications sub-categories. Assessment, triage, treatment and transport followed the processes of the COVID-19 treatment protocols according to the World Health Organisation (WHO) guidelines and hospital operations. Several supply- and patient-related challenges were identified and managed during centre development. **Conclusions:** The use of community resources, based on the flexible surge capacity concept, is feasible under restricted circumstances and reduced the burden on hospitals during the COVID-19 pandemic. Continuous education among multidisciplinary volunteer teams facilitated their full participation and engagement. The concept of flexible surge capacity may promote an alternative community-based care opportunity, irrespective of emergencies' aetiology.

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Introduction

The outcome of nations' responses and efforts to hamper the progression of COVID-19 seemed to rely on the levels of each country's resiliency. Some countries implemented proactive measures, while others stayed passive, hoping to emerge unaffected by the pandemic.^{1–6} In contrast to contained emergencies (i.e. geographically defined events with the integral incident site, e.g. bombing or flooding), pandemics are population-based events that create new challenges and need different approaches.⁷ Irrespective of the cause, the initial approach to an emergency relates to surge capacity (SC), a multidisciplinary task that aims to increase the number of staff, stuff, space and create guidelines (system) (these are the four vital elements of SC) to scale up capabilities of health care and other agencies, using available resources.^{7–9}

Hospitals are an important part of the response to emergencies. In a contained emergency, the first surge in hospitals begins within the facilities by using all on-duty hospital staff, devices and spaces based on the predesigned contingency plan (intrinsic capacities).⁷ The expansion of incidents necessitates a second SC,^{8,10} using all off-duty staff, reserved stuff and spaces. However, further development of the incident goes beyond facilities' capabilities and requires extrinsic capacities that involve two significant fields; similar healthcare facilities within the regional and national healthcare systems or community resources.^{5,7,8,11} The concept of interfacility SC has been developed over many years to facilitate integrations among diverse local, regional or national teams.^{12,13} Interfacility SC aims to recruit new resources to the affected areas and facilities, or evacuate some groups of patients to other sites or facilities.

Nonetheless, there are situations when the infrastructure is affected, creating difficulties in evacuating victims, such as in war situations, or higher risks of admitting victims to hospitals, such as in pandemics. These scenarios enforce the isolation of victims within their communities or homes and indicate a need for a flexible surge capacity (FSC), which aims at both using communities' resources (i.e. facilities and staff working in specific community activities can be trained and equipped to act as voluntary individuals) and organisations to provide care for the victims either on-site or offsite at non-medical facilities. Although scarcely described in the literature, proactive SC and FSC at the community level for the use of its resources is highly advantageous when first and second SCs are neither available nor possible to deliver.^{14–17} The need for flexibility in disaster and emergency response systems has been described by many; however, a descriptive concept of FSC was only introduced in 2020¹⁴ and has proved its feasibility, applicability and transferability in different infrastructures.^{15,16}

Theoretical framework of FSC

The theoretical framework of FSC combines the SC framework by Bonnett et al.,⁷ complexity theory by Therrien et al.⁵ and the collaboration theoretical framework.¹⁸ Bonnett et al.⁷ expanded Hick et al.'s¹⁹ concept and introduced the facility-based, community-based and extrinsic SC.^{7,19} In their framework, failure in facility-based SC resulted in a search for community-based SC, and if this was insufficient, an extrinsic SC was established. Both scenarios target only medical facilities and resources.⁷

Therrien et al.⁵ expanded Bonnett et al.'s⁷ discussion by adding the impacts of an incident's complexity to its resilience.⁵ The authors emphasised the importance of detailed and dynamic complexity to manage such complexity, as in SC. The former is updated knowledge on the risk or aetiology and management of scientific uncertainty, resources and internal decision-making and communication. The latter is the systematic management of stakeholders on municipal, regional and national levels, the disparity and inequity of the care

between populations, and the risks presented by the public, policymakers and professionals. Therrien et al.,⁵ suggested that these complexities can be managed by establishing a robust network and inter-organisational consistency by obtaining some common denominators within the four elements of SC.

Recognising that some factors can be common points for interaction between groups, several authors used the collaboration theoretical framework to identify such common denominators.⁵ FSC uses an established practical tool in disaster and emergency management and evaluation taught as part of MIMMS (Major Incident Medical Management and Supports) courses and described as CSCATTI.²⁰ In CSCATTI, 'C' stands for Command and control and indicates vertical and horizontal leadership and decision-making;^{21–23} 'S' for Safety clarifies self, scene and survivors' safety principles;^{24,25} the second 'C' refers to Communication and encompasses both internal and external communication and information sharing;²⁶ 'A' relates to Assessment indicating the need for a mutual understanding of the situation;²⁷ and finally, 'TTT' refers to triage, treatment and transport, which follow rules of medical management in severe and restricted conditions.^{27–29}

During the current pandemic, some hospitals could not admit newly diagnosed COVID-19 infected patients because of high bed occupancy and bed capacity management reasons. Therefore, some facilities created hospital-dependent home isolation centres (HICs) managed by hospital staff to provide health care and support.^{30–32} Although this measure relieved hospitals from the pressure caused by the patient influx, it still consumed hospital staff, leaving community resources intact. Although limited use of community volunteers in disease screening has been reported earlier,^{6,33–36} the FSC concept may offer comprehensive engagement and collaboration of communities' surge elements, which may enhance the professional care available during a crisis.

This study aimed to explore the possibility of implementing the concept of FSC to reduce the burden on hospitals by focussing on the community resources to develop HICs in Bangkok, Thailand, offering professional care to the community who were unable to attend overwhelmed hospitals for testing, care and follow-up.

Methods

Study design

A qualitative study was performed based on the perceptions and experiences of volunteers from one non-governmental organisation (NGO) led by Thai emergency physicians. This study adheres to a qualitative research design, a case study, whereby observations and individual interviews were conducted and subjected to qualitative content analysis.³⁷

Sampling

Interviews were conducted with purposive and snowball sampling, and the data saturation determined the sample size.³⁸ The purposive selections were based on the needs of a HIC, encompassing several volunteers in the response chain: professions, such as physicians, nurses and pharmacists; managerial positions, such as logistic and communication managers, public relations and senior-level managers; and model developers. In total, 13 of the 15 interviewees were women. The median age of participants was 34 years (interquartile range 5 years). Five participants were physicians, two were paramedics, three were physiotherapists, two were veterinarians and three worked in social science fields. Seven of the participants were employed in the public sector and eight in the private sector. Six participants were team leaders, while the others remained members of the teams.

Data collection and analysis procedure

Observations:

Data were collected prospectively by five observers who had experience in disaster and emergency management and the study methodology.^{37,39} Each observer notified whether the participants could establish the HIC following the CSCATTT acronym used in the FSC theoretical framework (i.e. notified whether command and control were installed, safety issues and communication options were considered, a mutual assessment was achieved, and appropriate triage, treatment and transport were conducted and planned). The observers independently scrutinised the procedures and took notes throughout the study until no new information was added. The collected data were subject to deductive content analysis.⁴⁰

Interviews:

Voluntary participants registered for an interview lasting approximately 60 min³⁸. Two interviewers performed semi-structured interviews by addressing the CSCATTT acronyms concerning the implementation and development of the HIC with open-ended questions. In addition, participants were able to critically comment on the process in a friendly environment and offer suggestions for further improvement. All interviews were recorded and transcribed by the lead author for content analysis.

Data analysis

A deductive content analysis explored existing theories within the data collected.^{39,40} First, the texts were read through several times to obtain a sense of the entire data content. The data were subsequently divided into meaningful units and then condensed, abstracted, interpreted and sorted into subcategories based on similarities and differences, which were reflected upon and discussed by PP, AK, YS, OS and PC, and later approved by all authors. Finally, the subcategories were sorted into categories^{37,41} (Table S1 in the Supplementary material).

Results

The home isolation centre

An NGO led by emergency physicians initiated the HIC. Local volunteers were recruited to conduct all operating processes and obtain medical devices and inventories from the communities. The total number of patients seen at the HIC 5471, with a daily variation between 10 and 280 cases. In total, 21 patients were critically ill and were sent to a hospital within 1 h after the physicians' evaluation. Most patients survived until discharge, with the exception of three patients who chose home care to be close to their relatives and subsequently died at home. An emergency team closely monitored 275 moderate-to-severe patients; of these, 74 patients were sent to hospital for admission and all other cases were followed-up until recovery. The length of stay ranged from 14 to 21 days and patients were discharged based on the criteria given in the National Institutes of Health's (NIH) and the World Health Organisation's (WHO) guidelines.^{42,43} Each patient passed through three main control stages:

1. **Registration:** Suspected patients were admitted after diagnosis was verified using a positive test from either antigen test kit or reverse transcriptase–polymerase chain reaction, as recommended by the NIH and the WHO. Patients were registered and informed about their rights and process.

2. **Treatment:** Patients were examined and treatment prioritised based on disease severity. Therapeutic protocols were adopted and constantly modified using NIH and WHO recommendations.^{42,43}
3. **Logistics:** Medications and necessary devices, tests and results were delivered to secure and safe locations by local volunteers.

The vital elements of surge capacity

Table S1 illustrates the components (staff, stuff, space and system), subcategories and quotes based on MIMMS (CSCATTT) from observations and interviews and challenges from the interviews.

Staff:

A multiprofessional team of medical and allied-medical staff was recruited. The synchronisation of roles was quickly put in place to enable the necessary provision of health care. Shared goals were established and a command-and-control post was formed to emphasise collaboration between workers, patients and relatives, and foresee necessary educational initiatives. The observation and interview reports revealed four subcategories in the command-and-control category (Table S1).

The first subcategory was coordination and collaboration, recognised as essential factors for implementing and regulating all strategies. The second subcategory was workforce engagement, which indicates a positive attitude towards the centre's development and meaningful work, achieved through positive reinforcement, no blame cultures, education and public acknowledgement. The third subcategory was responsibility clarification, defined as straightforward individual tasks and responsibilities related to the given mandates.

Finally, the cultivation and sense of ownership subcategory suggested the sustainability of the volunteers, knowing that their work is for the benefit of the entire community. Table 1 presents some of the comments cited by the staff regarding these subcategories.

Stuff:

Medical devices required for patients in a COVID-19 home isolation programme included a pulse oximeter and a thermometer, which were provided within the community and delivered in special boxes, known as 'happy boxes', despite some interruptions to supply and delivery. Communication was separated into internal and external components. Internal communication was the action to propel the HIC, which was achieved by regular meetings and transparent online discussions. External communication was defined by the connection between the workforce and patients, and public communication performed through well-known mass media applications and public relations specialists (Table S1). The use of telemedicine was particularly important since the external communication depended on telemedicine and telemonitor appliances that would allow health care to be delivered at a distance, facilitating connections between healthcare providers and patients at home. The appliances entailed network connection and video communication apparatus enabled the connection, either by the hospital arrangement or by using the patients' mobile applications, taking advantage of the extensive distribution of mobile phone owners and individuals' networks.

Space (Structure):

Using telemedicine, the space needed in this concept was the Internet, and the physical site was used solely for inventories.

System:

The centre was managed by an NGO made up of private individuals with high flexibility in strategic planning and

Table 1
Relevant quotations and comments referred to each sub-category and categories related to surge capacity elements.

Category	Sub-categories	Staffs' citations
Command and control (staff)	Coordination and collaboration	'Even if we did not know each other, we had a common vision of an alternative way to handle the pandemic. This vision nurtured collaboration. A few of us were the initiators and others followed. We called them early adopters. Of course, there was some resistance, but I think collaboration and enthusiasm were the core driving forces.'
	Workforce engagement	'The difficult matters were freely discussed without negative environments or feedback, and team leaders always expressed support and positive reinforcement creating no-blame environments.'
	Responsibility clarification	'The distribution of tasks is quite informal, but at the same time, we separate tasks that strictly belong to physicians, nurses or social workers accordingly to the professional and legal framework.'
	Cultivation and sense of ownership	'The critical processes were pre-designed, taught and discussed with volunteers; however, during operations, the ancillary flows could be discussed and modified according to volunteers' comments.'
Safety (stuff/system)	Telemedicine	'The data access limitation was strictly implemented; only team leaders could give data access authorizations.'
Communications (stuff)	External communication	'Facebook and Instagram were used to provide patients' outcomes and current knowledge with a friendly approach (colours and pictures).'
	External and internal communication	'Line application was applied to intra-organization, inter-organization and communicate with patients, since a majority of Thai people used the channel.'
Assessment (system)	Patient home isolation adequacy	'All patients were evaluated through video call with educated volunteers, and the inappropriate environments were advised to improve and wait for re-evaluation.'
Triage (system)	Patient triage – optimize resources	'Patients were prioritized to suit the resources. At first, the triage was conducted following the Department of Medical Service which referenced the WHO guidelines. After that, the triage criteria were separated to more detailed levels to increase the number of patients' accessibility.'
Treatment (system)	Current standard treatment protocols	'The treatments followed standards of care with rapid modifications as global recommendations.'
Transport (system)	Timely critical patient transportation	'Critical care transports were stressful and intense. All devices needed to be prepared and arranged for patients at home until arrival to a destination hospital. The team contacted a usual referral system and facilitated the processes'
Space/stuff	Materials	'The room is full of equipment stapled along a corridor. Paper boxes were piled marked happy with fancy colourful pictures.'

deployment. This team created interprofessional collaboration among staff and patients, and inter-organisational partnerships with governments, the Thai Red Cross and hospitals. The inter-organisational partnerships were limited to shared resources, strategies and tasks' development; however, using autonomous leaders, decision-making mechanisms (with both formal and informal communications channels) were formed following the principles of the incidence command system (i.e. CSCATTT). Command and control were mainly performed by emergency physicians trained to lead the system with scarce resources through table-top exercises, live simulations and actual experiences in major incidents.

The components of safety were subcategorised as patient and personnel safety. Patient safety included privacy, cybersecurity, and medication prescription and distribution procedures (a control line was created from prescription generation to pharmacy check and delivery to the patient). The centre used an online operation that allowed healthcare services to monitor patients with reduced social contacts and hospital visits. The risk of cyber threat was attenuated by allowing only verified persons to access the data, and a login was required to view and edit any data. Staff safety was identified as physical (personal protection equipment and social distancing), mental, spiritual health and personnel privacy. Staff mental and spiritual health was achieved by providing information and enabling transparent discussion about the process and its pros and cons.

The fundamental communication principles include goal-orientated contents and a proper channel to communicate. As a simplified and accessible communication method facilitated the entire process, a popular social media platform called Line was used

(see the 'Stuff' subsection). Assessment of patients was described as imitating face-to-face hospital services, starting from registration, patient examination and treatment protocols.

Patient treatment was prioritised according to clinical severity. The WHO published home isolation recommendations in August 2020, suggesting the need to thoroughly scrutinise patient eligibility, including clinical, environmental and technological aspects, before any provision of care⁴³ was provided. Modifications to these recommendations could be applied to suit organisational and national availability of telehealthcare.^{44,45} Infectious control measures were applied by providing household evaluations, inspections and modification of guidelines to all patients. People in close contact with patients were advised to self-quarantine and monitor symptoms. After being discharged by a physician, patients were educated in self-health care to facilitate their return to work and daily activities.

In contrast to other processes, there was a paucity of evidence in patient prioritisation, and triage was one of the most adaptable processes (Table 2). Patients were categorised into eight levels to match the provision of resources; hence, many patients were able to access treatments and recovered. Moreover, patients who required intensive medical care were triaged and received an initial evaluation and treatment before being transferred to the hospital's in-patient department, which alleviated the burdens in the hospital's emergency department.⁴⁴

Discussion

The HIC described in this study demonstrates the operational definition of preparedness and response to public health

Table 2
Patient triage and management.

Triage	Implication	Management
Dark red	Severely ill; dyspnea, respiratory rate >25/min Pulse oximetry <90%	Pharmacists' confirmation as soon as possible, and hospital contacts and referral within 1 h
Bright red	Dyspnea, respiratory rate >25/min Pulse oximetry 90–95%	Pharmacists' confirmation as soon as possible, and hospital contacts and referrals if possible. Oxygen concentrator and medications delivered within 4 h. 24 h telemonitoring by physicians and paramedics
Yellow	Symptomatic patients with oxygen saturation of more than 95% and risk factors; age >60 years, or diseases as follows: Chronic obstructive pulmonary disease or other chronic lung diseases Chronic kidney disease/cirrhosis Cardiovascular disease, including congenital heart disease Cerebrovascular disease Uncontrolled diabetes mellitus Obesity or bodyweight >90 kg Immunocompromised	Pharmacists' confirmation within 2 h Medication delivery within 6 h Physicians followed up every day
Dark green	Upper respiratory tract symptoms or feeling chest discomfort or feeling dyspnea and oxygen saturation of more than 95%	Pharmacists' confirmation within 6 h Medication delivery within 24 h Nurses followed up every day
Medium green	Other non-respiratory COVID-19 symptoms and oxygen saturation of more than 95%	Pharmacists' confirmation within 6 h Medication delivery within 24 h Nurses/paramedics/dentists followed up every other day
Bright green	Asymptomatic and oxygen saturation of more than 95%	Paramedics/dentists followed up every two days
Red recovery	Once red case but clinically improved	Physicians followed up every day
Yellow recovery	Once yellow case but clinically improved	Physicians followed up every day

emergencies, presented by the WHO.⁴⁶ Communities were engaged in all four phases of emergency management and necessary measures were implemented as part of the public health emergency response. Health care to protect and improve the medical condition of COVID-19 patients at home was provided and severe cases needing referral to hospitals were identified.^{47–50} The successful implementation of these centres based on the FSC concept could be transferred to other causes of population-based events by emphasising the significance of community resources, strengthening fundamental individuals' rights to health care, and alternative leadership in various levels of public health and disaster management systems.⁵¹

The theoretical frameworks of SC in health care examine a more pragmatic aspect and the consequences of effectiveness and implementation in the actual setting, especially in the community setting under time and resources constraints,^{52,53} with various degrees of integration.^{13,54,55} The use of complexity theory to further develop SC enhances self-organising, diversity and interaction between the system and environment.⁵ As a result, previously proposed frameworks highlighted the use of system, organisation and individual as planned or improvised manners. The FSC uses the collaboration framework, displayed as the practical tool (CSCATT), focussing on community and multidisciplinary engagements, and is in line with previous theories yet demonstrates a more flexible and proactive resilience.^{14–16,18}

This study shows that staff, staff and space in the FSC concept develop from local communities passively and proactively, are flexible to modify and include multidisciplinary involvement, as indicated in staff quotations (see Table 1). At the same time, the need for updated knowledge on the risks and aetiology and management of scientific uncertainty, resources and internal decision-making and communication (i.e. the detailed and dynamic complexity) was met by regular meetings and educational initiatives.

Recruiting workforces from the local community to form multiprofessional teams seems to facilitate a more effortless synchronisation of roles to provide necessary health care to the patients at home. Following the principles of command and control, cooperation, coordination and collaboration were the ultimate goals for all individuals and organisations involved within a local setting,

highlighting the perception of belonging and doing something for the benefit of all (shared goals).^{12,13,54,55} The HIC also facilitated staff engagement and clear responsibility for given tasks, resulting in common denominators and mutual respect and acquaintances in collaboration, which built up over time during the operations⁵⁴ and resulted in achieving shared goals and consensus on the best health care provision for patients. Furthermore, continuous staff education and cultivation facilitated their response engagement, gaining the required sustainability.^{15,16,56} Local staff recruitment also allowed special medical and social precautions to guarantee personnel safety and high staff performance.^{23,57–59}

Communications among workers, patients and the public were significant in the achievement.^{25,54,60} The rapid and complete information exchanges were widely addressed to link other elements; however, the degree and mode of communication were part of the challenges. In this study, regular, active, reciprocal and transparent communication was the leading cause of success.^{61,62} Leaders arranged to communicate content among teams to ensure goal-oriented details and such information was conveyed by professional communicators.²² Successful communications could also facilitate better assessment of the situation. The centre mirrored hospital steps from registration to drug delivery, a familiar way for all medical and allied healthcare providers to avoid misunderstandings. The process was reviewed daily and constantly improved.

Triage, treatment and transport were the three distinct sections for medical operation, described as patient prioritisation to optimise the resources (Table 2), patient medical therapies, medicines and devices inventory and delivery, and patient transfer. A triage system was designed to ensure patients received the correct triage, treatment and transport required.

Challenges of the home isolation centre

Challenges in developing the HIC were either related to supply or patient care. During the initial phase of the HIC set up, difficulties in supplying medication for COVID-19 treatment appeared and were resolved through NGO-government collaboration. One patient care-related challenge was the hospital referral for critical

patients and severely ill illegal migrants. These issues were eventually managed by using local hospitals with significant input from staff.

Finally, there was insufficient economic support from the government during the COVID-19 outbreak.⁶ Thus, the HIC, with operational and managerial expenses, was a donation-dependent organisation resulting in an insecure and unpredictable financial situation, despite partial support through the universal coverage scheme. Financial input was crucial for a sustainable operation; fortunately, the HIC received positive feedback through social media platforms resulting in national recognition and public acceptance, facilitating the NGO's financial contingency.^{63,64}

Limitations

There is a possible recall bias from the interviewees and missing data in the observational processes from the beginning of the operations due to a time difference between interviews and control and analysis of data. Moreover, the lack of similar studies does not allow a thorough analysis of this study in comparison with other investigations. Finally, the search was conducted in the English language and therefore did not consider similar research in languages other than English.

Conclusions

COVID-19 infection affected national health care and socio-economic systems globally. While the usual healthcare systems were at their maximum surge, an extension of services to the community facilities, as an FSC, was feasible and applicable to reduce the burden on hospitals during the pandemic. Moreover, public health education initiatives among multidisciplinary volunteer teams overcame the participation and engagement barriers. This study represented the achievable integration of home isolation under restricted infrastructures; a similar NGO can be arranged favourably when facing dynamic global casualties. As this study emphasised reduced burden for the hospitals, future research on the application of the FSC concept needs to focus on situations where the hospital is the target of an emergency and when a hospital evacuation may be necessary. Such a scenario would enhance the capabilities of the health system in response to all threats.

Author statements

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Ethical approval

This study was approved by the Human Research Ethics Committee, Faculty of Medicine Ramathibodi Hospital, Mahidol University (MURA2021/786).

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Competing interests

None declared.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.puhe.2022.06.025>.

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