LOCATION DECISION CRITERIA FOR COMMUNITY ISOLATION FACILITIES: A CASE STUDY OF COVID-19 RESPONSE

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ABSTRACT

The objective of this study is to identify the criteria that influence the decision-making process for selecting a suitable location for a community isolation facility in the context of managing cases of Infectious Respiratory Diseases, with a primary focus on the COVID-19 pandemic. Data was collected from a sample of ten individuals with expertise in the field, who have encountered COVID-19 situations. This data collection involved the administration of questionnaires and semi-structured interviews. Subsequently, the Content Validity Index (CVI) approach was employed to scrutinize the gathered data. The findings indicated that two out of the 18 criteria identified through a comprehensive literature analysis, namely Rental Cost and Main Road Proximity, were excluded from consideration. Additionally, the study revealed a correlation between the size of a city and the significance of criteria such as Rental Costs and main roads in the decision-making process. Furthermore, various contextual elements, including geography, demography, and lifestyle, were found to exert influence on location selection criteria. Importantly, these criteria can guide the selection of suitable areas and inform strategies for addressing future respiratory disease outbreaks. Collaboration between multiple stakeholders, including the government and the general public, remains integral in determining these criteria.

Keywords: Community Isolation Facility, Content Validity Index, COVID-19, Location Selection, Decision-Making Criteria

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INTRODUCTION

In recent years, the global community has grappled with a series of pandemics, whether triggered by natural occurrences or human activities. These outbreaks have had far-reaching repercussions, affecting both the world economy and the lives of countless individuals (BMJ, 2006). This underscores the critical importance of pandemic preparedness within scholarly discussions (Mody & Cinti, 2007). Moreover, outbreaks tend to manifest suddenly and unpredictably, catching us off guard (Dasaklis et al., 2012). Often, the development of vaccines and medicines lags behind, necessitating government interventions that don't solely rely on pharmaceutical solutions (Tognotti, 2013). Throughout history, the strategy of isolation has remained a prominent and effective method for containing the spread of diseases, a practice with deep-rooted historical significance. (Conti, 2017)

Frequently, epidemics encompass respiratory infections of high contagion, capable of facile airborne transmission. The expeditious dissemination of the virus has the potential to result in a significant increase in the number of illnesses within a little timeframe (World Health Organization, 2005). The management of such disorders frequently requires the utilization of specialized negative pressure rooms. Nevertheless, it should be noted that not all hospitals possess the necessary infrastructure to provide such amenities. Also, it is not recommended to manage individuals with infections in conjunction with other patients inside conventional hospital environments. Therefore, it is frequently necessary to transfer infected patients to separate facilities, typically located at a considerable distance from the primary hospital buildings (Fusco et al., 2009).

The emergence of the novel coronavirus SARS-CoV-2, referred to as COVID-19, was initially identified in December 2019 in Wuhan, Hubei Province, People's Republic of China (World Health Organization Thailand, 2020). COVID-19 primarily spreads through airborne and droplet transmission and is characterized by extended incubation periods. Notably, asymptomatic carriers play an unwitting role in propagating the disease. The surge in global COVID-19 cases has placed an unprecedented strain on hospital capacities. Hospitals typically maintain operational capacity for addressing acute medical needs, and this surge has overwhelmed many healthcare facilities (Fusco et al., 2009), underscoring the pressing necessity for the expansion of field hospitals and community-centered isolation facilities to mitigate the stress on healthcare infrastructure.

The establishment of isolation facilities plays a crucial role in reducing the transmission of diseases and lowering mortality rates (Chen et al., 2021). During the SARS outbreak in China, the rapid deployment of field hospitals eliminated the need for new construction when facing new outbreaks and has also proven effective in dealing with COVID-19 (Fang et al., 2020). These facilities offer a vital solution for individuals facing financial constraints or those with inadequate options for home isolation (Bhardwaj et al., 2021). Moreover, they mitigate the risk of infecting other family members compared to home-based isolation (Lopez et al., 2021). In Germany, isolation facilities have been established for homeless individuals to curb the spread of infections and provide access to medical care, social welfare, and support for social issues such as alcohol and drug addiction. This approach effectively addresses both health and social challenges (Horig et al., 2023), highlighting the essential role of these isolation facilities in ensuring that individuals with social limitations receive the necessary care and experience an improved quality of life.

The significance of carefully considering the choice of locations for isolation facilities is emphasized by the researcher. Therefore, a study was undertaken to examine the various criteria that influence the selection of locations for the isolation of patients with respiratory illnesses. The primary objective entails the analysis of pivotal determinants that impact the selection of locations for community isolation facilities. The overarching aim is to enhance and

refine the guidelines governing the establishment of community isolation facilities for more effective responses to future outbreaks.

LITERATURE REVIEWS

Quarantine and isolation represent critical strategies in epidemic control, substantially curbing infections and mitigating healthcare resource stress. Prompt implementation of these measures significantly reduces cumulative infections, deaths, and the strain on healthcare facilities (Pan et al., 2020).

Quarantine facilities encompass home-based and government-designated options. While home quarantine minimizes viral spread, issues arise due to poor communication, insufficient understanding, and unclear government support (Hu et al., 2020) (Nazari et al., 2020) (Upadhyay et al., 2021). Government facilities exhibit varying restrictions; community isolation centers, for instance, require local Consent (Wongputh et al., 2021). Even hotels can serve as quarantine sites, though they may impact the facility's image and employee well-being (Choi & Choi, 2021). Meanwhile, field hospitals necessitate ample space and supervision (Wang et al., 2021).

Hospital location emerges as a paramount criterion in facility establishment. Studies highlight that time, distance, traffic, and land prices significantly influence patients' timely access to care (Vahidnia et al., 2009) (Soltani & Marandi, 2011). The Fuzzy Analytical Hierarchy Process (FAHP) reveals that traffic conditions and land prices are crucial considerations (Soltani and Marandi, 2011). Similar studies employing the Fuzzy AHP method underscore common criteria like distance from main roads, population Density, environment, and capital expenditure (Chatterjee & Mukherjee, 2013) (Miç & Antmen, 2019). These findings underscore the importance of geographical aspects in location selection.

The COVID-19 pandemic, leading to a surge in infections, highlighted a pressing need for additional patient beds. This prompted governments worldwide to establish isolation centers, such as China's Fangcang field hospitals, created in large public spaces (Fang et al., 2020). Research in this context considers criteria beyond medical considerations, emphasizing safety (Hashemkhani Zolfani et al., 2020).

Various techniques have been employed to select quarantine locations, including the Analytic Hierarchy Process (AHP), the Delphi technique, and fuzzy decision-making tools (Zeferino et al., 2020) (Aydin & Seker, 2021) (Akpınar & Ilgın, 2021). Findings frequently highlight criteria like accessibility, readiness, and safety as (Zeferino et al., 2020) (Aydin & Seker, 2021). In addition, studies incorporating geographic information systems (GIS) stress the importance of Proximity to public transportation (Boyaci & Sisman, 2022).

While the criteria influencing general and field hospital locations share commonalities, field hospitals exhibit unique priorities due to their distinct objectives, such as Proximity to communities, safety, and readiness for treating severely ill patients. Therefore, this research focuses on the selection of locations for establishing community isolation centers, recognizing their unique limitations.

RESEARCH METHODOLOGY

This study aims to investigate the process of location selection by comprehensively reviewing relevant literature. A total of 18 criteria were identified, as outlined in Table 1. Subsequently, a sample group of 10 experts was thoroughly chosen, with each individual meeting the specific selection criteria. They possess direct experience in operating facilities for respiratory infections, hold decision-making authority in location selection, and are well-versed in community epidemiology. This diverse expertise ensures a well-rounded perspective to inform the research.

The evaluation of these criteria was carried out through a combination of questionnaires and semi-structured interviews with the participating experts. Following this data collection phase, the Content Validity Index (CVI) was employed to ensure the congruence of the selected criteria with the core content and objectives pertaining to the selection of a location for the isolation facility.

Table 1 Selection Criteria Derived from Literature Review

Major criteria	Sub-criteria	Major criteria	Sub-criteria
Cost	Transportation Cost (C1)	Demography	Population Density (D1)
	Operational Cost (C2)		Community Consent (D2)
	Rental Cost (C3)	Environment	Water Treatment System (E1)
Transportation	Hospital Proximity (T1)		Waste Management System (E2)
	Residential Distance (T2)	Facilities	Size (F1)
	Main Road Proximity (T3)		Separatable Zone (F2)
	Readiness (T4)		Expandability (F3)
	Accessibility (T5)		Security (F4)
	Travel Time (T6)		Utilities (F5)

Content Validity Index (CVI)

The Content Validity Index (CVI) is a method in which experts evaluate individual statements for relevance, clarity, difficulty, and comprehensiveness. They assess to what degree the statement aligns with the content being measured. The options are set at four levels of measurement as follows: "1" for not relevant, "2" for somewhat irrelevant, "3" for somewhat relevant and "4" for very relevant.

$$\mathrm{CVI} = \frac{\sum \mathrm{R}_{3,4}}{\mathrm{N}} \quad (1)$$

Where:

$\sum R_{3,4}$ represents the number of items that all experts rated with levels 3 and 4.

N is the total number of items or questions.

The criteria for considering content validity are a score of 0.8 or higher. Items rated as 1 and 2 should be revised to ensure that the research tool adequately covers the variables being studied.

The Content Validity Index for Scale (S-CVI) is a method for calculating the content validity index for the entire document, which depends on the content validity for each item (Content Validity for Item: I-CVI).

I-CVI refers to the proportion of experts who agree that a specific question corresponds to the operational definition. It is calculated by taking the number of experts who gave a score of 3 or 4 for that question and dividing it by the total number of experts, as shown in the formula.

$$\mathrm{I-CVI} = \frac{\mathrm{n_c}}{\mathrm{N}} \quad (2)$$

Where:

$\mathrm{n_c}$ =Number of experts who opined that the question corresponds to the operational definition (3 or 4 points).

N = total number of experts

The I-CVI value should be no less than 0.78. Anything less than this must be improved. The calculation of the content validity index (S-CVI) can be done by calculating the average of the I-CVI values and having a quality criterion of S-CVI not less than 0.90.
The criteria used to consider the I-CVI value is that in the case of using 3 - 5 experts, the I-CVI value should be equal to 1.00. In the case of using 6 - 10 experts, the I-CVI value should be 0.78.

Table 2 Number of Experts and Definition of Acceptable CVI Values

Number of experts	Acceptable CVI values	Source of recommendation
2 experts	At least 0.80	Davis (1992)
3 - 5 experts	Should be 1	Polit and Beck (2006), Polit et al. (2007)
At least 6 experts	At least 0.83	Polit and Beck (2006), Polit et al. (2007)
6 - 8 experts	At least 0.83	LYNN (1986)
At least 9 experts	At least 0.78	LYNN (1986)

Source: Yusoff (2019)

Content Validity Index for Scale: S-CVI

$$\frac{\mathrm{S-CVI}}{\mathrm{UA}} \tag{3}$$

Where:
$\mathrm{S-CVI}$ = Number of questions for which experts' rate 3 or 4 points.
UA = Total number of questions

$$\frac{\mathrm{S-CVI}}{\mathrm{Ave}} \tag{4}$$

Where:
$\mathrm{S-CVI}$ = Sum of CVI of all questions.
Ave = Total number of questions
The criteria used for consideration is that the S-CVI/Ave value should be 0.90 or higher. The S-CVI/Ave value of the translated research instrument may use a value of 0.80.
To streamline the criteria and eliminate those with lower levels of acceptance, Table 2 provides an overview of the acceptable Content Validity Index (CVI) values, taking into account the number of experts evaluating the questionnaire. Any criteria that garnered a CVI score below 0.78 was excluded from consideration. In the event that new criteria emerge, the questionnaire will undergo refinement before a subsequent survey is conducted. Conversely, if no additional criteria arise, the results will be thoroughly interpreted and condensed for utilization in the subsequent phases of this study.

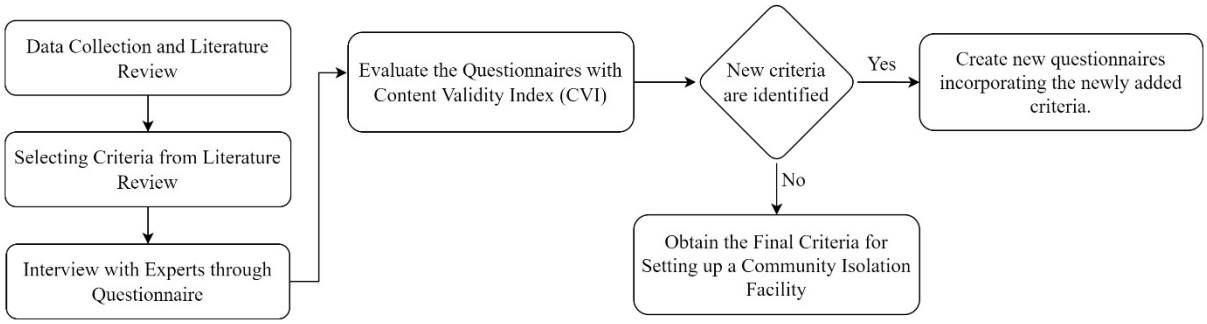

Figure 1 Conceptual Framework

RESEARCH RESULTS

Gathering data involved conducting surveys through questionnaires and interviews with a sample of ten individuals who are experts in epidemiology, possess practical experience in managing COVID situations in field hospitals and community isolation facilities, and hold decision-making authority in the selection of isolation facilities. These experts were categorized into three groups: academic, public health, and local government, as illustrated in Figure 2.

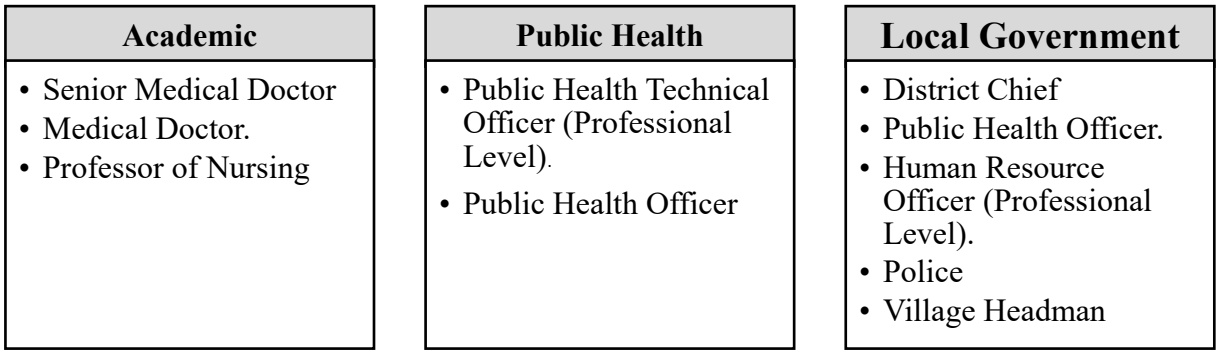

Figure 2 Grouping of Experts

According to the findings of the survey, a total of 18 criteria were identified. Out of these, 16 were determined to be relevant, while 2 were found to be irrelevant. This information is presented in Table 3. The criteria that are associated with getting a flawless I-CVI score of 1.00 are as follows: operation Cost, population Density, community Consent, hospital Proximity, Residential Distance, Separatable Zone, security, and utilities. Furthermore, six criteria achieved an I-CVI score of 0.90, namely Transportation Costs, Readiness, Water Treatment System, Waste Management System, Size, and Expandability. Two criteria, namely Accessibility and Travel Time, achieved an I-CVI score of 0.80. The aforementioned criteria satisfy the I-CVI score standards of at least 0.78, rendering them suitable for use in later phases of the research. Nevertheless, the two criteria, namely Rental Cost and Main Road Proximity, received ratings of 0.70 and 0.40, respectively, which were found to be lower than the established threshold of 0.78. As a result, they have been omitted from the criteria used to identify locations for isolation facilities.

Table 3 Rating of Criteria Consistency by 10 Experts

No.	Sub-criteria	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Expert 8	Expert 9	Expert 10	Experts in Agreement	I-CVI	UA
1	Transportation Cost	1	1	1	1	1	1	1	1	0	1	9	0.90	0
2	Operational Cost	1	1	1	1	1	1	1	1	1	1	10	1.00	1
3	Rental Cost	1	0	0	1	1	0	0	0	0	1	4	0.40	0
4	Population Density	1	1	1	1	1	1	1	1	1	1	10	1.00	1
5	Community Consent	1	1	1	1	1	1	1	1	1	1	10	1.00	1
6	Hospital Proximity	1	1	1	1	1	1	1	1	1	1	10	1.00	1
7	Residential Distance	1	1	1	1	1	1	1	1	1	1	10	1.00	1
8	Main Road Proximity	1	1	1	0	1	1	1	0	0	1	7	0.70	0
9	Readiness	1	1	1	1	1	1	1	1	0	1	9	0.90	0
10	Accessibility	1	0	1	1	1	1	1	1	0	1	8	0.80	0
11	Travel Time	0	0	1	1	1	1	1	1	1	1	8	0.80	0
12	Water Treatment System	1	1	1	1	1	1	1	1	0	1	9	0.90	0
13	Waste Management System	1	1	1	1	1	1	1	1	0	1	9	0.90	0
14	Size	1	1	1	1	1	1	1	1	0	1	9	0.90	0
15	Separatable Zone	1	1	1	1	1	1	1	1	1	1	10	1.00	1
16	Expandability	1	1	1	1	1	1	1	1	0	1	9	0.90	0
17	Security	1	1	1	1	1	1	1	1	1	1	10	1.00	1
18	Utilities	1	1	1	1	1	1	1	1	1	1	10	1.00	1
												S-CVI/AVE	0.89	
	Proportion relevance	0.94	0.83	0.94	0.94	1.00	0.94	0.94	0.89	0.50	1.00	S-CVI/UA		0.44
												Average proportion of items judged as relevance across the ten exports	0.89	

DISCUSSION & CONCLUSION

Establishing an isolation facility requires meticulous consideration of various criteria due to its unique constraints. The analysis revealed the following categories of criteria:

- **Universally Essential Criteria**: These are criteria unanimously agreed upon by all experts, including Operational Cost, Population Density, Community Consent, Hospital Proximity, Residential Distance, Separatable Zone, Security, and Utilities.
- **Criteria with Differing Perspectives**: Some experts view criteria like Transportation Costs, Readiness, Water Treatment System, Waste Management System, Size, and Expandability differently but still recognize their significance.
- **Secondary Criteria**: Accessibility and Travel Time, though important, are considered secondary compared to the criteria mentioned above.

A CVI evaluation of these criteria with ten experts shows that most of the criteria are comprehensive and essential for informed decision-making. However, "Rental Cost" becomes less crucial in regions with ample public spaces but gains significance in densely populated urban areas like Bangkok. Similarly, "Main Road Proximity" varies in importance. While academia might consider it non-essential, local agencies find it vital for transporting supplies. This demonstrates the impact of regional population densities and resource availability on isolation facility location selection.

In summary, isolation facilities play a pivotal role in curtailing the transmission of infectious diseases and reducing mortality rates. They provide essential medical care, minimizing infections within families and offering critical treatment for individuals facing housing or financial constraints (Chen et al., 2021) (Lopez et al., 2021) (World Health Organization. Regional Office for the Western, 2020). Notably, countries like Germany and Australia have effectively employed such facilities for homeless populations, aiding in both COVID-19 management and enhancing the well-being of these groups (Horig et al., 2023) (Miller et al., 2020).

This research focuses on location selection criteria, excluding ethical and social aspects. However, it's vital to acknowledge that geography, climate, city size, and population dynamics influence location choices (Schilling et al., 2014). Aydin and Seker (2021) in Turkey highlights different selection criteria, underscoring the diversity in these considerations. This study is specific to respiratory diseases; other infectious diseases like smallpox may require distinct assessments due to varying symptoms and care methods (Kerrod et al., 2005). The identified criteria provide a foundation for future investigations to determine criterion weights. This can be accomplished using multi-criteria decision-making approaches to achieve optimal location selection. Ultimately, this research contributes to the development of comprehensive disaster response guidelines for future planning endeavors.

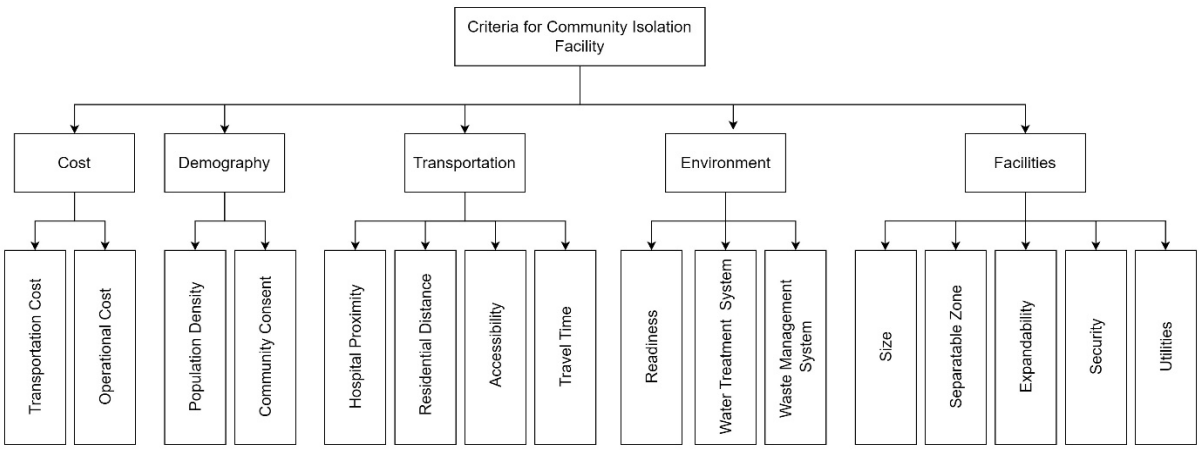

Figure 2 New Hierarchy Structure Experts Evaluated by CVI

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