

Case Study of Rapid Construction of Composite Modular Hospital During Covid-19 Pandemic

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ABSTRACT-

In areas where there was a major COVID-19 epidemic, one of the most successful ways to restrict and combat the pandemic was to swiftly construct emergency facilities. However, to compensate for the lack of legal norms and laws, such quick building megaprojects require more than a formal management structure to create organizational citizenship behavior among participants. In this research, various emergency hospitals built specifically for COVID-19 are used as case studies to develop a mechanism model and investigate the impact of the COVID-19 event's perceived strength on emergency megaproject citizenship behavior. Huoshenshan and Leishenshan, two specialty field hospitals, were developed, built, and commissioned in record fast to deal with the outbreak.

The COVID-19 reaction has grown dependent on the rapid deployment of modular healthcare facilities. Emergency hospital projects have been commissioned by governments, and design for manufacture and assembly has played a critical role. An innovative public health concept is Fangcang shelter hospitals. They were first introduced in China in February 2020 in response to the COVID-19 epidemic of 2019. These hospitals in China were large-scale, temporary hospitals that were quickly constructed by transforming existing public venues into health-care facilities, such as stadiums and exposition centers. They provided medical treatment, illness monitoring, food, lodging, and social activities to patients with mild to moderate COVID-19 who were isolated from their relatives and communities.

This paper provides empirical guidance for project managers on how to encourage community participation in emergency megaprojects through public emergency management in order to achieve project objectives.

Keywords-*Modular construction, Healthcare facilities, Response to pandemic outbreaks, Specialized field hospitals, Emergencies architecture, Composite modular buildings, Prefabricated structures*

1. INTRODUCTION-

The COVID-19 epidemic broke out over the planet at the beginning of the year 2020. By the 10th of August 2020, 19.72 million people had been infected in 216 countries or areas, resulting in 728,013 deaths. The pandemic epidemic of coronavirus disease 2019 is a global public health and safety disaster. "Early test, early diagnosis, early treatment, and early isolation" require large-scale testing. Rapid development of emergency hospitals in places with a major COVID-19 epidemic was one of the most successful approaches to combat the pandemic. In January 2020, the Chinese government agreed to create large-scale emergency facilities in Wuhan, China, the most badly impacted city, within two weeks, due to the dramatic increase in the number of COVID-19 patients requiring treatment. [1][3]

The coronavirus pandemic is the worst public health crisis in human history. It is forcing governments across the world to examine their health-care systems more closely. Instead of simply anticipating a "return to normal" once the immediate crisis has passed, it is time for India to engage in a societal debate about the need for a paradigm shift in our health system. We can learn from other nations, particularly China, about how to build hospitals quickly in order to tackle covid-19 and other pandemics.[2][3] In the healthcare system, hospitals play a key role in providing essential health services. Responding to patients with varying degrees of illness severity has been a challenge for healthcare systems around the world. COVID-19 is a pandemic that is now wreaking havoc over the globe. Because of variable patient demand, which may affect hospital capacity and general functioning, as well as developing

dangers based on hospital location, medical personnel, patient, and healthcare method, this pandemic causes an increase in disease transmission. In order to deal with the hurdles, hospitals, particularly in developing nations like India, must have completed their preparations for the COVID-19 pandemic before these events happen.[8][1]

We examine how several countries, particularly China, set up hospitals swiftly in the event of a pandemic, like as the Covid-19 outbreak, and how India should respond.

2. RELATED WORK-

2.1. MODULAR COMSTRUCTION OF HEALTHCARE FACILITIES AS A RESPONSE TO PANDEMIC OUTBREAK-

Due to a major spike in the number of COVID-19 patients in need of treatment, the Chinese government committed in January 2020 to build two large-scale emergency facilities in Wuhan, China, the city most adversely afflicted, within two weeks.[1]

The term "space modular hospital" refers to a facility that is constructed in advance. A modular house with distinctive purposes is built utilizing a range of prefabricated steel structural systems to suit the building's functional needs and operating features during construction.[1][2]

2.1.1. CASE STUDY FROM TWO EMERGENCY HOSITAL PROJECTS IN WUHAN, CHINA-

The China Construction Third Engineering Bureau, the general contractor for both hospitals, started work on Huoshenshan Hospital and Leishenshan Hospital. These two emergency hospital megaprojects, as construction megaprojects in response to the COVID-19 pandemic, entail large expenditure, short construction timelines, and difficult responsibilities. The pandemic's quick expansion has resulted in a massive overcrowding of Wuhan's existing hospital admission system. As a result, the emergency hospital construction phase was rushed, requiring several parties to coordinate human, financial, and material resources and cooperate at the same time.[2][3]

Wuhan Leishenshan hospital (short for "Leishenshan") or Wuhan Thunder project is a temporary emergency center for patients with newly infected pneumonia with the coronavirus. In engineering construction, using modular composite building completed products minimizes field operations' workload and saves time.[4][3]



FIG1. Mega Project- China completes Huoshenshan Hospital within 10 days [9]



FIG2. Leishenshan Hospital in Wuhan races against Coronavirus [9]

The abandoned parking lot of the Wuhan Military Games Athletes' Village in Jiangxi District is home to Leishenshan Hospital, which has a site area of around 220,000 m² and a total building area of nearly 80,000 m². The logistics area and the medical treatment area are the three divisions of the medical staff living quarters of Leishenshan Hospital.[4][9]



FIG3. The Leishenshan Hospital's overall plan. [4]

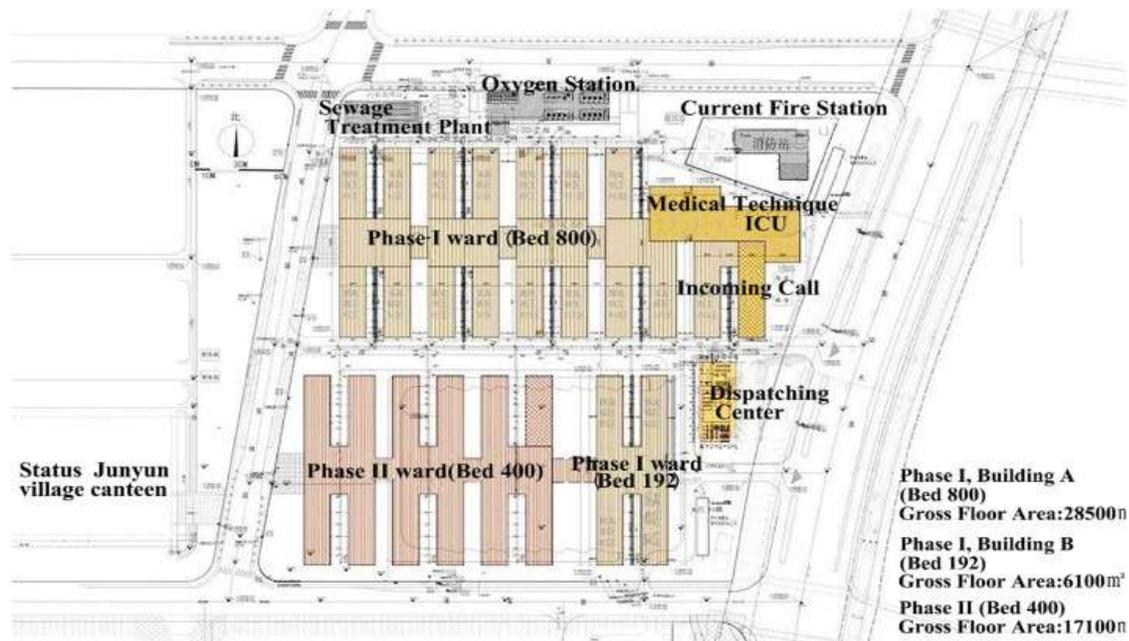


FIG4. In urgent emergency engineering tasks, modular composite buildings are used. [4]

2.1.2. MODLING IN BIM AND POP-

A hospital, like a construction project, has complex design needs that are influenced by a variety of unknowns, and its technical requirements may be much more demanding than those of other projects of comparable complexity. BIM has already been investigated to determine if it may help meet these technological demands while also promoting hospital expansion. BIM can help enhance design quality and productivity in a multitude of areas, including building plan rehearsal and optimization, and construction site management, thanks to its 3D display and virtual reality simulation capabilities.[10][11]

POP modelling can be used in BIM to provide complete data interrelationships, resulting in a more interactive model for better project planning, collaboration, and visualization.[12]

The effective building of Leishenshan Hospital was aided by all these traits.

2.2. CONSTRUCTION OF MEDICAL HOSPITALS IN VARIOUS COUNTRIES-

2.2.1. COVID-19 HEALTHCARE RESOURCES SPATIAL ACCESSIBILITY: A CASE STUDY FROM ILLINOIS, USA-

The severe acute respiratory syndrome coronavirus 2 (SARSCoV-2) has created a novel coronavirus disease that has spread throughout the world. Around 1.6 million coronavirus cases had been confirmed worldwide as of April 10, 2020, with over 475,000 persons sick and over 17,000 deaths in the United States alone. Hundreds of thousands of individuals have been admitted to hospitals as a result of the virus.[6]

2.2.2. A CASE STUDY IN THE TURKISH TERRITORY HEALTHCARE SERVICE ON HOSPITAL PREPARENESS AGAINST THE COVID-19 PANDEMIC. –

Hospitals must have finished their preparations prior to the outbreak of the pandemic in order to deal with the issues it poses. As a result, this work provides an integrated approach to the hospital preparation assessment problem based on a decision-making paradigm using interval-valued spherical fuzzy sets.

The WHO checklist has been tweaked to meet Turkey's COVID-19 pandemic response requirements. Turkey is one of the world's top six countries in terms of overall number of tests, and it is rapidly growing.[7]

2.3. TO TACKLE COVID-19, SPECILIZED FIELD HOSPITALS ARE BEING DELIVERED EXTREMELY QUICKLY-

2.3.1. FANGCANG SHELTER HOSPITALS ARE AN INNOVATIVE APPROACH TO DEALING WITH PUBLIC HEALTH CRISE-

Wuhan, China's capital and the provincial capital of Hubei, was the epicenter of the COVID-19 outbreak. As of March 27, 2020, COVID-19 confirmed cases in Wuhan made up nearly 60% of all confirmed cases in China.

To combat the coronavirus disease outbreak in 2019, Fangcang shelter hospitals were built and deployed for the first time in China. The Fangcang shelter hospitals' performance during the Chinese coronavirus pandemic implies that they could be useful in future public health emergencies, such as new epidemics, and large-scale disease or injury situations, such as mass poisonings or natural catastrophes. [5]

The Fangcang shelter hospitals can quickly set up and provide a huge number of hospital beds, as well as excellent non-life-threatening medical care.[5][6]

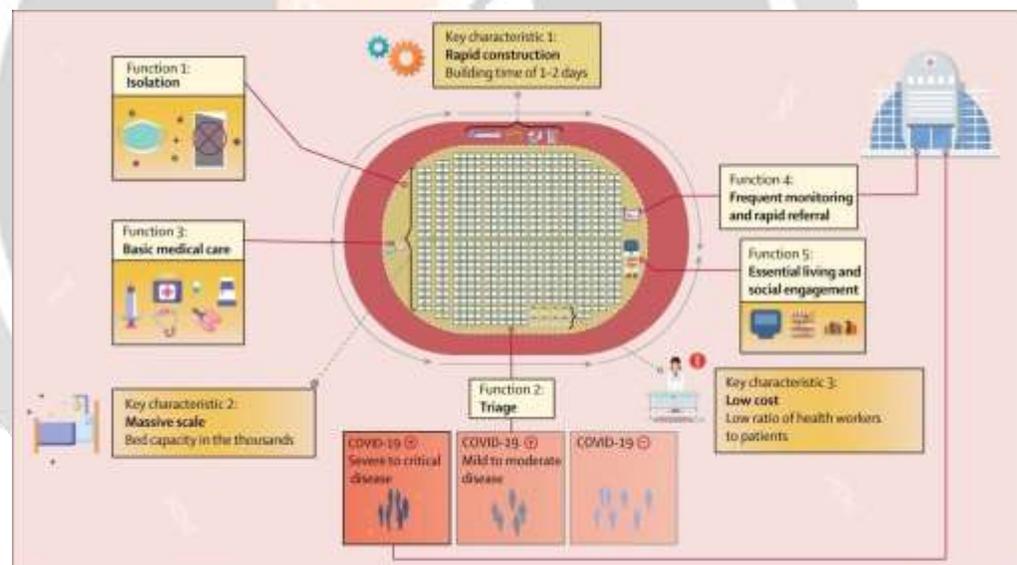


FIG5. Fangcang shelter hospitals [5]

2.4. THE CURRENT SITUATION OF CHINA'S PUBLIC HEALTH EMERGENCY MANAGEMENT IN RESPECT TO COVID-19 AND THE ISSUES IT FACES-

COVID-19 has quickly expanded throughout most countries, resulting in a once-in-a-generation global health emergency. As of August 10, 2020, there has been 19,718,030 verified COVID-19 cases and 728,013 deaths worldwide. Policymakers and hospitals were unable to adapt quickly enough to the unexpected development, causing global healthcare to experience unprecedented turmoil. The World Health Organization labelled the outbreak a

pandemic on March 11, 2020, citing the substantial public health threats it posed. It's doubtful that the present healthcare system will be able to handle the outbreak.[6]

2.4.1. FOR THE COVID-19 PANDEMIC, AN EMPHASIS ON ISOLATION SPACE CREATION (ISC) MEASURES-

The Corona Virus Disease 2019, a global epidemic, has pushed several affluent countries' healthcare systems to breaking point. Coronavirus has caused a lack of healthcare facilities such as hospital bed spaces and ventilators as a result of its quick dissemination and high transmission rate. The worst-affected countries have implemented a variety of methods to slow or stop the virus's spread.[13]

2.4.2. IMPROVEMENTS IN LAWS AND REGULATIONS, AS WELL AS THE CONSTRUCTION OF A HEALTH EMERGENCY SYSTEM-

The Chinese government has consistently prioritized health emergency management, changing attitudes, and responding rapidly to major public health situations while also updating critical laws and regulations. At the same time, the creation of emergency management systems has accelerated. Following the 2003 SARS pandemic, the Chinese government made emergency planning and regulation a top focus [6]

2.4.3. IMPROVED EARLY WARNING AND MONITORING SYSTEM-

Surveillance systems play a big role in early warning systems. In order to analyze and manage public health emergencies, many countries have put in place similar systems.[6]

2.4.4. THE EMERGENCY MATERIAL MANAGEMENT SYSTEM IS BEING IMPROVED ALL THE TIME-

The amount of emergency medical supplies kept on hand by health administration departments or hospitals determines the amount of emergency medical supplies available. Many public health disasters have occurred since the 2003 SARS pandemic, resulting in a significant demand for emergency supplies in a minimum period of time, exposing a personal protective equipment stockpile shortfall. As a result, all levels of the Chinese government realized the importance of having medical supplies on hand in the event of a public health emergency, and a reserve medical supply system was established.[3][6]

3. HOW MAY INDIA'S HEALTHCARE SYSTEM BE IMPROVED?

The new coronavirus pandemic is the worst public health disaster in human history. It is forcing governments all around the world to examine their health-care systems more closely.

Instead of simply anticipating a "return to normal" once the immediate crisis has passed, it is time for India to engage in a societal debate about the need for a paradigm shift in our health system. There are various points that we consider it –

- The importance of tertiary healthcare should not be prioritized-
The much-anticipated Pradhan Mantri Jan Arogya Yojana under Ayushman Bharat was intended to be a game changer: it lets patients to use a government insurance scheme to attend private hospitals. While acknowledging that private hospitals have a role to play in the care of extremely ill Covid-19 patients, the health insurance scheme's method of enlisting private providers appears to be insufficient.[8]
- Private healthcare providers must now and in the future meet public health requirements-
Governments have long supported private healthcare to operate as a lucrative "business" dominated by profit-driven corporate hospitals. During the outbreak, it became clear that commercial private players could not be left to their own devices because they have vital public health responsibilities to fulfil. However, there is little legal framework in place to ensure that these commitments are met on a regular basis.[8]

4. HOSPITALS ARE BEING FORCED TO EXPAND DUE OF THE COVID-19 PANDEMIC-

With a nationwide recovery rate of 49.21%, the health-care system has had to learn quickly about telemedicine, personnel protection, and infrastructure improvements in order to ensure that all Covid-19 patients receive treatment.

Hospitals have been obliged to adapt with limited infrastructure, space, and personnel resources, particularly those designated as Covid-19 treatment hospitals in various states. Healthy patients were separated from suspected and Covid-positive patients early in the pandemic; the focus shifted to critical care treatment; hospitals staggered staff schedules to decongest wards; and e-consultations and remote management of chronic conditions such as diabetes and heart disease were scaled up.

In India's healthcare system, private hospitals are extremely essential. Many people turn to them when they have serious health issues. Despite severe legislation and lockdown, COVID-19 cases are on the rise, with a spike expected once lockdown is lifted. We have devised and applied several techniques for better preparedness to handle the surge of this pandemic as one of the largest multispecialty hospitals and a designated COVID center from other countries.[8]

5. STUDY OBJECTIVE-

A coronavirus epidemic is sweeping India, as it does the rest of the world (COVID-19). The private sector is the backbone of an Indian healthcare facility. Only a few large facilities in the country are now treating COVID-19 patients, while others are struggling due to a lack of manpower, administration, and experience with the epidemic. Despite the lockdown, the number of patients is increasing, and every hospital in the country should be prepared to deal with the first pandemic in history. Following the onset of the 2019 novel coronavirus epidemic in Wuhan, China, in January 2020, the escalating number of confirmed and suspected cases outstripped the admitting capacity of the designated hospitals.

To adequately prepare for the pandemic's onset, we must devise and implement a number of strategies. We'd want to share our experience and hope that the solutions created and implemented by China and many other countries would assist many other acute care facilities in India.

6. METHODOLOGY DESIGN-

To assess the development possibilities of how India should adopt strategies to build hospitals during pandemics in the future, the methodologies of system analysis, structural and functional analysis, content-analysis and event-analysis, expert assessment, and prognostic approach were used. To deal with the COVID-19 pandemic's crisis, different solutions have been implemented. During the pandemic, we created solutions to address the issues of administration, hospital organization and supply management.

We gathered linked relevant material that supports or contradicts the factors listed in the research's Introduction Section, and then conducted our analysis based on the findings.

7. FINDINGS AND CONCLUSION-

COVID-19 has wreaked havoc on public health services. Wuhan, the COVID -19 epicenter, had significant challenges in terms of medical supply and hospital admitting capacity. The establishment of two specialized field hospitals, Huoshenshan Hospital and Leishenshan Hospital was a crucial approach in the outbreak's combat. The construction of these two hospitals took less than ten days, saving time and ensuring the health of approximately 5,000 people.

Building a good and scientific emergency management system takes time and effort. In order to develop an emergency management mode for public health circumstances that is acceptable to India, it is vital to overcome present issues and learn from established foreign countries such as China and others' models and experiences.

One of the main objectives of the Chinese government is to examine the consequences of disasters and improve disaster management. As a result, the goal of this research was to evaluate China's current condition of health emergency management, as well as India's flaws and concerns. The findings could help the government and other health-care organizations improve India's emergency-care system.

8. CONCLUSION-

Pandemics are best fought with enough troops, equipment, supplies, and expertise. The most significant aspects of our preparations, however, are the planning and rationalization of resource usage in resource-limited contexts. Measures done immediately will assist lessen the burden on tertiary and secondary hospitals and improve documentation, data collecting, diagnosis, and care without jeopardizing patient or health worker safety.

This section examines the lessons learned from the outbreak in order to improve public-private sector collaboration-

- Many countries are realizing that health-care capacity cannot be built amid a crisis. A good public health system takes time and money to develop. For decades, India has neglected to invest in health, and this must change post-Covid19. At a minimum, health spending should rise to 2.5 percent of GDP.
- A scarcity of emergency personnel and inadequate emergency funds must be improved.

Our method to preparing for the COVID-19 pandemic may not have been the best, but we believe the core management concepts we followed will help many other countries discover the best path to combat the epidemic.

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