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Building Pathology and COVID-19: A Literature Review and Commentary on Field Hospital Setting

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Abstract

In 2019, there was an emerging disease, namely Coronavirus 2019 (COVID-19). This disease firstly emerged in Asia before there was a worldwide spreading. COVID-19 is highly contagious. The pandemic results in more than 100 million infections worldwide (by the end of January 2021). Each country has to have a good public health plan to correspond with the increasing number of the patient. To correspond with the rapid increase in the number of COVID-19 patients, finding for sufficient space for patient care is needed. The presently available number of hospitals might be limited and it usually requires an urgent setting of the new building for management of the situation. The field hospital is usually set. In this work, the authors performed a retrospective literature review to summarize the available data on building pathology and COVID-19. The aim of the study is about the quality of the field hospital buildings and the defects in the buildings. The standard databases, SCOPUS and PubMED are used for literature searching. The derived publications are summarized and extracted for a conclusion. According to the literature analysis, there are very few publications on the topic of building pathology of a field hospital for COVID-19 containment. The role of field hospital in outbreak management is confirmed in thee literature. However, the specific report regarding building pathology of field hospital is limited. The newly constructed field hospital is usually in the rapid emergency mode. Based on the present analysis, it can show that there is a lack of concern on building pathology of the field hospital. Due to the rapid construction of field hospitals for COVID-19 outbreak management, the quality control and standardization are important. Further researches on the building pathology and quality management of field hospital are recommended.

Keywords: Coronavirus, pandemic, medical, site, structure

1.0 INTRODUCTION

In 2019, a new disease, COVID-19 was firstly detected in Asia. It firstly appeared as a mysterious disease resulting in a group of patients with a common history of visiting to a market (Hsia, 2020). After in depth investigation, the new pathogen, SARS CoV-2 was identified and the new disease was declared. This disease is a new viral infection and can cause respiratory disease. Since the disease can spread from human to human via respiratory contact. The disease rapidly spread and becomes a worldwide spread disease at present (Hsia, 2020). This new disease has already caused more than 100 million infected persons (by the end of January 2021). To correspond with the great number of the patient, each country has to have a well disease containment plan. Adding to active case search, it is necessary to have a good medical system to passively counteract with the influx of patients during the outbreak.

The place of management of the patient is necessary for management of an outbreak. The hospital is a basic place for management of the patient. In each area, there are usually a fixed number of hospitals with a certain capacity to correspond to an amount of patients. However, when an outbreak occurs, the rapid increasing in the number of patients occurs and it might affect the local health service system. The problem of limited medical facilities might occur. To correspond to the rapid increase in the number of COVID-19 patients, finding for sufficient space for patient care is needed. The presently available number of hospitals might be limited and it usually requires an urgent setting of the new building for management of the situation. The field hospital is usually set. However, the newly constructed field hospital is usually in the rapid emergency mode. The present stress induced by COVID-19 pandemic is a specific situation that the academic society total lacks in experience. The in-depth situation analysis will be useful for giving and starting lessons learnt. The building pathology of the field hospital becomes an interesting issue that is limited mentioned in the literature.

Due to the present COVID-19 pandemic, many new field hospitals were constructed and during the construction process. The building pathology is a possible problem for any kind of buildings including to hospital building. Since there are rapid increased numbers of field hospitals, the data on building pathology of the buildings are important and timely issues. Since there is a lack on the report

regarding construction of field hospital for COVID-19 management, it is rational to perform a study on this specific issue and this is the motivation of the present research. In this article, the authors specifically reviewed and discussed on the building pathology and COVID-19 with special focus on field hospital. In the present research, a retrospective literature review for determining the defect/pathology and quality (design and sufficiency) of the field hospital buildings is done.

■2.0 LITERATURE REVIEW

2.1 Field Hospital

Hospital is a place for medical activity. In general, a construction of a hospital has to be well planned and it usually takes time. However, the hospital is some urgently required. In some specific situation, it might not be able to fulfill a complete requirement for construction of s a hospital. Field hospital is the term used for a specifically set hospital to correspond to a specific situation in a hard manner with limitations. A field hospital is usually set in an area with a serious situation such as natural disaster or war. The limited facilities are common and become a challenge in maintaining a field hospital service (Martin et al., 2010). For the first setting, the design and organization of field hospital is an important issue. It is necessary to confirm for the efficacy and safety of the field hospital buildings (Bricknell, 2001).

The good maintenance of field hospital is necessary. How to administer a limited resource to serve the service is a challenge. Donation of medical facilities and volunteer medical personnel are useful for operating a field hospital after a crisis (WHO/PAHO, 2003). It is also necessary to keep a standard of the place setting. Without a good standardization, there might be an unexpected problem in a field hospital. For example, if there is no good sanitation and environmental management planning, the emerging infectious disease might occur within field hospital. For example, due to a poor ventilation design in a field hospital building, an outbreak of chicken pox can occur (Hepburn & Brooks, 1991).

2.2 Building Pathology of Field Hospital

Basically, a hospital must be carefully designed and built. The good engineering control is necessary since a good primary construction means a good function of the building and it will do no harm in the future (Anderson, 2019). The materials have to be well selected and should be durable and can prevent signal interference (Hanada et al., 1998). The quality control of construction is important. However, there might sometimes be a building pathology due to several reasons such as poor construction technique, serious external insult or aging of the structure. A good architectural design might provide the flexibility of hospitals to change over time, but it cannot prevent the problem of building pathology resulted from a poor construction process. Without a good maintenance plan, the hospital building pathology can easily occur (Olanrewaju et al., 2018). The building pathology might be seen in the general hospital building. It might also be seen in the field hospital building, but it is little mentioned. In fact, the rapid construction of a field hospital might increase risk of building pathology and it is necessary for having a good control system (Zhou et al., 2021). Therefore, it is hereby focused for analysis in the present article.

■3.0 METHODOLOGY

The present study is designed as a retrospective study. In this work, the authors performed a retrospective literature review to summarize the available data on building pathology and COVID-19. The standard biomedical literature summative analysis according to guidelines proposed by Cooper et al. (2018) was followed. For the retrospective study, database searching was firstly done. The standard databases, SCOPUS (www.scopus.com) and PubMED (www.pubmed.com) are used for data searching. Only reports in the English language are included for further analysis. The derived publications are summarized and extracted for a conclusion.

Based on the technique proposed by Hopia et al. (2016), the authors used the standard medical bioinformatics technique for literature searching and interpretation. The searching tools are standard databases, SCOPUS and PubMED, which are the international referencing scientific databases. The computational database uses Boolean approach for operation (Wilczynski et al., 2005). The key words for searching include “field hospital”, “COVID”, “building” and “pathology”. The keywords are keyed as query terms for database searching. The databases are online computational tools that have an automatic function for matching search terms and provide the best matched records data, the related publications. The derived key word matched literatures are extracted for full assessment. The content validation of the literature is done to drive final recruited literature for further summative analysis. The summarization on the core concept of the finally recruited literatures is done. The exclusion is set for any literature with limited data or lack of complete data.

■4.0 RESULTS OF DATA ANALYSIS

According to the database search, there are 109,940 publications on COVID-19 but there are only 57 publications regarding the pathology of field hospital for COVID-19 (searched on 28 February 2021). After content validation, only 5 are finally recruited for final summative analysis. The summarization of the available data is done and the results are specifically described in different aspects as the following subheadings.

4.1 Field Hospital and COVID-19 Outbreak Containment

As already mentioned, the COVID-19 usually rapidly spreads when it emerges in a new setting. The limitation of the available medical facilities during the outbreak is a common situation. It is necessary to find the sufficient facilities within the short period to counteract the rapid progress of disease outbreak. The setting of the new hospital becomes the new approach. The new field hospital can serve the rapidly increasing number of patients. Additionally, it is an effective way for isolation of problematic infectious case from the other patients. This is a useful application in asymptomatic mild COVID-19 cases that require quarantine management.

The good example of field hospital construction is the field hospital in Wuhan, China during the 2019 outbreak. The construction of the new field hospital, Leishenshan Hospital project, gives many lessons to the followers (Luo et al., 2020). This specific field hospital is a big field hospital covering an area of 34 000 m2 with 1,000 beds. This new field hospital is a model in further study in civil engineering regarding a rapid construction of a building in an emergency mode (Zhou et al., 2020). After this referencing model, there are many other newly set field hospitals. In some poor developing countries, a simple temporary tent is used and claimed as a field hospital, which is an issue for consideration on building standardization. Until present, although there are many reports regarding COVID-19, there are limited reports on field hospital. Some important reports are hereby presented (Table 1).

Table 1 Some reports on field hospital and COVID-19

Authors	Details
Chaudhary et al. (2021)	Chaudhary et al. (2021) discussed on many limitations on the facilities for patient care in field hospital.
Li et al. (2020)	Li et al. (2020) discussed on Fangcang shelter hospitals during the COVID-19 epidemic. They concluded that, "*while the designated hospitals saved lives of patients with severe COVID-19, it was the increased hospital-bed capacity of the large number of Fangcang shelter hospitals that helped slow and eventually stop the COVID-19 epidemic in Wuhan*" (p. 830).
Luo et al. (2020)	Luo et al. (2020) discussed on lessons learnt from ultra-rapid delivery of specialty field hospitals to combat COVID-19, the Leishenshan Hospital project in China. They noted that, "*adhering to a product, organization, and process (POP) modeling approach combined with building information modeling (BIM) allowed for the ultra-rapid creation, management, and communication of project-related information, resulting in the successful development of this fully functional, state-of-the-art infectious disease specialty hospital*" (p. 1077).
Liu et al. (2020)	Liu et al. (2020) discussed on laboratory diagnostics within a modular field hospital at the time of COVID-19 in Wuhan. They mentioned for requirement of special plan for the laboratory area setting within the field hospital building.
Zhou et al. (2020)	Zhou et al. (2020) discussed on construction of 5G all-wireless network and information system for cabin field hospitals. They noted for the importance of communication system in the field hospital.

Based on Table 1, it can be concluded that there are some studies on the field hospital building for COVID-19 management. Most studied are usually on the arrangement of infrastructure facilities. The best examples are the studies on how to design the communication system and how to arrange the limited area into different sections for different medical activities. However, there is a lack for study on the quality of the building.

4.2 Building Pathology and COVID-19 Outbreak

In the general situation, the under standard hospital building still exists. For example, the case of a hospital building that is out of building standards in the United States is proven to be at risk of collapse from an earthquake (McCue & Thompson, 2012). As noted by Barten et al. (2019), the building pathology of hospital building is sometimes forgotten and there were some reports on collapse of some parts of the hospital that causes a disaster event to both patients and medical personnel.

Therefore, it is no doubt that the problem might exist, but forgotten during COVID-19 pandemic. As already mentioned, the field hospital is usually set to contain the COVID-19 outbreak. Many field hospitals might be roughly constructed. In a rapid manner, the quality control of construction becomes an issue to be focused on the new building. The building pathology might occur. The building pathology might be due to the background, geography and landscape, materials (such as stone) use for construction, construction engineering technique and interior design and management. It is usually focused on the rapidness of constructing; therefore, the neglected controlling of quality might be possible. Nevertheless, in many settings, the local people might not accept for having a new field hospital for COVID-

19 in their community. The setting has to be done in abandoned area and the old abandoned building has to be adapted for use. In that case, of using abandoned building, it usually lacks for complete investigation on safety and the building pathology might exist.

■5.0 DISCUSSION

According to the present research, there are limited data regarding field hospitals in the present COVID-19 pandemic crisis. Although there are many reports on COVID-19 worldwide, the specific studies on hospital building are extremely limited. Many reports on field hospitals during COVID-19 outbreak focus on the medial service and workflow organization (Spagnolello et al., 2020). A lack of reports on the field hospital building is seen. There might be an overlooking on the importance of building pathology of field hospital building that is used for field management of COVID-19 patients. With a rapid construction, there might be a lack of quality control and this might further lead to some building pathological problems. It seems that there is no knowledge on how to set a proper safe field hospital building to correspond to a big pandemic. There should be an urgent collaboration internationally from building pathology academicians to study on specific issues on building pathology of COVID-19 field hospital.

Regarding the quality of the field hospital, there is no standard guideline for designing and construction. Additionally, the insufficient field hospital is a common problem worldwide. Due to a rapid demand, many field hospitals might be built with the lack of a good quality control.

The control of field hospital building construction becomes an interesting issue for further studies. It is no doubt that the pandemic results in a very rush manner of construction. The problem of under standardized construction procedures might be expected. A very rush manner of construction might help rapid correspondence to emerging disease, but it might mean a lack of safety. Indeed, a rapid response to pandemic usually brings a question on the quality. For example, the COVID-19 vaccine is rapidly designed and launched and it becomes a critique issue from scientific society on the efficacy and safety (Sumon et al., 2021). Similarly, the rapidly built COVID-19 field hospital might bring the problem and there must be a standard for control of field hospital building for COVID-19 containment.

Regarding COVID-19 field hospital, there is still no report on incidence due to building pathology. However, there is already a report on the collapse incidence of COVID-19 quarantine site (https://www.aljazeera.com/news/2020/3/8/china-coronavirus-quarantine-hotel-collapse-kills-10). Hence, it is no doubt that the quality control of the setting of a COVID-19 field hospital is very important.

■6.0 CONCLUSION

In this short commentary article, the authors focus a consideration on the possible building pathology issue on the presently set field hospital for COVID-19. The problem of field hospital insufficiency is common. There is also a lack of studies on building pathology of field hospital buildings. Although the knowledge on hospital buildings is available, there is a lack of specific knowledge regarding field hospital buildings. The rapidly increasing in number of patients leads to an urgent need of medical care place and rapid construction of the field hospital. Nevertheless, the control of newly constructed or modification of the old abandoned place for using as field hospital is needed. The present study can imply the need for the development of studies on field hospital buildings and consensus for setting guidelines for controlling the design and construction of field hospitals.

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