TOP 10 RESEARCH ACHIEVEMENTS

Mobile and Extendable Negative Pressure Clinic Module For Contagious Disease Hospital Service

Department
Department of Industrial Design

Principal Investigator
Tek-Jin Nam

Homepage
http://mcm.kaist.ac.kr

To solve the shortage problem of negative pressure wards in the pandemic situation, we developed Mobile Clinic Module (MCM), a modular negative pressure ward system that enables building, effectively transporting, and storing medical environments for moderate to severe patients in a short time. MCM enables stepwise negative pressure conversion and effective air circulation in the ward. MCM addresses the requirement of usability, emotional satisfaction as well as functionality, utility and cost. It can also be used for various mobile healthcare facilities.

1. Background

In a pandemic situation, such as COVID-19, the demand for negative pressure wards to treat infectious patients surges. Existing prefabricated buildings have been focused only on quarantine, which makes it difficult to support medical activities. We addressed this problem by design-centric approach considering the needs of various stakeholders such as medical staff, patients and administrators.

2. Contents

Key Features of Mobile Clinic Module (MCM)

MCM is a modular system for building negative pressure ward. It supports rapidly installation, effective transportation and storage. MCM considered usability and emotional satisfaction as well as the basic requirements of bio-safety, cost and efficiency.

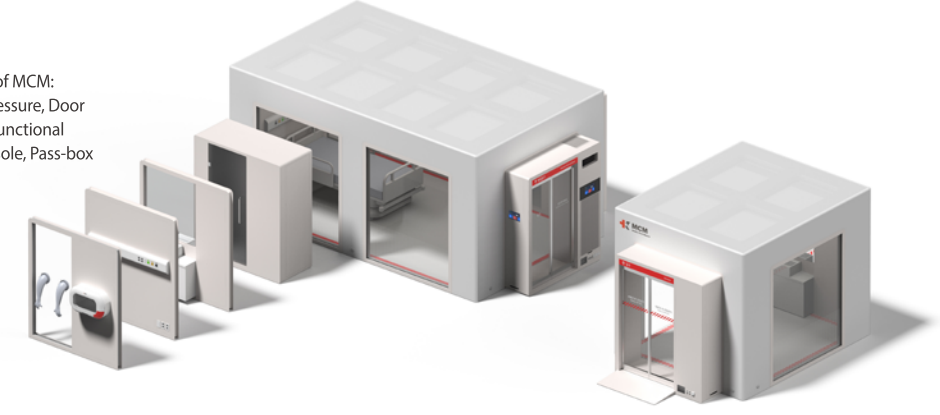

Figure 1.
Main components of MCM: Frame (Negative Pressure, Door etc.), Air tent, and Functional panel(Medical Console, Pass-box and Globe etc.)

MCM's main components are Frame, Air tent and Function panel. It is possible to build various medical facilities by assembly of three. The key component is the negative pressure frame which effectively makes differential pressure spaces. The air tent makes it easy and quick to install rooms. The air pressure is kept by the sensing system. The functional panel reinforces the structural stability of the tent while providing functional support. The medical panel supplies essential medical gas. The glove & pass box panel can be used to transfer objects without wearing protective clothing.

The basic MCM unit consists of the anteroom and the patient room can be installed within about 15 minutes. Compared with the reconstruction method, it reduce costs by about 80%. When stored, the volume is reduced by about 75%, the weight by 60%. The whole ward can be transported by air.

Design Development and Evaluation

MCM was developed through user-centered design and iterative prototyping. We have understood the processes for hospitalization and treatment of infected patients through collaboration with medical staff. Within four months, user-research, design, prototyping and the ward construction have been completed. We received positive feedback from the clinical evaluation done at the Korea Institute of Radiological and Medical Sciences' outdoor parking lot space with 500-square-meter where the ward is installed.

Figure 2. A negative pressure ward in the Korea Institute of Radiological & Medical Science

Figure 3. Inside of the negative pressure ward

3. Expected effects

MCM will become an essential quarantine system in the infectious disease crisis situation that will be repeated periodically. It will prevent the collapse of medical system in emergency. During the normal period, it will minimize unnecessary ward extensions. It can be used as a variety of medical facilities such as mobile hospital, emergency beds in residential treatment centers and screening clinics as well as the isolation ward.

Research outcomes

The study aimed at practical use in the COVID-19 crisis situation, and the negative pressure isolation ward installed in the Korea Institute of Radiological & Medical Science is the main achievement.

[Patent] Assembled Modular System for Building Positive and Negative Pressure Facilities (2021. 1. 27. Korean Patent Registration confirmed)
Eight cases including the negative pressure frame for the mobile negative pressure ward construction, the mobile negative pressure ward unit including the anteroom, the mobile negative pressure ward unit for the intensive care unit negative pressure, the medical equipment panel for the mobile negative pressure ward construction, the mobile negative pressure ward construction globe and pass box panel. (2020. 12. 10. Application)

[Award] Red Dot Award: Product Design 2021, Best of the Best