HVAC System Design and Practices to Minimize COVID-19 Risks

An Online Continuing Education Course for Engineers

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The global outbreak of Severe Acute Respiratory Syndrome, SARS-COV-2, commonly known as COVID-19 or Coronavirus, has caused serious damages to public health, communities, and the global economy. The World Health Organization (WHO) declared COVID-19 as a pandemic-causing respiratory illness (like the flu) with symptoms such as a cough, fever, difficulty breathing, body ache, etc.

As per the current knowledge and definition of modes of transmission by the Centers for Disease Control and Prevention (CDC), there is the possibility that the spread of COVID-19 may occur through airborne particles in indoor environments. The residual droplets containing SARS-Coronaviruses can travel through air currents caused by Central Air-conditioning System ducts, where all or some air in the building is circulated and can contribute to the spread of the disease to other patients, workers, and visitors in a healthcare facility. The CDC has thus recommended keeping the suspected Corona patients in specially designed ventilated rooms referred to as isolation rooms.

The most important approach to lowering the concentrations of airborne contaminants, including any viruses, is to increase ventilation, maintain pressure gradients, and high-level filtration. This course focuses on the design of ventilation, filtration, air recirculation system, and associated engineering controls in Healthcare Isolation Rooms based on an industry-wide consensus and guidelines published by (CDC, ASHRAE, WHO, AIA, and FGI).

The intended audience for this course includes building owners, architects, HVAC engineers & designers, facility operators, service and maintenance personnel, infection control specialists, EH&S professionals, and anyone who is interested in pandemic control.

Key Learning

The HVAC systems should be designed to achieve the following key objectives.

- HVAC services that deliver the anticipated levels of comfort and functionality
- A zero-tolerance approach to patient safety and infection control
- Types of isolation rooms and their functions
- Role of ventilation, air changes, and pressure gradients
- Appropriate pressure differentials between isolation rooms and the adjacent spaces.
- HEPA Filtration concepts to isolation facilities
- Air distribution concepts and pressure monitoring
- Up-gradation of general-purpose healthcare rooms to temporary isolation centers
- Challenges and compliance with the applicable codes and standards
- Safe infection control practices other than HVAC services

Contents

1.0. Chapter 1: Disease Transmission & Isolation Rooms

Coronavirus disease (COVID-19), technically known as "Severe Acute Respiratory Syndrome, SARS-COV-2," was initially identified in an outbreak of viral pneumonia in Wuhan, the Republic of China, in December 2019. The spread of Coronavirus has caused a considerable degree of fear, worry, and concern with an exponential growth of people being infected worldwide daily.

As per the current knowledge and definition of modes of transmission by the Centers for Disease Control and Prevention (CDC), there is the possibility that the spread of COVID-19 may occur through airborne particles in indoor environments. The healthcare workers are at the front line of the COVID-19 outbreak response, and as such, are exposed to hazards that put them at increased risk of infection. The CDC has, therefore recommended keeping the suspected Corona patients in specially designed ventilated rooms referred to as isolation rooms.

The intent of this course is to mitigate the risks of COVID-19 virus transmission by the heating, ventilation, and air-conditioning (HVAC) system in healthcare and non-healthcare using ASHRAE guidelines in conjunction with other International Health Guidelines outlined by the CDC, WHO, and OSHA.

1.1 Modes of Disease Transmission

There are five main modes of transmission of microorganisms:

a. Contact transmission
b. Droplet transmission
c. Airborne transmission
d. Common vehicle transmission
e. Vector-borne transmission

1.1.1. Contact Transmission

Contact transmission is the most important and frequent mode of transmission of nosocomial infections (Hospital-Acquired Infections). It is subdivided into two groups: direct-contact and indirect-contact transmissions.

a. Direct-contact transmission involves direct body-to-body contact, resulting in the physical transfer of microorganisms between a susceptible host and an infected person, such as when a healthcare worker turns a patient, gives a patient a bath, or performs other patient-care activities. Direct-contact transmission can also occur between two patients, with one serving as the source of the infectious microorganism and the other as a susceptible host.
b. Indirect-contact transmission occurs when a susceptible host has contact with a contaminated, usually inanimate, intermediate object, such as contaminated instruments, needles, or dressings, or contaminated hands that are not washed, and gloves that are not changed between the handling of patients.

1.1.2. Droplet Transmission

Droplet transmission is a form of contact transmission. However, the mechanism of transfer of the microorganism to the host is quite different from contact transmission. Droplets are generated from the source person primarily during coughing, sneezing, and talking, and during the performance of certain procedures such as suctioning and bronchoscopy.

Transmission occurs when microorganism-fille… …m the infected person are dispersed through th… …e, nasal mucosa, or mouth. Because drop… …r handling and ventilation are not rec…

Note: droplet transmis… …sion.

1.1.3. Airborne Transr…

This type of transmissio… …s airborne droplet nuclei or dust particles. S… …evaporated and concentrated droplets (k… …s remain suspended in the air for long periods… …n the patient room or travel over long distanc… …ese microorganisms can be infectious dependi… …droplets.