

HVAC Considerations for Converting Patient Rooms to Infection Isolation Rooms or Protective Environmental Rooms

Introduction

The COVID-19 pandemic has shown the need for flexibility in hospitals to address an increased patient population with suspected airborne-transmissible diseases while protecting immunosuppressed patients who are especially susceptible to those diseases. The Facility Guidelines Institute (FGI) *Guidelines for the Design and Construction of Hospitals*, inclusive of ASHRAE Standard 170, provides requirements for Protective Environment (P.E.) rooms, Airborne Infection Isolation (A.I.I.) rooms, and combined A.I.I./P.E. rooms. P.E. rooms are intended for immunosuppressed patients, and A.I.I. rooms are intended for infectious patients (primarily those with infections spread through airborne transmission). The differences between P.E. rooms, A.I.I. rooms, and other patient rooms are the requirements for filtration and positive or negative air pressure relative to adjoining spaces. This paper will discuss some of the HVAC challenges associated with converting a standard patient room to an A.I.I., P.E. or A.I.I./P.E. room.

Conversion Design Considerations

The first step is developing an Infection Control Risk Assessment (ICRA) which assesses the risk of surface, air, and waterborne infection and the effectiveness of controls for reducing that risk. The ICRA addresses infection control of the patient room(s) to be converted and other areas impacted by that construction.

Next, the mechanical engineering team must perform a complete analysis of the existing HVAC system serving the room to be converted to ensure all issues noted in the ICRA and requirements of the FGI *Guidelines* are addressed. Analysis of the new application should review sufficiency of outdoor air; supply air capacity; exhaust air capacity and discharge conditions; cooling capacity; heating capacity; humidification/dehumidification; and control systems. Table 7.1 of ASHRAE Standard 170 requires patient rooms have a minimum of 4 total air changes per hour (ACH) with 2 ACH being outdoor air; A.I.I., P.E. and A.I.I./P.E. rooms require a minimum of 12 total ACH with 2 ACH being outdoor air. Where the total ACH cannot be achieved from the central system for converted rooms, HEPA-filtered recirculated air may be used. The outdoor air changes are still required in these applications.

Anterooms provided at A.I.I., P.E., and A.I.I./P.E. suites must have appropriate pressure relationships to both the patient room and the corridor as defined in ASHRAE 170 Chapter 8. Differential pressure between the A.I.I. room and adjacent non-A.I.I. rooms must be a minimum of -0.01 in. WC (-2.5 Pa). Differential pressure between P.E. rooms and adjacent non-P.E. rooms must be a minimum of +0.01 in. WC (+2.5 Pa). Anterooms serving A.I.I., P.E., or A.I.I./P.E. rooms must have their own air terminal units for both supply and exhaust for reliable control of differential pressure relationships (see NIH DRM 6.1.15). Differential pressure conditions must be controlled and monitored, including visual displays at each door with magnehelic gauges, or digital readout.

Diffusers for P.E. and A.I.I./P.E. rooms must be a non-aspirating type and located directly over the patient bed to wash the patient area with air and minimize entrainment of other air within the space, which reduces potential cross-contamination between a patient and caregiver. Providing non-aspirating diffusers directly above the patient bed can direct high velocity air onto a patient, though, resulting in discomfort; as a result, air velocity and temperature must be carefully analyzed/controlled by the design using ASHRAE Standard 55 and good engineering practice. This may include high accuracy sensors, larger diffusers, and fast-acting air valves and coil actuators to maintain a comfortable patient environment.

Exhaust air from the A.I.I., P.E., and A.I.I./P.E. suites, toilet room air, and anterooms must be exhausted directly outdoors. In converted P.E. and A.I.I./P.E. rooms, the exhaust grilles or registers shall be located near the patient room door. A.I.I. rooms shall have the exhaust grille directly above the patient bed or at the headwall.

Requirements for commissioning, testing, and certification must be included in the design documents to ensure the facility functions as intended and provides a safe environment for patients and caregivers. Architectural aspects of conversion of patient rooms to P.E., A.I.I. and A.I.I./P.E. rooms will be addressed in a future article.

Additional Reference

1. Guidelines for the Design and Construction of Hospitals, by The Facility Guidelines Institute. 2018 Edition
2. ANSI/ASHRAE/ASHE Standard 170-2017, Ventilation of Health Care Facilities

