Aim to Maintain High-Quality Air Throughout Your Facility

The Joint Commission has identified the need to increase the field's awareness and understanding of the Life Safety Code*.* To address this need, The Joint Commission Perspectives* publishes the column Clarifications and Expectations, authored by George Mills, MBA, FASHE, CEM, CHFM, CHSP, director, Department of Engineering. The Joint Commission. This column, co-authored this month with Dick Moeller, PE, FASHE, HFDP, CHC, LEED AP, principal, Mazzetti (Lynwood, Washington), clarifies standards expectations and provides strategies for challenging compliance issues (primarily in life safety and the environment of care, but also in the vital area of emergency management). You may wish to share the ideas and strategies in this column with your facility department's leadership.

The clean air that flows throughout a hospital is something that most patients—and staff—take for granted. However, working behind the scenes is a complex and sensitive mechanical system that must function continuously and consistently to support optimal patient care. Although environment of care (EC) leaders recognize the importance of high-performing ventilation equipment—called HVAC (heating, ventilation, and air-conditioning) systems—surveyors continue to identify ventilation issues during surveys. The following sections take a closer look at the key role HVAC systems play in sustaining a safe environment.

A Brief Background

HVAC systems maintain the building environment within a desired range, independent of outdoor conditions, providing year-round control of temperature, humidity, airflow (pressurization), and filtration. Although air management is necessary throughout a building to foster patient comfort and healing, it is especially critical in areas where patients or patient care supplies and equipment (for example, pharmaceuticals, sterile instruments, supplies) are most at risk, such as in operating rooms or oncology units.

In the health care setting, a primary function of the HVAC system is to keep the air free of airborne contaminants, such as viruses, bacteria, and spores, which may exacerbate a patient's current condition, cause illness, or even lead to death in highly vulnerable patients, such as an immunocompromised individual. Although health care-acquired infections come mainly from contaminants found on surfaces, humans, and devices, the HVAC system plays an essential role in minimizing the spread of contaminants and infection.

The Joint Commission addresses how the HVAC system controls airborne contaminants in Standard EC.02.05.01, Element of Performance (EP) 6, which states: “In areas designed to control airborne contaminants (such as biological agents, gases, fumes, dust), the ventilation system provides appropriate pressure relationships, air-exchange rates, and filtration efficiencies.” The EP lists the areas that must be designed for control of airborne contaminants, including operating rooms, special procedure rooms, delivery rooms, laboratories, and so on. Although the list is extensive, it is not exhaustive, and organizations should refer to the Facility Guidelines Institute’s (FGI’s) Guidelines for Design and Construction of Health Care Facilities, 2010 edition, for more complete information. (Note that the FGI Guidelines incorporate the American Society of Heating, Refrigerating and Air-Conditioning Engineers’ [ASHRAE’s] Standard 170, Ventilation of Health Care Facilities for ventilation requirements. This standard establishes the minimum requirements for air system construction, space environmental conditions, filtration levels, and pressure relationships.)

Directing Air Flow

Consistent control of directional airflow is a significant factor in preventing the spread of airborne contaminants. Air should move from clean to dirty spaces, particularly in higher-risk locations. For example, the HVAC system delivers conditioned air into the operating room, which is positively pressurized (pushing air out from the space). Outside the operating room, the sterile corridor is also positively pressurized, but less so than the operating room, allowing air to move from the operating room outward into the sterile corridor (from most clean to less clean). The negatively pressured and soiled utility room draws air in but does not let contaminated or soiled air leave the area. Hence, the air...
that originates in the operating room moves into the sterile corridor and is drawn to the negatively pressured and soiled utility room.

Maintaining the appropriate pressure relationships requires continued effort, as the HVAC system must reliably provide the correct amounts of both supply air and return/exhaust air from each space. Many conditions outside the control of the HVAC system, such as building design and construction, open doors and/or windows, and improperly designed and operated equipment, can affect the HVAC system's ability to maintain code minimum pressure differentials. Even systems meeting the initial criteria for design, construction, and operation will likely change over time and, therefore, may not continue to provide the original pressure differentials between spaces.

Many critical areas in hospitals now use different methods to ensure that they uphold proper space pressure differentials. These methods can be simple visual indicators, digital or analog pressure readouts, and/or alarm systems, all of which serve to notify staff that spaces are in compliance or have fallen outside the necessary pressure relationships.

Managing Outside Air
The percentage of outside air allowed in different spaces is mandated by various guidelines and codes, including those from the Centers for Disease Control and Prevention (CDC) and ASHRAE. Depending on the space, a combination of outside air and reconditioned internal air is often required. In some cases, 100% outside air, where the entire amount of air delivered to a space is from outside the building, is permissible. In addition to considering the minimum code requirements when determining the right amount of outside air, building designers must consider additional factors, including, but not limited to, odor control, the need to “flush” the space, occupant activity, and potential occupancy use.

A 100% outside air system is not always the best choice for some healthcare spaces, as outside air is often significantly contaminated with particulate (dirt, allergens, bugs, spores, viruses, and so on) that can cause problems for vulnerable individuals. Outside air has to be conditioned before it can be introduced into a healthcare facility, which involves filtration, heating, or cooling, and possibly humidification or dehumidification, depending on outside conditions. Conditioning 100% outside air for use in a healthcare space can be costly because the HVAC system has to work harder and use more energy than it does when conditioning inside air or a combination of recycled and outside air.

Reliable Filtration
To keep air clean, an HVAC system must include a process to ensure a minimum level of cleanliness. A key element of this is the air filter. The industry used to employ a nonstandard method for measuring air filter efficiency, which led to some inconsistency across organizations. To standardize air filter performance, ASHRAE designed a ratings scale known as MERV (minimum efficiency reporting value). This scale supports filter rating accuracy and consistency, improving consistent, reliable efficiency and reducing the cost of HVAC design while preserving patient safety.

ASHRAE Standard 170 has specific minimum requirements regarding the location and efficiency of HVAC filtration. With few exceptions, a hospital HVAC system requires two filter banks in patient care areas. The first houses a primary filter (MERV 7) that removes large particulate (lint, leaves) and is necessary to keep the HVAC unit clean. This type of filter is common to all building types. The second filter (MERV 14) removes particulate small enough to pass through the primary filter, including any additional contamination that might occur from the HVAC equipment.

Organizations should regularly check that the correct filters are in place, maintained, and functioning normally. This limits the chance of filter system component damage, which may create the potential for particulate bypass and the introduction of airborne contaminants into a high-risk space. Organizations should also verify that filters are appropriately reinstalled when replaced. For example, the filters need to be properly seated within the frame, and there should be no leakage occurring in or around the frame.

Keeping Systems Efficient While Minimizing Risk
HVAC systems used to be more static. However, with the advent of new technology, many organizations are dynamically controlling their HVAC systems to respond to facility demand while still providing a protective environment for patients and staff. Although this approach is beneficial in terms of efficiency and energy consumption, a dynamic system can introduce risk if not monitored closely.

For example, less-critical spaces within the hospital that used to be rigidly controlled at constant volume (that is, the airflow into and out of the space never changed) are now permitted to fluctuate in response to space demands. Some of those areas have no pressure differential requirement, which allows the space to fluctuate from positive to neutral or to negative. Consequently, there is a need to recognize and compensate for the effect of changing pressure differentials in different locations.

Similarly, organizations are now allowed and even encouraged to take advantage of technology to reduce total airflow during periods of nonuse for energy efficiency in
critical spaces within a hospital, such as operating rooms. However, during these periods, only a reduction of total airflow is permitted and the space is required to maintain the code-mandated temperature/humidity and pressure differentials relative to surrounding locations. This can be accomplished through dynamic flow control components in both the supply and return/exhaust systems, which are controlled in sequence through strategically located sensors and may be connected to an alarm and/or monitoring system.

**Keep an Eye on the HVAC**
The configuration and operation of hospital HVAC systems can range from simple to complex, but all HVAC systems serve the basic function of temperature and humidity control plus the more critical activities of filtration and pressure differential maintenance. To comply with Joint Commission standards as well as other regulations governing ventilation, organizations should regularly monitor critical areas, checking for functioning HVAC equipment, proper temperature, humidity, airflow, and filtering. Moreover, they should have methods for responding to issues, thereby reducing risk before it leads to patient safety hazards.

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*This month's column, which also appears in the August 2014 issue of Environment of Care* News, explains how HVAC systems help preserve patient safety. Next month’s column will continue to discuss compliance issues related to the environment of care.*