A SAFE AND FUNCTIONAL ENVIRONMENT

Technical Information Paper 59-026-0514

PURPOSE. To provide compliance strategies for the Joint Commission's safe, functional environment standards that includes understanding —

- How hospitals establish and maintain a safe, functional environment
- How the physical setting impacts patients' well-being
- The features of a safe, functional environment in a hospital setting
- The importance for hospitals to prohibit smoking except in specific circumstances
- How hospitals manages their environments during demolition, renovation, or new construction to reduce risk to those in the organization
- How to manage HCW involvement in maintaining a safe and functional environment

See Appendix A to test your knowledge of the key principles for creating and maintaining a safe and functional hospital environment.

REFERENCES. Comprehensive Accreditation Manual for Hospitals, 2014, The Joint Commission One Renaissance Blvd. Oakbrook Terrace, IL 60181.

INTRODUCTION

A hospital's physical environment (PE) influences patient outcomes, satisfaction, and safety. The physical space in which care is given also affects the patients' family members and the healthcare workers (HCWs) providing the care. The PE must be clean, comfortable, appropriately furnished, and provide privacy and space that allows HCWs to work efficiently. In addition, the PE should support and stimulate patient healing.

The Joint Commission does not specifically address how a hospital should incorporate the many aspects of a safe, functional and healing environment. However, there are several things that should be considered, including; provisions for space, accessibility, light, ventilation, noise, cleanliness, and furnishings, especially when designing and

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constructing new and renovated spaces. When designed into and managed as part of the PE, these elements create suitable surroundings that support patient care and dignity, allow ease of interaction with staff and family members, and reduce safety and health risks.

Engaging Activity

Evidence-based design (EBD) is a field of study that emphasizes the use of credible evidence to influence the design process to measurably improve patient and worker safety, clinical outcomes, environmental performance and operating efficiency. Some key initiatives of EBD include single-patient rooms, noise-reducing construction materials, easily accessible work stations, and improved floor plans for patients and HCWs. Studies show that when designed into and managed as part of the PE, these EBD elements influence well-being, promote healing, relieve patient pain and stress, and reduce health acquired infections (HAIs), medical errors, and patient falls.

Click here to learn more about how EBD can have a positive effect on patients and HCWs: http://www.youtube.com/watch?v=6afKavZbw7YObjectives . After viewing this video please list some of the EBD initiatives mentioned that can be researched and implemented within your healthcare facility.

FACTS

The Hospital Establishes and Maintains a Safe, Functional Environment

A healing environment is a psychologically supportive, physical setting designed to reduce stress and help patients and families cope with illness, hospitalization, and bereavement. The environment is constructed, arranged, and maintained to cultivate patient safety, provide facilities for diagnosis and treatment, and provide for special services appropriate to the needs of the community.

When interior spaces meet the needs of the patient population and are safe and suitable to the care, treatment, and services provided, the result is reduced stress on the patient, facilitation of faster healing, and the promotion of wellness.

The layout and design of the optimal health care facility should do the following:

- Meet the needs of patients
- Promote staff efficiency
- Comply with the Americans with Disability Act (ADA)
- Promote wayfinding
- Control circulation and flow

Meeting Patient Needs

The best health care facility designers are those who design patient care areas to accommodate families. They empower patients by giving them more control over temperature, lighting, privacy, visitation, and the type and volume of music to decrease stress and improve healing. Also, providing adequate space for patient rooms, waiting and reception areas, treatment areas, examination rooms, storage, and staff space is essential. It is also important to provide age-specific furnishings for pediatric and geriatric patients. Finally, it is critical to minimize patient walking distances by consolidating outpatient services for more efficient operation. The first floor is ideal for direct access by outpatients.

Promoting Staff Efficiency

An optimal health care facility design also promotes staff efficiency by minimizing the travel distance between frequently used spaces, such as the distance between the emergency room and radiology. Grouping or combining in-patient services with similar system requirements and functions is also helpful, such as locating the surgical intensive care unit adjacent to the operating suite. Support spaces (waiting rooms, soiled and clean utility rooms, housekeeping closets, etc.) should be located so that they may be shared by adjacent departments.

Staff efficiency is improved when hoists and other ergonomic technologies are provided to protect nurses and enhance patient safety while lifting, turning, and transporting patients. Decentralized nursing stations allow easy visual supervision of patients by limited staff and reduce fatigue and additional time walking between the nursing stations and the patients' rooms. An efficient logistics system (elevators, pneumatic tubes, box conveyors, manual or automated carts, and gravity or pneumatic chutes) is essential for the efficient handling of food and cleaning supplies and the removal of waste, recyclables, and soiled material. Centralized storage of supplies reduces the amount of time nurses waste while hunting for and gathering supplies.

Complying with the Americans with Disabilities Act and Architectural Barriers Act (ADA-ABA) Guidelines

The ADA-ABA guidelines are adopted by the Department of Defense and they are good resources when improving accessibility within the health care facility. Some of the ADA-ABA's requirements are to ensure that grades are flat enough to allow easy movement, and that sidewalks and corridors are wide enough for two wheelchairs to pass easily. The ADA Standards also stipulate that entrances are designed to accommodate patients with slower adaptation rates to dark and light. Marking glass walls and doors to make their presence obvious is important as well. March 15, 2012 was the compliance date with the 2010 Americans With Disabilities Act (ADA) Standards for new construction and alterations.

Wayfinding

Wayfinding is the process of using spatial and environmental information to find one's way in the PE. Patients, visitors, and staff all need to know where they are, what their destination is, and how to easily get there and return. Building elements, color, texture, and pattern as well as artwork and signage can be used to effectively give directions and make typical routes simple and clearly defined.

Controlling Circulation

A hospital is a complex system of interrelated functions requiring constant movement of people and goods. Much of this circulation should be controlled. A well-designed facility creates simple, direct routes that–

- Allow outpatients to visit diagnostic and treatment areas without traveling through inpatient functional areas and encountering severely ill inpatients,
- Allow visitors access to patient nursing units without having to go through other patient care functional areas, and
- Prevent patients and visitors from wandering into industrial or logistical areas or floors.

Trash, recyclables, and soiled materials should be separated from the movement of food and clean supplies, and both should be separated from patients and visitors routes. Of course, the transfer of human remains to and from the morgue should always be kept out of the sight of patients and visitors. Much of this can be accomplished by providing dedicated service elevators for movement of clean supplies, waste, and building maintenance services.

Features of a Safe and Functional Environment

A safe and functional environment consists of the following features:

- Lighting is suitable for care, treatment, and services.
- Proper ventilation, temperature, and humidity levels are suitable for the care, treatment, and services provided.
- Areas used by patients are clean and free of offensive odors.
- The hospital provides emergency access to all locked and occupied spaces.
- The hospital keeps furnishings and equipment safe and in good repair.

Lighting

Lighting design is a major factor in creating a healing environment and preventing medical errors. Choosing the right lighting can be complicated, as patients, HCWs, and even visitors all have unique needs. For example, lighting should de-institutionalize a facility by creating the look and feel of a home environment to help patients and visitors relax. At the same time, appropriate lighting is needed so that HCWs can see well enough to accurately do their jobs.

Patients. Considerations for lighting include –

- Ensuring general lighting includes access to natural daylight and outside views wherever possible. Such lighting reduces depression among patients with seasonal affective disorder or bipolar depression and decreases length of stay in hospitals. Natural lighting can also improve sleep and circadian rhythms, lessen agitation among dementia patients, and ease pain,
- Installing bed lighting that provides multiple light levels to allow adjustment based upon patient preferences,
- Installing ceiling-mounted luminaries that diffuse the light, allowing comfortable light for normal activities and reducing discomfort glare for patients in prone or reclined positions, and
- Installing night lighting that illuminates the floor and provides a clear path to the bathroom or doorway in the darkened room, while minimizing sleep disruption.

Also, different types of patients have differing clinical needs for lighting, these needs may include:

- Geriatric – provide indirect lighting to avoid glare.
- Newborns – minimize light in neonatal intensive care units (NICUs) and well-baby nurseries to avoid retinal damage.
- Well-baby nurseries – provide sunlight without direct sun to establish a natural circadian rhythm, a daily routine, and promote development.

The need to create a pleasant and efficient working environment for HCWs is essential, especially for staff who may work for long periods without access to natural daylight. Lighting solutions that mimic the effects of daylight have been proven to increase feelings of wellbeing amongst workers, improve efficiency, and improve worker retention. Increased lighting levels can reduce worker stress and errors associated with charting, filling prescriptions, administering medication, and performing other critical patient-care tasks. Also, as people get older, their need for light increases due to reduced transmittance of aging eye lenses. The average nurse age is 47, and 50 percent of volunteers are over age 65.

Lighting considerations to enhance HCW performance include –

- Installing separately controlled exam lighting that delivers higher level intensity over the entire bed for examination, as well as for performing minor procedures. Color rendering and correlated color temperature are important considerations for visual acuity and accurate interpretation of the patient's pallor, skin, and tissues.
- Independently illuminating hand-washing sinks in patient rooms with sufficient intensity for task effectiveness while minimizing glare and disruption to the patient.

- Installing night lighting to allow HCWs safe passage through the room at night without disrupting the patient.
- Installing low-level observation lighting that allows nighttime viewing of patients without disrupting their sleep.
- Installing adequate and appropriate lighting in areas where critical medical tasks, computer work and other administrative tasks are performed.

Visitors. Visitor lighting considerations include –

- Installing separate lighting in the visitor area within the patient room to allow glare-free, visually comfortable reading and ambient illumination that will not disturb the patient.
- Providing high-quality, glare-free lighting in waiting areas.

Ventilation, Temperature and Humidity

Hospital heating, ventilation, and air conditioning (HVAC) systems control air temperature, air flow, air quality and humidity. HVAC systems directly affect the comfort, safety, and health of all building occupants. The variables for implementing an effective hospital HVAC system are broad. For example, HVAC systems must be designed and maintained to promote occupant comfort, enhance infection prevention and control, protect sensitive equipment and supplies, and minimize hazards in an emergency by –

- Providing fresh air and thermal comfort for patients, HCWs, support personnel, and visitors.
- Maintaining air-pressure relationships, such as positive pressure in operating rooms, intensive-care units, nurseries, and protective-environment rooms and negative pressure in airborne-infection isolation rooms and soiled utility rooms.
- Maintaining special ventilation requirements in autopsy, sterile supply rooms, operating rooms, intensive care units, immunosuppressed patient floors, and neonatal care units, to name a few.
- Containing and removing airborne biological and chemical contaminants that have the potential to compromise patient and HCW safety.
- Maintaining appropriate temperatures in pharmacies and drug storage areas where 'temperature dependent' drugs are stored.
- Maintaining appropriate temperatures in information technology and server rooms and in ambulance and control rooms that have heat-producing equipment which can easily fail or malfunction in extreme air temperatures.
- Detecting fires and eliminating smoke from exits and exit enclosures.

Additional Reading

Requirements to ensure high-quality ventilation can be found in a new standard written by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and the American Society for Healthcare Engineering (ASHE).

ANSI/ASHRAE/ASHE Standard 170-2013, Ventilation of Health Care Facilities, defines ventilation system design requirements that provide environmental control for comfort, as well as infection and odor control. Indoor Air Quality Guidelines are set out by the Centers for Disease Control (CDC), the Facility Guidelines Institute (FGI), and the Joint Commission (TJC).

Clean and Free of Offensive Odors

Hospitals must be easy to clean and maintain, free of unwanted matter, soil and illness causing germs. This can be accomplished by –

Choosing appropriate and durable finishes for each functional space

- Careful detailing of doorframes, casework, and finish transitions to avoid dirt-catching and hard-to-clean crevices and joints.
- Providing adequate and appropriately located housekeeping spaces.
- Using special materials, finishes, and details for spaces which are to be kept sterile. New antimicrobial surfaces should be considered for such locations.

Operations and maintenance practices that will maintain indoor environmental quality include –

- Controlling dust by maintaining barrier floor mats and using high efficiency vacuum cleaners.
- Cleaning floors, maintaining carpets, and preventing accumulation of excess moisture or cleaning residue.
- Controlling moisture, leaks, and spills by drying surfaces promptly, preventing build-up of moisture condensation, and maintaining the building envelope, including the roof. Note: water-damaged, porous building materials, or furnishes may have to be replaced if they are not dried and cleaned within 24 hours.
- Controlling pests by using integrated pest management methods as part of the overall building maintenance program.

Proper hygienic cleaning includes a blend of cleaning processes and effective surface disinfection. Effective cleaning processes include –

- Selecting the right Environmental Protection Agency-registered, hospital-grade disinfectant for the job and using the proper concentrations with the proper dwell time.
- Cleaning protocols that include special focus on high-touch surfaces; for example door handles, light switches, phones, and keyboards.
- Effective soil removal by using advanced tools and equipment such as color-coded microfiber cleaning cloths and flat mops; multi-filtration, high efficiency particulate air (HEPA) vacuums that filter soil, allergens and pathogens to 0.3 microns; and touch-free, spray-and-vac systems.

- Waste removal procedures that separate, isolate and contain unwanted substances and regulated medical waste in soiled utility rooms. Designated waste removal routes should be away from general traffic.

Sources of unpleasant odors include chemical odors from medicines, chemical disinfectants and cleaning products, sick rooms, bacteria, mold, mildew, and food to name a few. Further, unpleasant odors, such as cigarette smoke, maintenance chemicals, and vehicle exhaust, can be drawn inside the building through the HVAC air intakes. Some remedies for indoor air quality issues include –

- Providing proper ventilation and maintaining the HVAC systems.
- Establishing clear procedures for recording and responding to indoor air quality complaints.
- Promptly identifying and repairing all water leaks and water damaged areas.
- Choosing products that emit low or no volatile organic compounds when purchasing replacement carpets, flooring, office furniture, paints, disinfectants and cleaning products.
- Following the manufacturer's instructions for the use of all disinfectants and cleaning products.
- Properly storing cleaning and maintenance chemicals with containers tightly sealed.
- Following an Integrated Pest Management system to prevent risks related to use of pesticides.
- Avoiding the use of air fresheners and room deodorizers which can cause eye, nose, and throat irritation.
- Properly storing all foods and disposing of trash promptly.

Locked and Occupied Spaces

Doors may be locked where the clinical needs of the patients require specialized security measures or where the patients pose a security threat, provided that **ALL** of the following are met:

- Staff can readily unlock doors at all times (keys are carried at all times or staff can unlock doors remotely).
- Smoke detection is provided throughout the area, or doors can be unlocked remotely from an approved, constantly attended location within the locked space.
- A sprinkler system is provided throughout the locked space which will open the locks in the event the system is activated.
- The locks are electrical locks that automatically release in the event of a fire or other emergency.
- The locks are electrical locks that fail safely so as to release upon loss of power to the device.
- The locks can be opened in the event of the activation of the smoke alarm system.

Furnishings and Equipment

Furniture in a health care facility must be safe and in good repair, sturdy and stable, and free from cracks, loose bolts or screws and other signs of damage. Furniture should be made of textiles that resist moisture, stains, odor, bacteria, fungus and fire and that can be easily cleaned and disinfected. Furnishings should have smooth, clean lines and minimal cracks and crevices that eliminate areas where dirt or bacteria can be harbored. Being able to wipe out dirt and debris between the seat and the back is essential for chairs and sofas.

Furniture should be weighted so that it cannot be tipped over easily. Tables in the form of cylinders and cubes are virtually tip-proof. Edges and corners should be rounded to minimize the potential for injury. Table tops should be made of wood veneer or plastic laminate. Glass-top tables in patient care areas should be avoided. Lamps should have weighted bases and a tip-resistant design. A locking finial helps prevent unauthorized removal of the lamp shade. Lamps should be equipped with a three-prong, grounded, UL-approved plugs. Lamps used in psychiatric, Alzheimer, and substance abuse areas must be equipped with a bulb enclosure that restricts access to the bulb and socket area.

Specialized furniture and equipment may be necessary to address the safety and health issues for a variety of patient populations, including behavioral health, bariatric, pediatric, and geriatric patients as well as their family members and visitors.

- Behavioral health patients must not be able to turn furnishings into weapons. This is a critical safety issue. In addition, facility managers should ensure the following is done in behavioral health areas:
  - Identify and remove or replace non-breakaway hardware (for example, install appropriate shower heads, shower bars, and closet bars and weight test all breakaway hardware).
  - Install tamper-resistant electrical outlets and tamper proof screws in ventilation diffusers.
  - Redesign, retrofit or introduce security measures (for example, locking mechanisms and patient monitors and alarms).

Additional Reading

The National Association of Psychiatric Health Systems' "Design Guide for the Built Environment of Behavioral Health Systems" provides detailed guidance that will minimize safety and health risks in behavioral health areas.

- Bariatric patients are those patients who weigh from 300 to 1,000 pounds. Improving safety and health in bariatric care includes–
  - Providing adequate space and equipment (for example, larger waiting and family lounges to support obese family members and ambulatory patients and

family wash rooms that provide toilets that are floor mounted, not wall mounted).
  - Ensuring an adequate number of inpatient rooms on each unit are designed for bariatric patients that can accommodate larger furniture, ceiling lifts, and the increased turning radius needed for wheelchairs and equipment.
  - Providing wider wheelchair clearances throughout the facility.
  - Providing more hand rails and reinforced hand rail mountings.
  - Providing toilet rooms of 70 square feet vs. the typical 50 square feet to allow for two staff members and a wheelchair.
  - Providing extra-wide patient beds, gurneys, wheelchairs, walkers, and extra-wide stretchers in ambulances with wider doors.
  - Providing higher-capacity bed scales at the point of entry.
  - Ensuring higher PSI rating of flooring material and plumbing fixtures.
  - Providing bariatric chairs with expanded widths, up to 40 inches, that can support a minimum of 700 pounds. Some furniture can withstand 1,400 pounds dead load weight. Reinforced arms are an integral part of bariatric seating.

Another important consideration is to ensure the furniture used in bariatric care areas does not appear obviously different. It should be designed so as not to overpower the space it occupies, and it should blend well with other furniture in the area.

The U.S. Department of Veterans Affairs offers a “Safe Bariatric Patient Handing Toolkit” that contains further information on reducing safety and health risks when working with bariatric patients. The 2010 edition Facility Guidelines Institute “Guidelines for the Design and Construction of Healthcare Facilities” includes information on uses of patient lifts and patient and caregiver safety.

- Pediatric units – Minimizing safety and health risks in pediatric care areas include:
  - Providing tamper-resistance electrical receptacles.
  - Providing pediatric furniture that helps make children as comfortable as possible, both physically and psychologically. Chairs, tables, and therapeutic seating are available in small scale versions that fit the needs of children. Whimsical touches such as vibrant colors and child-friendly images on upholstery can make the medical environment seem less scary.
  - Using nontoxic materials and finishes are essential for children’s furniture. The furniture must be able to withstand heavy use and harsh cleaning products.
  - Making sure that any metal hardware, such as bolts and screws, are concealed and the furniture is constructed so that very few of these are needed. A minimum number of joints in the furniture will lessen the chance of

small fingers being pinched. Rounded edges and corners further improve safety.
  - Stability is essential for pediatric furniture. Given a chance, children can be depended upon to climb and stand on tables and chairs. The furniture should be designed so that it is not easy to tip over.

- Geriatric patients– Safety considerations in geriatric patient care areas include:
  - Providing special senior-friendly lighting, soft colors, and noise abatement features.
  - Providing hand rails.
  - Providing special flooring that reflects light in a way that makes missteps less likely.
  - Providing thicker mattresses to reduce pressure.
  - Providing blanket warmers.
  - Providing telephones with larger buttons.
  - Providing special pillow speakers to make listening to music or watching television more comfortable.
  - Eliminating excess furniture that may create a tripping hazard.
  - Adjusting self-closing doors so that they don't close too quickly.
  - Making sure that the seat height of chairs and sofas is at least 18 inches from the floor.
  - Providing seating that is stable and of high-quality construction so that it does not tip easily.
  - Making sure that all chairs and sofas have arms and the ends of the armrests are easy to grip. In addition, the arms should be at a proper height and of sufficient strength that people can use the arms to support themselves when getting in or out of the chair. Seat depths that are shallower than typical lounge seating are easier to exit.

Noise Reduction

Constant noise can produce an increased heart rate, stress, confusion, cardiac problems, disrupted sleep patterns, decreased cognitive function, and altered hormone levels in patients. Noise-induced stress is contagious, impacting the attendant family member who eventually winds up at the nurses' station complaining about a variety of issues, each worsened by extraneous noise.

These symptoms are not unique to patients. HCWs who work in noisy environments for long shifts, day in and day out, have similar stress-induced experiences, making them vulnerable to exhaustion, burnout, and depression. The Joint Commission mentions noise as a potential risk factor related to medical and nursing errors.

Noise reduction activities include:

- Controlling noise at the source. Patients often complain that the noise they experience comes from staff, hallway noise, other patients, double rooms, roommates, equipment, technology, and general hospital noise.
- Using noise reducing acoustical ceiling tiles and walls.
- Increasing staff awareness by educating staff on the effects of noise on patient healing.
- Taking baseline decibel (dB) readings in various locations within the facility (e.g., main center nurses' station, first and last room on each side of the unit (odd- and even-side hallways) during various times and days of the week. Facilities should set goals for 40 dB during the day and 35 dB during the night, as recommended by the World Health Organization.
- Installing sound meters (stoplights at nurses stations: red – unacceptable noise level; yellow – increasing noise level; green – acceptable noise level) to warn staff when noise levels are above unacceptable limits
- Reducing overhead calls.
- Monitoring alarm panels, medical equipment monitors, telephones, and interactive toys and develop polices to turn down tones on phones and nurse call systems at night.
- Locating report areas away from patient rooms.
- Establishing a maintenance program for wheeled carts to keep them from squeaking.

Auditory privacy

The auditory environment plays a big role in Health Insurance Portability & Accountability Act (HIPAA) compliance. In the hospital setting, nurses and physicians appropriately exchange critical information at the right time and in what is now labeled as the right place. To ensure auditory privacy–

- Use high-performance acoustical ceilings to absorb sound within a space.
- Block sound transmission between spaces with a combination of high performance ceilings and effective wall and furniture design and layout.
- Cover the remaining intruding sound within a space by using an evenly distributed, comfortable sound masking system that can be adjusted to meet the desired privacy level.

Additional Reading

ASTM E 1130 describes a means of measuring speech privacy between spaces, while ASTM E 1374 describes the acoustical principles and interactions that affect the acoustical environment and speech privacy in an open space. Similarly, ANSI Standard S 3.5 discusses a method of measuring the intelligibility of speech.

The Hospital Prohibits Smoking except in Specific Circumstances

Health care facilities should develop a written policy prohibiting smoking in all buildings. The policy should specify exceptions for patients in specific circumstances, and those circumstances should be well defined. If the hospital decides that patients may smoke in specific circumstances, it designates smoking areas that are physically separate from care, treatment, and service areas. The hospital should take action to maintain compliance with its smoking policy.

Note: The Joint Commission treats electronic cigarettes (E-cigarettes) the same as conventional smoking materials. Learn more about the hazards associated with the use of E-cigarettes by clicking on this hyperlink.

The Hospital Manages its Environment during Demolition, Renovation, or New Construction to Reduce Risk to Those in the Organization

Joint Commission Standard EC.02.06.05 spells out the need to design and build safe facilities that meet patient needs. The Army's Unified Facilities Criteria (UFC) 4-510-01, Design: Medical Military Facilities, 1 November 2012 and the Guidelines for Design and Construction of Health Care Facilities, 2014 edition, administered by the Facility Guidelines Institute and published ASHE are valuable references for hospital design.

Preconstruction Infection Control Risk Assessment (PICRA)

Building occupants must be protected against fire hazards and other risks related to air quality requirements, infection control, utility requirements, noise, vibration, and other hazards that affect care, treatment, and services in occupied spaces during demolition, construction or renovation activities.

The PICRA is a multidisciplinary risk assessment used to identify and mitigate the risks from infection in an occupied healthcare building during construction or maintenance. Successful use of a PICRA involves the following four steps:

- Identify key personnel involved in completing a PICRA.
- Recognize health and safety hazards associated with construction and renovation projects.
- Use the PICRA to identify measures to mitigate infection risk.
- Implement and monitor the effectiveness of activities used to mitigate risk.

Construction is a recognized risk factor for HAIs in immunosuppressed patients such as those experiencing bone-marrow transplants and healthy patients in compromised high-risk situations such as in an operating room. The disturbance of dust; the infiltration of unfiltered outdoor air; the disruption of HVAC systems; and water leaks resulting in mold growth have led to life-threatening and fatal infections with environmental fungi such as *Aspegillus*, *Fusarium, Scedosporium*, zygomycetes, and soil-borne bacteria such as

Nocardia. Disruption of water and water filtration systems can result in infection from waterborne bacteria such as Legionella.

A PICRA should be conducted on all projects, from a minor repair to major construction. The size or cost of the project is not a predictor of the activities that will lead to an increased risk to the building occupants' safety and health.

The PICRA should be a continuous process. Compliance should be monitored routinely by a PICRA team. The PICRA team should be multidisciplinary, and include:

- Infection Control Officer
- Facility Manager
- Architect/Contractor
- HCWs from affected areas
- Safety/Occupational Health Manager
- Industrial Hygienist
- Risk/Patient Safety Manager
- Epidemiologist
- Housekeeping

PICRA team members should review and discuss the scope of the project, timelines, and any issues that arise as the project progresses. In addition, the PICRA team must inspect the construction area to make sure that the selected infection control measures are put in place and to monitor their effectiveness throughout the project. The PICRA and all inspections must be documented.

Construction and renovation in the hospital setting come from a variety of activities that can lead to environmental problems that compromise the safety and health of the building occupants, including patients, HCWs, visitors, volunteers and even the personnel performing the maintenance, renovation, construction, and demolition work. Such construction activities include the following:

- Routine preventive maintenance
- Renovation
- Construction
- Demolition
- Landscaping
- Clean-up of damage after a natural or manmade disaster

Some general considerations when beginning a project are the following:

- Project design. Design considerations begin with the HVAC system. Airborne contamination can result when HVAC systems are improperly designed, built, or maintained. Ventilation systems are an important infection control tool. Water systems should limit waterborne pathogens like Legionella. Hand washing sinks

and emergency eyewash devices should be plumbed into the domestic water supply. Finally, special care should be given to finishes and surfaces to insure that they are easy to maintain, clean and repair, and do not support microbial growth.

- Infection control risk mitigation. Infection control risk mitigation should begin with attention to the location and the scope of the project and the placement of high-risk patients relative to the project. It should also include an assessment of the potential impact on areas located adjacent to the proposed construction area.
- Construction activities. Construction considerations begin with a focus on the building and site areas anticipated to be affected by construction and include an assessment of external as well as internal construction activities.
  - *Disruption of essential services*. Considerations should include the impact of potential outages or emergencies and the protection of patients during planned or unplanned outages and the availability of written plans for emergencies such as water outages, water leaks, and possible shut-down of the HVAC systems. Such plans must identify who is responsible, who needs to be notified, and the specific actions to take.
  - *Construction hazards*. Some examples of actions to take to manage risks associated with construction hazards are setting up barriers and other measures to protect adjacent areas; designating routes to bring in construction equipment and materials and to remove waste and debris; keeping HCW and visitor foot traffic near construction zones to a minimum; limiting the introduction of toxic substances, protecting construction workers against occupational exposure to inorganic dusts; using wet methods to reduce dust; establishing cleaning schedules and procedures; and designating hand washing sinks, bathrooms, and food facilities for construction workers' use.
  - *Ventilation.* Ventilation of the construction zone is important, as is using anterooms and tacky mats to contain airborne contamination, dust and dirt.
  - *Storage and fire safety.* Facilities must designate appropriate storage areas to prevent construction materials and debris from blocking the means of egress and from accumulating and adding to the building's fuel load in the event of a fire. HCWs and construction workers must know alternate emergency exits and exit routes. Exits and exit routes should be well marked.
  - *Noise and vibration*. Noise and vibration can have an adverse effect on patients, especially NICU patients. In addition, vibration can adversely affect delicate surgical procedures and the quality of MRI and CAT scan images.

Tools and Resources – The PICRA Matrix

The PICRA matrix is a published assessment method that is widely accepted by engineers and architects, and is one effective method for completing a PICRA. The key principle for classifying projects is determining the degree of dust created, which is done through consideration of pre-construction, demolition, construction, post construction,

and cleanup activities as well as educational and monitoring needs, before, during, and after construction and renovation.

Use of the PICRA matrix follows four basic steps:

1. Classify the construction project into a specific construction type
2. Identify the patient risk group
3. Match the patient risk group with the construction type
4. Select appropriate infection control strategies to protect the building occupants from infectious agents

Step 1. Classify the project. The key principle for classifying projects is determining the degree of dust created. Consideration must be given to all phases of the project: pre-construction, demolition, construction, post-construction, and cleanup activities.

Table 1. Construction Type Matrix

Construction Type	Description
A	Inspections and non-invasive activities. Includes, but is not limited to removal of ceiling tiles for visual inspection, limited to 1 tile per 50 square feet; painting with minimal dust production; installing wall covering; electrical trim and minor plumbing work; and activities that do not generate dust or require cutting of walls or access to ceilings other than for visual inspections.
B	Small-scale, short-duration activities that create minimal dust. Includes, but is not limited to installation of telephone and computer cabling, access to chase spaces, cutting of walls or ceiling where dust migration can be controlled.
C	Any work that generates a moderate to high-level amount of dust or requires demolition or removal of any fixed building components or assemblies. Includes, but is not limited to sanding of walls for painting or wall covering; removal of floor coverings, ceiling tiles and case work; new wall construction; minor duct or electrical work above ceilings; major cabling activities; and any activity that cannot be completed within a single work shift.
D	Major demolition and construction projects. Includes but is not limited to activities that require consecutive work shifts, require heavy demolition or removal of a complete ceiling system, and new construction.

Step 2. Identify patient risk groups. Each facility should categorize patients per group within a specific patient population. The key principle used for categorizing patients is their susceptibility to infection.

Table 2. Patient Risk Groups Matrix

Low	Medium	Medium-High	High
• Office areas • Other	• Cardiology • Echocardiography • Endoscopy • Nuclear Medicine • Physical Therapy • Radiology/MRI • Respiratory Therapy	• CCU • Emergency Room • Labor & Delivery • Newborn Nurseries • Pediatrics • Out Patient Surgery • Pharmacy • Laboratories (specimens) • Post Anesthesia Care Unit • Surgical Unit	• Immuno-compromised Patients • Burn Unit • Central Sterile Supply • ICUs • Cardiac Cath lab • Medical Unit • Negative Pressure Isolation Rooms • Oncology Unit

Step 3. Match patient risk group with construction type. The project type should run down one axis, with the patient type along a second axis. The point where these two converge on the chart establishes the risk class or the amount of risk for the project, Class 1 being the lowest and Class IV being the highest risk.

Table 3. Risk Class Matrix

Construction Type				
Patient Risk Group	**A**	**B**	**C**	**D**
Low	I	II	II	III/IV
Medium	I	II	III	IV
Medium High	I	II	III/IV	IV
High	II	III/IV	III/IV	IV

Step 4. After this analysis is complete, the PICRA team can then identify the required precautions to take based on the level of risk and begin to implement the construction plan.

Table 4. Required Infection Control Precautions by Risk Class

Risk Class	During Construction Project	Upon Completion of Project
I	• Execute work by methods to minimize raising dust from construction operations • Immediately replace ceiling tiles displaced for visual inspection	• Clean work area upon completion of task
II	• Provide active means to prevent airborne dust from dispersing into atmosphere • Water mist work surfaces to control dust while cutting • Seal unused doors with duct tape • Block off and seal air vents. • Place dust mat at entrances and exits of work areas • Remove or isolate the HVAC system in areas where work is being performed	• Wipe work surfaces with cleaner/disinfectant • Contain construction waste in tightly covered containers before transport • Wet mop and/or vacuum with a HEPA filtered vacuum before leaving work area • Upon completion, restore the HVAC system where work was performed
III	• Remove or Isolate the HVAC system in the area where work is being done to prevent contamination of the duct system • Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal the area from the non-work area or implement a control cube method (cart with plastic covering and sealed connection to the work site with HEPA vacuum for vacuuming prior to exit) before construction begins. • Maintain negative air pressure within the work site utilizing HEPA-equipped air filtration units • Contain construction waste in tightly covered containers before transport • Cover transport receptacles or carts. Tape the covering unless solid lid is provided.	• Do not remove barriers from the work area until the completed project is inspected by the PICRA team and thoroughly cleaned by housekeeping • Remove the barrier materials carefully to minimize spreading of dirt and debris associated with construction • Vacuum the work area with HEPA- filtered vacuums • Wet mop area with cleaner/disinfectant • Upon completion, restore HVAC system where work was performed

Risk Class	During Construction Project	Upon Completion of Project
IV	• Isolate the HVAC system in area where work is being done to prevent contamination of the duct system • Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal the area from the non-work areas or implement a control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins • Maintain negative air pressure within the work area utilizing HEPA equipped air filtration units • Seal holes, pipes, conduits, and punctures • Construct an anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving the work site or they can wear cloth or paper coveralls that are removed each time they leave work site • All personnel entering the work site are required to wear shoe covers. Shoe covers must be changed each time the worker exits the work area	• Do not remove barriers from the work area until the completed project is inspected by the PICRA team and thoroughly cleaned by housekeeping • Remove the barrier material carefully to minimize spreading of dirt and debris associated with construction. • Contain the construction waste in tightly covered containers before transport • Cover transport receptacles or carts. Tape the covering unless a solid lid is provided • Vacuum the work area with HEPA -filtered vacuums. • Wet mop the area with cleaner/disinfectant. • Upon completion, restore the HVAC system where work was performed

The PICRA team should take the following steps when implementing the construction plan:

- Educate and train staff on the exit routes and the location of alternate exits and infection control precautions.
- Prepare and isolate the construction area.
- Monitor and document compliance and effectiveness.
- Schedule and conduct walk-through inspections.
- Maintain documentation of walk-through inspections.

Additional Reading

The APIC State-of-the-Art Report: The Role of Infection Control During Construction in Health Care Facilities provides a detailed explanation of the PICRA process.

Staff Involvement in Maintaining a Safe and Functional Environment

Human factors are used to describe the interactions between three interrelated aspects of work: the worker, the tasks performed, and the workplace itself. The goal of human factors is to make it easier for HCWs to carry out work in the right way and thereby improve effectiveness, efficiency, productivity, job satisfaction, and patient safety.

- The workplace includes safety culture, work patterns (for example, staffing levels, shift-work, part-time, flex-time, over-time, and telework), resources, communications, leadership, and teamwork to name a few. Such factors are often overlooked during the design of jobs but have a significant influence on worker behavior.
- The job includes the working environment, workload, nature of the tasks to be performed, and equipment used. Tasks should be designed according to ergonomic principles and take into account both human limitations and strengths. This includes matching the job to the physical and mental strengths and limitations of people. Mental aspects include situational awareness, attention, decision making requirements, stress and fatigue.
- An individual's competency, skills, personality, attitude, and risk perception play a role in worker behavior.

There are a number of human factors approaches used in healthcare today, and they include:

- Designing for standardization and simplicity. The probability of errors occurring is reduced when variability, mental workload, and decision-making are reduced. This approach makes deviations from normal procedures easier to detect, and it can reduce training needs and time needed to complete tasks.
- Designing for the most vulnerable, weakest or least able user. This ensures all system users, regardless of their language, age, experience, educational background, and physical characteristics are capable of carrying out critical tasks safely.
- Including users in the design process. Involving system users in work decisions and planning (for example, design of forms, ward layout, storage, recordkeeping, and procurement of equipment and devices) increases ownership and commitment, increases worker retention, and fosters an environment in which HCWs choose to be motivated and contributing.
- Designing-in safety. Designing safe processes and systems minimizes worker doubt, reliance on memory or attention, unsupported decision making and excessive mental workload.
- Error modes and predictability. Workers need to understand what may go wrong and the importance of not taking shortcuts, using work-arounds, and violating safety rules.
- Procure for safety. Equipment maintainers and users need to be involved in the medical equipment acquisition process to make sure that new equipment is

compatible with existing systems and that chosen models are effective, intuitive, and easy to operate.

- Promote teamwork. Effective teams have several basic elements in common: collaboration, participative decision-making, a commitment to commons goals, continuous learning, openness to new ideas, an ability to adjust to unforeseen circumstances and a willingness to embrace diversity. Good teamwork can reduce patient safety problems, and it can improve HCW's morale and sense of well-being.
- See the big picture. Workers need to be mindful that changes made locally can impact other functions and systems within the organization.
- Manage change. New medical technologies, systems, and processes are constantly introduced into the EC, and they often bring with them a whole new set of hazards. Therefore, knowledgeable individuals need to conduct safety and health risk assessments regularly to identify hazards and implement controls to manage risk.

HCW involvement is key to creating a safe and functional environment of care as well as a safe and healthy workplace. When HCWs become an integral part of the safety process, meaningful and lasting changes occur. HCWs develop a sense of responsibility and pride in the success of the overall safety program, increasing safety and health awareness which affects not only them, but their patients and coworkers.

Additional Reading

The Role of the Physical and Social Environment in Promoting Health, Safety, and Effectiveness in the Healthcare Workplace by Anjali Joseph, Ph.D., Director of Research, The Center for Health Design discusses how the physical environment, along with other factors such as technology, workplace culture and social support impact HCWs.

Summary

A safe and functional physical environment improves patient care and worker safety by–

- Creating a healing environment by making hospitals more pleasant, comfortable, and supportive for patients and HCWs.
- Eliminating environmental stressors such as noise, lighting, and temperature that negatively affect patient outcomes and staff performance.
- Improving patient and HCW safety by reducing infection risk, injuries and medical errors.
- Increasing worker job satisfaction and reducing turnover, which in turn, improves the quality of the care provided to patients.

Prepared by: Industrial Hygiene Medical Safety Management Program
Dated: 1 May 2014

Appendix A

Quiz

1. According to the Joint Commission, a safe, functional and healing environment should include provisions for:

A. Space
B. Ventilation
C. Noise
D. All of the above

2. When designed into and managed as part of the physical environment, evidence-based design elements can positively influence well-being, promote healing, relieve patient pain and stress, and reduce medical errors, infections and falls.

A. True
B. False

3. According to the American Disability Standards, facilities constructed on or after March 15, 2012 must comply with:

A. Uniform Federal Accessibility Standards
B. 1991 ADA Standards
C. 2010 ADA Standards
D. All of the above

4. A good wayfinding design lets HCWs, patients, and visitors know where they are within the hospital and help them to easily arrive at their destination through the use of:

A. Color, texture and patterns
B. Artwork
C. Signage
D. All of the above

5. Suitable lighting de-institutionalizes a facility by creating the look and feel of a home environment and provides visual interest to stimulate patients' moods in a positive way.

A. True
B. False

6. Good ventilation reduces potential for microbiological growth and infection and includes:

A. Warm temperatures
B. High humidity
C. Proper pressure relationships
D. Recirculated air

7. According to the World Health Organization, noise levels on inpatient floors should be kept to:

A. 85 dB during the day and 60 dB during the night
B. 85 dB during the day and 55 during the night
C. 60 dB during the day and 35 during the night
D. 40 dB during the day and 35 dB during the night

8. Furniture should:

A. Be sturdy, free of defects, and easily cleaned and disinfected
B. Resist moisture, stains, odor, and fire
C. Be age appropriate
D. All of the above

9. According to the Joint Commission, E-cigarettes are exempt from the hospital's smoking policy.

A. True
B. False

10. A hospital may make exceptions for patients who smoke, provided that they:

A. Designate approved smoking areas
B. Define the circumstances in which patients may smoke in writing
C. Post a fire watch near approved smoking areas
D. Require patients to use E-cigarettes

11. The primary purpose of a PICRA is to mitigate the risks from infection in both occupied and unoccupied healthcare buildings during construction or maintenance.

A. True
B. False

12. The size and cost of a project are the principal criteria used to decide when a PICRA must be conducted.

A. True
B. False

13. Projects that create a moderate to high-level amount of dust or require demolition or removal of any fixed building components or assemblies are construction type:

A. A
B. B
C. C
D. D

14. Human factors are used to describe the interactions between several work features, such as:

A. The worker
B. The tasks performed
C. The workplace
D. All of the above

15. The probability of HCWs committing errors is reduced when variability, mental workload, and decision-making are reduced.

A. True
B. False

Answer key:

1-D	2-A	3-C	4-D	5-A	6-C	7-D	8-D
9-B	10-B	11-B	12-B	13-C	14-D	15-A	