Quick Guides

Quick Guide, Chapter 1: Infection Control Risk Assessments

Expanded information, case studies, references and other important items related to infection control risk assessments are available in Chapter 1 of this publication.

The design and construction of health care facilities influence infection outcomes. To help reduce infection risks, health care organizations should perform an infection control risk assessment (ICRA) when designing, renovating or constructing a health care facility. An ICRA is required by many jurisdictions through the adoption or use of the Facility Guidelines Institute (FGI) *Guidelines for the Design and Construction of Hospital, Outpatient and Residential Health Care Facilities* (three separate documents). Using the ICRA process can help hospitals identify infection risks and potential solutions.

An interdisciplinary ICRA team should include experts in both medical and building sciences, such as front-line caregivers from clinical departments affected by the project, facility management, quality improvement representatives, environmental safety specialists, infection preventionists, epidemiologists, architects, interior designers, engineers, human factors specialists, environmental services staff, and contractors. Other disciplines, such as risk management or lab personnel, may be helpful on an ad hoc basis.

The ICRA team is responsible for conducting a health care risk assessment. A common approach to this process includes five steps:

1. Identify the hazards.
2. Decide who might be harmed and how.
3. Evaluate the risks and decide on the precautions.
4. Record findings, propose action and identify who will lead on what action.
5. Review the assessment and update if necessary.

Design solutions may be straightforward (such as choosing plumbing fixtures that can reduce the risk of contaminated water) or they may be more nuanced (such as locating a hand hygiene sink in a space within a patient room that promotes hand hygiene compliance).

Solutions to mitigate risks during construction may be more prescriptive and can be identified through tools such as an ICRA precautions matrix. An ICRA precautions matrix can help determine steps to take when conducting a construction or renovation project in a health care facility. Using the American Society for Heath Care Engineering (ASHE) ICRA precautions matrix as an example, an ICRA team would rate the type of construction (i.e., painting, sanding, duct work or new construction) and the risk of the patient groups affected (e.g., office areas, emergency rooms, operating rooms, burn unit). The precautions matrix would determine precautions needed (i.e., minimizing dust, cleaning the area after project completing, maintaining negative air pressure, using high efficiency particulate air (HEPA)-equipped air filtration units).

Best practices related to ICRA processes include:

- Ensure the ICRA team is interdisciplinary. Get infection prevention involved early in the design process.
- Involve the ICRA team to address minimum standards identified in several guidance

sources, including the Centers for Disease Control (CDC) and FGI *Guidelines.*

- Use the ICRA precautions matrix to determine precautions needed during construction activity.
- Include construction-related requirements of the ICRA into contract documents.
- Since safe design relies not only on the ICRA process but also on other aspects of a health system as well (organizational policies, staff, etc.), consider different perspectives and take a systems view of safety.

Quick Guide, Chapter 2: Hand Hygiene Infrastructure

Expanded information, case studies, references and other important items related to hand hygiene infrastructure are available in Chapter 2 of this publication.

Hand hygiene is essential to safe health care, and the infrastructure to support hand hygiene plays an important role in how well hand hygiene compliance is maintained. That infrastructure includes the design and placement of sinks, faucets, hand-drying facilities and dispensers of alcohol-based hand rub.

Studies show that the location of sinks is more influential than the number of sinks. One study found that each additional meter between the patient's immediate surroundings and the nearest sink decreased the likelihood of handwashing by 10 percent. However, pathogens can be spread by water splashed from sinks, so water pressure should be optimized and flow should be offset from the drain. Some studies have shown that sinks designated for handwashing, and not for patient use, improved hygiene.

Valves within faucets that automatically turn on and off by themselves have been shown to contribute to pathogen transmission, even though the design intention is to reduce transmission by negating the need for users to touch the handle. These faucets may have low flow, tepid temperature and internal components (valves) that may harbor biofilm, which can contribute to microbial amplification.

Paper towels are preferable to warm-air blowers for drying hands, because the towels can be used to turn off the faucet after use and the blowers may spread pathogens. However, pathogens can be spread by contaminated towel dispensers.

Availability of alcohol-based hand rub dispensers has been shown to improve hand hygiene compliance. The optimal location for dispensers appears to be just outside the doorways to patient rooms. In that location, the dispenser is typically highly visible, it is on the route of the caregiver, and the action of entering the room is a trigger for the caregiver to perform hand hygiene. Dispensers immediately near or on patient beds also help compliance. The design of the dispenser also is important – a bright color and a design that differentiates the hand rub dispenser from soap dispensers improve usage.

Designers should consider human factors when designing hand hygiene facilities. These principles can be put into effect in the following ways:

- Minimize the complexity of hand hygiene.
- Provide design features that force appropriate behaviors.
- Minimize the time spent on hand hygiene.
- Provide cues to prompt hand hygiene.
- Assess the usability of new hand hygiene systems.
- Test new systems in real-life conditions.

Best practices related to the design of hand hygiene facilities include:

- Ensure handwashing sinks are separate from patient-use sinks and are not used for waste disposal. Handwashing sink placement should be near the point of care.
- Ensure adequate space between areas used for medical preparation, and use splash guards where appropriate.
- Faucets should be operable without using hands, such as with foot controls or wrist

blades, and the water should angle away from the drain and flow at moderate pressure to minimize splashing.
- Choose paper towel dispensers that can be operated without touching, and avoid warm air dryers where noise or dispersion of bacteria would present patient risk.
- Install alcohol-based hand rub dispensers at patient room doors and at every bed.
- Evaluate the location of soap and glove dispensers at the hand hygiene sink during design.
- Ensure adequate space for waste containers is provided at the hand hygiene sink.
- During the design process, make hand hygiene processes an explicit point of concern.

Quick Guide, Chapter 3: Reprocessing

Expanded information, case studies, references and other important items related to reprocessing are available in Chapter 3 of this publication.

Areas in a hospital where sterilization and high-level disinfection are performed should be designed to permit effective workflow and maintain maximum cleanliness. Important issues to consider in the design of such spaces include the type of equipment used, the proximity to areas requiring the sterilized or disinfected equipment, the ability of surfaces to withstand copious amounts of water, and the flow of equipment and personnel.

The sterilization process involves five steps, the final four of which affect the design of the sterilization area. The first step is gross decontamination – the removal of visible debris – which happens frequently at the site of use and therefore doesn't affect the design of the sterilization area. The remaining four steps are decontamination, packaging for sterilization, sterilization, and storage, each of which affects space design.

The type of sterilizing equipment used affects design. For example, a table-top sterilizer does not require much infrastructure. Steam sterilizers require a certain quality of steam, separate access for maintenance and careful placement of air ducts. Hydrogen peroxide plasma sterilizers operate at lower temperatures than steam sterilizers, and thus demand less of the infrastructure. Ethylene oxide sterilizers demand more infrastructure because of safety issues and processing requirements unique to this modality.

The requirements for space used for high-level disinfection may differ from those of the space used for sterilization. Endoscopes and vaginal probes are examples of two items commonly reprocessed in high-level disinfection areas. Many hospitals use automated endoscope reprocessors, which have specific water pressure needs. The chemicals used in high-level disinfection must be disposed of properly, which may necessitate more infrastructure.

In both sterilization areas and high-level disinfection areas, the lighting in the sink areas must be bright to allow for effective removal of all visible debris. Staff in these areas must wear personal protective equipment, which can take up space and affect air temperature requirements. In addition, the spaces should be designed to minimize staff interruption and distraction.

The materials used in these areas must withstand copious amounts of water: wood or pressboard should not be used, and walls must not allow for fungal growth if saturated with water. Humidity and ventilation of these spaces also must be closely controlled.

Best practices in designing sterilization and high-level disinfection areas include:

- Flow through the space must be unidirectional from dirty to clean.
- Pipes, conduit or ductwork located above work areas should be enclosed to prevent dust accumulation, and ceilings should be made of materials that do not shed particulates.
- Sterilizers should be located in restricted areas to prevent accidental removal of unsterilized equipment.
- Hand-washing sinks should be readily available so staff can wash after handling items yet to be processed and before handling processed items.

Quick Guide, Chapter 4: Cleaning of Environmental Surfaces

Expanded information, case studies, references and other important items related to the cleaning of environmental surfaces are available in Chapter 4 of this publication.

Effectively cleaning and disinfecting surfaces in health care settings is essential to the prevention of infections. Pathogens such as methicillin-resistant *Staphylococcus aureus* (MRSA) and others (e.g., spores of *Clostridium difficile*, *Acinetobacter baumannii*, etc.) can survive for a long time on surfaces and infect patients, and studies have shown that traditional chemical cleaning methods do not always adequately remove the pathogens.

New technologies have entered the market and show promise in reducing these pathogens, including improved chemical disinfectants, antimicrobial surfaces that may reduce the numbers of organisms on a surface over time, and “no touch” automated disinfection systems.

It is a best practice to form a multi-disciplinary team that establishes policies and procedures regarding room cleanliness and disinfection. The team should include staff from administration, infection prevention and control, nursing, environmental services, and facility management. The team should develop a five-stage plan:

1. Determine which chemicals will be used to clean and disinfect surfaces, paying particular attention to the specific needs of the health care organization and various departments. Once the chemicals are chosen, establish usage guidelines.

2. Define policies and procedures, including what the cleaning tasks are, which department is responsible for each, how often the task should be completed, and which products will be used for each task. Pay particular attention to identification of “orphan items” that may not have been clearly designated to anyone for cleaning. Checklists and daily assignment sheets are useful tools for maintaining adherence to protocols.

3. Train environmental service staff and any other personnel designated to clean surfaces. New hires should be trained, and existing staff should have ongoing training. Staff should take part in yearly competency testing.

4. Effectiveness of cleaning and disinfecting should be regularly monitored, such as with direct observation, fluorescent marker systems or adenosine triphosphate (ATP) ATP bioluminescence assays. Timely feedback should be provided to staff, including the results of the cleaning and disinfecting monitoring results.

5. The multidisciplinary team should conduct an analysis and evaluate new technology for environmental cleaning and assess the need and application of these new technologies in their hospital setting.

Quick Guide, Chapter 5: Water-Related Environmental Infection Control

Expanded information, case studies, references and other important items related to water-related environmental infection control are available in Chapter 5 of this publication.

Plumbing in a health care facility can house pathogens. Taking steps to minimize pathogen growth is important. Pseudomonas grow in stagnant water found within the plumbing system, such as in joints, dead legs, encrustations and plumbing enhancements. The pathogens are closely associated with biofilms, which provide protection and food, and they are typically dispersed when biofilm reaches certain development phase or during sloughing events such as when the water system is disrupted, such as during construction or during high-demand periods.

Since completely eliminating these pathogens is unlikely even in new construction, it is important to develop a water safety or management program that iteratively monitors water at predetermined locations and addresses out of range control metrics when noted.

A multidisciplinary water management team should be developed in all health care facilities. This team, which should be given the authority to implement water decisions, has a number of important tasks. These include mapping the water system; analyzing hazards; developing mitigation strategies; establishing metrics; enacting policies that identify hazards; conducting surveillance for disease caused by waterborne pathogens; and developing a strategy for replacement of current higher-risk premise plumbing problem areas. Each team member has specific areas of responsibility.

A risk assessment is an important step in water system management. The risk assessment should identify potential problems with the domestic the water source, inlets, flow, stagnation, heat transference, faucets/showers/drains and other areas. Another important part of the risk assessment is to develop a plan to deal with water disruptions, both planned and unplanned, since such disruptions can lead to the dispersal of pathogens.

Regular monitoring of water disinfection strategies by the water source is key to understanding incoming water risks. Water quality reports should be routinely reviewed, and, if utilized, supplemental disinfection methods adjusted accordingly. Adjunct disinfection strategies for health care facilities to consider include hypochlorite, chlorine, chlorine dioxide, copper-silver ionization, hyper-chlorination filtration, ultraviolet light and thermal control. All have advantages and disadvantages.

Best practices regarding waterborne pathogen management include:

- Create and empower a multidisciplinary water management team. Among other purposes, this team socializes the concept of a water safety program.
- Perform a risk assessment for all water systems and water-containing equipment. Include water within equipment, stagnant water plumbing during construction, and rarely used locations, such as eye-wash stations and emergency showers.
- Be involved in renovation and construction to provide safe plumbing expertise.
- Avoid in-hospital decorative water features (water walls, reflecting pools, fountains).
- Be aware of waterborne pathogens and the diseases they may potentially cause, and maintain surveillance for trends. Some of these diseases include pneumonia, bloodstream infections, surgical site infections, meningitis, gastroenteritis and urinary tract infections.

- Develop and execute an action plan to mitigate risks and address outbreaks when they occur.
- Monitor key metrics established by the water safety team to demonstrate that the water safety program is working. Key metrics may include 1) process control measures, such as chlorine levels or measurements of temperature control, 2) the burden of pathogens in humans (patients and health care professionals) and/or 3) the burden of pathogens in water as epidemiologically indicated.

Quick Guide, Chapter 6: Flow of Patients, Personnel, Equipment and Waste

Expanded information, case studies, references and other important items related to the flow of patients, personnel, equipment, and waste are available in Chapter 6 of this publication.

The risk of infection transmission in a hospital can be reduced by a number of strategies, including proper configuration of space, airflow design that minimizes the spread of pathogens, and design features that ensure the optimal flow of people and material to minimize cross contamination.

Separating patients who are actively ill with an infectious disease from other patients, either through isolation or barriers, is an important component of infection prevention. Consequently, designing spaces such airborne infection isolation rooms is important. Another way to limit the spread of infection is the development of “respiratory hygiene/cough etiquette,” protocols which encourages patients and visitors with a cough or fever to cover their cough with tissues and to perform hand hygiene. This is especially important in emergency departments, where patients and their families often wait together for long periods of time and infectious patients may not be recognized immediately. Providing barriers (such as plexiglass dividers) for worker safety at triage entry points and provision of space for masks, tissues and hand sanitizer are examples of design considerations to support infection prevention.

Designing “flow” in in a health care setting also can reduce the spread of infection. For example, emergency departments may be designed with “pods” and zones and may include procedures that allow for triage “flex” to accommodate changes in patient volume. Creative use of barriers can help when crowding may present a challenge. Design should also consider the movement of environmental waste in the hospital, so that it can be removed and disposed of without the risk of pathogen spread.

Among the best practices in hospital design for reducing the spread of infection are:

- A multidisciplinary team should consider all aspects of infection prevention when the functional program of a new health care facility is being developed.
- Just as with new construction, infection prevention staff should be part of the planning team for updating and renovating existing facilities. Reflexively recreating existing work flows or spaces should be avoided.
- Incorporate infection prevention staff into plans for all areas of the hospital, including disaster and surge capacity planning.
- Consider designing an AII isolation room/area that enables unidirectional flow of health care professionals (HCP) entering/exiting for patients with highly infectious diseases.
- Use Human Factors Engineering (HFE) methods to analyze tasks as they are performed in existing spaces. Ask “what design features contribute to the lack of compliance”. Work with HCP to design spaces/systems that support efficient workflows for HCP to access clean supplies while still protecting clean and sterile supplies from contamination.
- Remember that the separation of clean and dirty functions to limit cross contamination is fundamental to infection prevention.
- In areas designed to control airborne contaminants, ensure the ventilation system provides appropriate pressure relationships, air-exchange rates, filtration efficiencies, temperature and relative humidity.
- Provide space outside of clinical areas for removal of supplies from external shipping boxes.

- Ensure adequate storage on patient units for reusable patient care equipment and a location where these items may be cleaned.
- Explore new technology or simple containment approaches for the disposal of human waste.