MANUAL 6:
Infection Prevention & Control During Construction / Renovation of Perioperative Services

Design & Construction

AORN | TOOL KIT

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Introduction

Infection prevention and control (IPC) is a core competency of perioperative professionals for provision of operative procedures. Having the skills to accomplish IPC is very important for perioperative nurses and others well before a construction or renovation project begins. A close collaboration is needed between perioperative nurses and infection preventionists (IPs) along with architects, mechanical engineers, and contractors who are developing plans for creating new space or renovating existing space.

Perioperative nurses know and provide care in the perioperative services space. IPs have expertise on applying IPC strategies, from the planning and design phase through completion of the construction, aimed at mitigating risks from microorganisms that are present in the built environment.

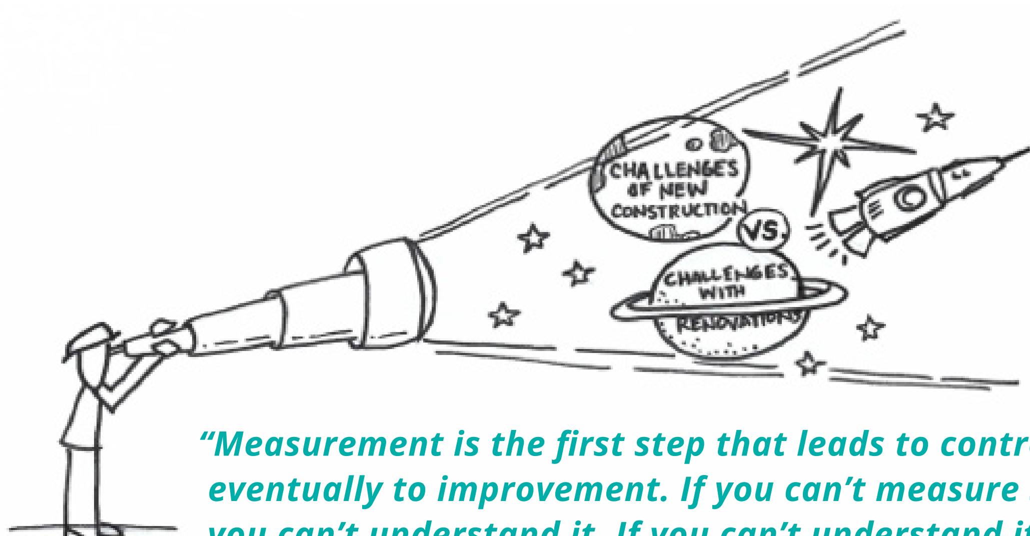
As described in other manuals in this tool kit, perioperative leaders and professionals understand workflow and care processes. This is critical input that is provided in planning and design and includes functional programming. IPs collaborate with perioperative care professionals for any work involving perioperative care space that undergoes construction, renovation, or maintenance (CRM), with the aim of keeping everyone safe and containing any reservoirs of microorganisms in or on surfaces in the built environment.

This manual provides an overview of the following:

- Infection Control Risk Assessment (ICRA) as a component of an overall Safety Risk Assessment
- Elements of design that promote infection prevention (eg, an effective heating, ventilation, and air conditioning [HVAC] system to protect the surgical site; optimal location and number of hand washing stations)
- Containment measures to protect operating rooms, the clean core, sterile storage, and other areas from the active work zone
- The ICRA permit
- The role of the perioperative professional from construction to commissioning and owner (ie, health care facility) occupancy

MANUALS IN TOOL KIT:

1. How we begin - Developing the Team
2. Design in Depth - building codes, room types, terminology.
3. Construction Projects Steps
4. Reading construction Documents
5. Design Guide for SPD
6. **Infection control and prevention**



"Measurement is the first step that leads to control and eventually to improvement. If you can't measure something, you can't understand it. If you can't understand it, you can't control it. If you can't control it, you can't improve it."

- H. James Harrington

Design Process

VALIDATION

Big Picture

- Define high-level space program
- Review future state process maps
- Detail space planning
- Align needs/wants with schedule and budget

CRITERIA DESIGN

Key Adjacencies and Critical Flows

- Department adjacencies and locations
- Critical flows (review and improve)
- Site plan layout
- Building footprint/massing
- Capture future space needs
- Confirm scope and costs
- Opportunities for innovation

DETAIL DESIGN

Focus on Details

- Room-specific requirements
- Furniture, fixtures, and equipment (FF&E)
- Review mechanical, electrical, IT, security
- Coordinate code requirements
- Discuss site details and landscape
- Reconfirm scope and cost
- Finalize and sign off interior/exterior design & signage

CONSTRUCTION DOCUMENTS

Prepare Documents

- Final coordination with each discipline
- Confirm constructability with Construction Manager (CM)
- Final documentation and coordination ("blueprints")
- Final review with regulatory agencies

CONSTRUCTION ADMINISTRATION

Break Ground

- City and State Reviews
- Shop drawing Reviews
- On-site observations
- Review and Process change orders

OCCUPANCY

Grand Opening

- Change Management
- Transition Planning
- Supply/stage space
- Trial/practice runs
- Open Doors!

Post Occupancy Evaluation

- Evaluate performance to the original design intent

Infection Control Risk Assessment (ICRA)

The ICRA is aimed at minimizing and preventing risk of disease transmission during construction, demolition, renovation, maintenance, operations, and response to emergency situations (eg, water intrusion), involving the built environment or environment of care. The ICRA process involves an interdisciplinary team that is led by the facility's IP(s). The work of the team is to document an assessment of risks and proactive measures to mitigate the identified risks that could occur during CRM activities.

The ICRA process identifies and considers the patient population at risk, the nature and scope of the project, and the functional program of the construction project. ICRA determines the potential risk of transmission of various air and waterborne biological contaminants in the facility. It also identifies important design elements, such as the location and number of hand washing stations; HVAC designs; workflows; and patterns of transport of products, sterile supplies, and equipment to the surgical suite and return of used instruments to the sterile processing department (SPD). Effective design elements and insights from perioperative professionals involving work practices like storage and transport of supplies are included in the Facility Guidelines Institute (FGI) Guidelines for Design and Construction of Healthcare Facilities and should be reviewed when planning construction of points of care delivery for perioperative services.

Patients undergoing operative procedures in operating rooms are likely the most vulnerable to exposure to potential pathogens that can cause surgical site infection (SSI). Therefore, it is critical that perioperative professionals be engaged and provide input into the ICRA process to ensure safety and continuity of operative care during CRM work.

KEY STEPS FOR ICRA FOR CRM PROJECTS

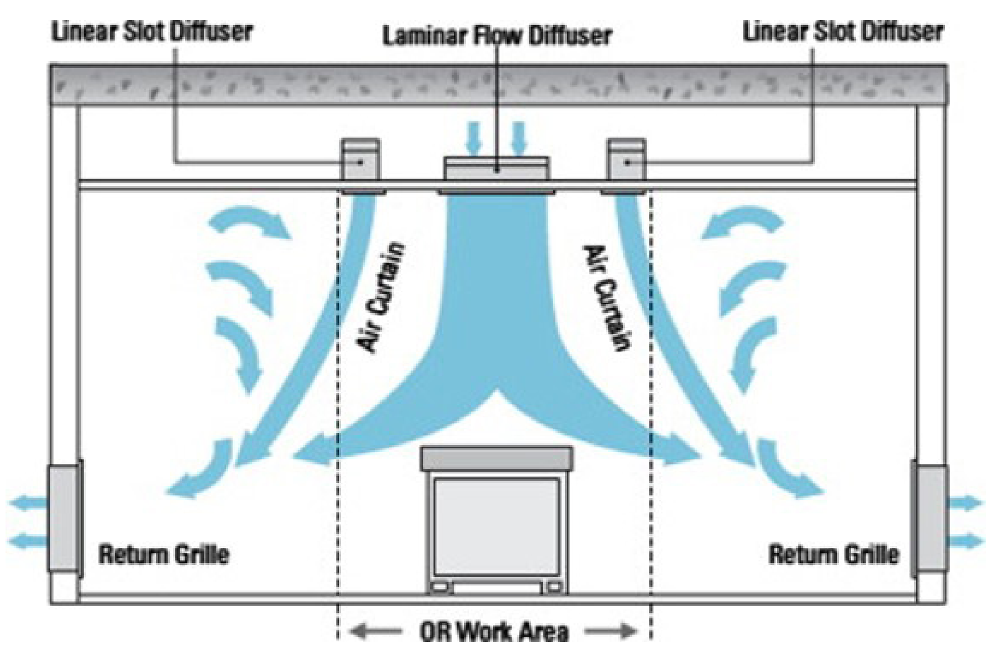
ICRA and risk mitigation measures include the following five steps:

1. Defining the scope, space, and nature of the CRM project
2. Identifying risks to patients and personnel associated with the CRM work
3. Applying the ICRA matrix and extent of precautions needed
4. Assessing adjacent areas/zones of the active work and risks to patients and personnel in these zones
5. Establishing a risk mitigation plan, containment/monitoring of the work zone, and a process to report observed gaps in cleanliness/containment of the work zone and adjacent areas

Design for Preventing Infection & Increasing Patient Safety

AORN's Guideline for Design and Maintenance of the Surgical Suite provides a wealth of evidence-based elements of design of perioperative care services. These were highlighted in a recent review in the January 2024 issue of the *AORN Journal*, and select elements are highlighted here:

- HVAC systems are a very important component of preventing SSIs. ASHRAE 170, Ventilation of Health Care Facilities, is a design standard that is adopted by many state agencies that approve construction plans in health care facilities. This standard is also incorporated into the FGI Guidelines. For most ORs, it specifies:
  - » HEPA filtration of supply air,
  - » 20 total air changes/hour,
  - » a temperature range of 20° C to 24° C (68° F to 75° F), and
  - » relative humidity of 20% to 60%
- Finishes and flooring material
- Number and location of hand washing stations
- Location and number of lighting fixtures and equipment booms in relation to HVAC supply diffusers
- Clean / sterile core
- Location and number of soiled equipment rooms
- Physical proximity of the surgery suite to the SPD (eg, with a goal to mitigate the need for immediate use steam sterilization within the restricted zone)



Typical HVAC design for an OR. Includes supply air to keep the OR in positive pressure, number of air changes/hour, temperature, and relative humidity. From: Zhai Z, Osborne AL. Simulation-based feasibility study of improved air conditioning systems for hospital operating room. *Frontiers of Architectural Research.* 2013;2(4):468-475.

The ICRA Team & the Documentation Process

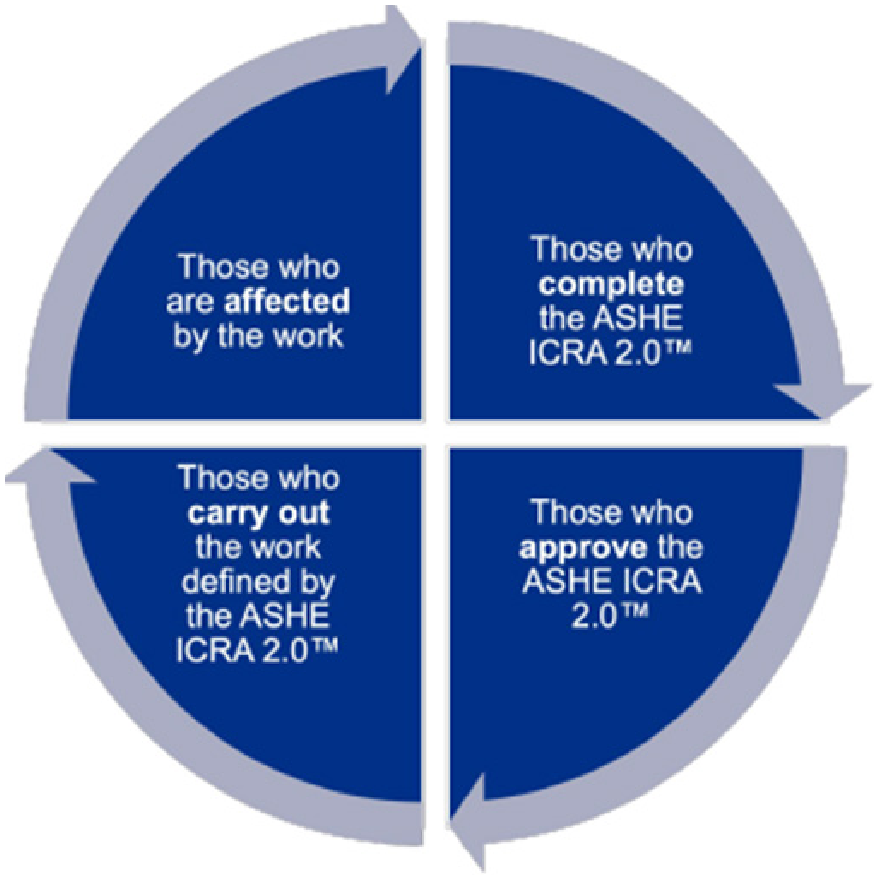
The ICRA team applies the principles of risk assessment and mitigation as well as provides input into planning and design aimed at preventing infection and supporting safety of everyone in the surgery suite and associated support services (eg, SPD). Examples of key steps in the ICRA process include the following:

- Convene an ICRA team for review and recommendations on all construction, demolition, or renovation projects involving the environment of care. The ICRA team is interdisciplinary and includes an IP, perioperative professional(s), and others involved in operative care (eg, surgeons, anesthesia providers, surgical technologists, SPD personnel, safety lead, facility management lead, construction services personnel, mechanical engineering personnel, and facility planning/design personnel).
- The ICRA team develops an understanding of the scope and nature of the project, reviews construction/renovation plans, describes the patient populations involved, and considers the safety of all during construction activities.
- The team applies the ICRA matrix and issues an ICRA permit, when applicable, that outlines preventive measures to contain the active work zone from adjacent areas where patient care is being provided.

Note: The extent of preventive measures varies by scope and scale of the work and some projects, such as those for office areas, unoccupied spaces, and certain public areas, may not require an ICRA permit.

The American Society of Health Care Engineering (ASHE) has published an updated version of the ICRA process and matrix, ICRA 2.0. This manual cites use of this version and is recommended for CRM projects involving perioperative care services: ASHE ICRA 2.0™ Tool kit | ASHE

At a Glance:
Building the ICRA Team



Emerging Issue:

Protection of Surgical Instruments on the Back Table

There are an increasing number of investigations documenting contamination of surgical instruments placed on the back table and other areas outside of the sterile field zone. This contamination is time dependent, meaning the longer the time after containers of instrument are opened on the back table, the higher the likelihood of contamination.

Sources of contamination include traffic of personnel by the back table prior to the start of the operative procedure. AORN guidelines therefore recommend covering instruments with a sterile drape to provide protection during times of increased activity. Another aspect under active investigation is design of an HVAC system that protects not only the patient on the OR bed but also the back table.

Perioperative professionals are encouraged to raise the issue of more effective HVAC design during planning of OR construction or renovation. They can also advise the design team on patterns of personnel in the OR that can avoid close proximity to the back table.

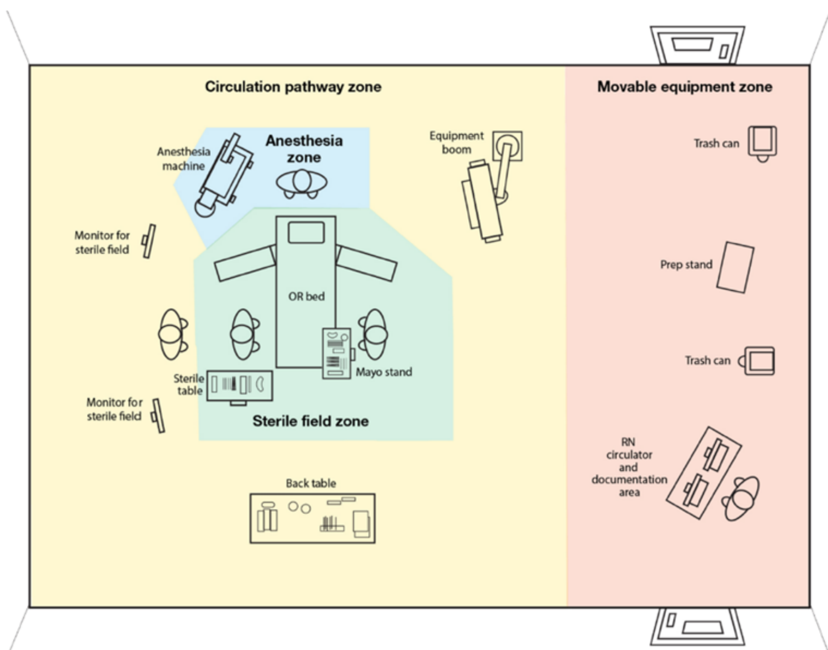


Figure 2. Color-coded diagram of an OR delineating four different workflow zones. *Reprinted with permission from* Guidelines for Perioperative Practice. *Copyright © 2024, AORN, Inc, 2170 S Parker Road, Suite 400, Denver, CO 80231. All rights reserved.*

Application of ICRA 2.0 to the Construction Project

Step 1: Determining the extent of the type of construction or renovation work. This is primarily focused on the extent of disruption to the existing space or adjacent areas.

Step 2: Determine the patient risk group(s) receiving care in spaces that will be impacted by the construction activity. These range from

- low (eg, non-patient care areas) to
- medium (eg, patient care support services like the waiting room, decontamination zone in the SPD, the shipping receiving area) to
- high (eg, patient rooms, clean storage room, inpatient unit, emergency department), to
- highest risk (operating room/restricted zone, transplant unit, intensive care units, interventional cardiology/radiology room).

Step 3: Determine the class of precautions needed based on the extent of the project and risk group(s) that will be impacted by applying the ICRA 2.0 matrix. The classes of precautions range from I - V, details for which are on the adjacent page. Each class of precaution describes containment and control strategies that are implemented before start of work and maintained during work activities. The ICRA document should be reviewed and updated each time there are substantial changes to the work effort, which can either increase or decrease the classification.

Step 4: Determine the strategies needed based on ICRA class, issue an ICRA permit that outlines these, and begin any monitoring throughout the work based on direction from the ICRA team.

Table 3 - Class of Precautions: ______

Patient Risk Group	Construction Project Type: TYPE A	TYPE B	TYPE C	TYPE D
LOW Risk Group	I	II	II	III*
MEDIUM Risk Group	I	II	III*	IV
HIGH Risk Group	I	III	IV	V
HIGHEST Risk Group	III	IV	V	V

Infection control permit and approval will be required when Class of Precautions III (Type C) and all Class of Precautions IV or V are necessary.

Environmental conditions that could affect human health, such as sewage, mold, asbestos, gray water and black water will require Class of Precautions IV for LOW and MEDIUM Risk Groups and Class of Precautions V for HIGH and HIGHEST Risk Groups.

*Type C [Medium Risk groups] and Type D [Low Risk Groups] work areas [Class III precautions] that cannot be sealed and completely isolated from occupied patient care spaces should be elevated to include negative air exhaust requirements as listed in Class IV Precautions.

CLASSES OF ICRA PRECAUTIONS:

I. Basic: Applies to Type A (non-invasive) work. An example would be fire wall inspection by the facilities management team. This likely does not require issuing of an ICRA permit.

II. Minimally controlled: Applies to Type B work in low and medium patient risk groups and Type C work in low patient risk groups. An example might be anticipation of limited generation of dust / debris during repair of flooring in a kitchen area.

III. Moderately controlled environment: Applies across all patient risk group types depending on inability to seal and isolate the work area from occupied patient care spaces. Examples include work that involves removing and replacing walls, doors, and door frames and other activities like cutting, grinding, drilling, or sanding.

IV. Highly controlled environment: Application involves various patient risk groups and typically involves work that generates moderate dust and debris, like demolition and major construction work.

V. Extremely controlled environment: Applies to Type C work in the highest patient risk group and Type D work in the high and highest patient risk groups. An example would be renovation of an operating room inside of the surgery services suite.

Putting it All Together:

ICRA Permit Development and Posting

An important aspect of any construction project is assessment of areas and spaces adjacent to, above, and below the construction or renovation site. The patient risk group for these areas may be different than in the immediate vicinity of the construction work and may be a higher risk group. Therefore, the following aspects of active work need to be considered:

- Noise and vibration from hammering and work activities
- Additional dust or debris from core drilling, hammering, or equipment movement
- Disruption or interference with the HVAC system that might alter appropriate air pressure relationships, air exchanges, and temperature and humidity control
- Vertical connections between floors that could provide a pathway for migration of dust and airborne pathogens such as stairways, elevators, and vertical lift shafts
- Disruptions in hot and cold water systems that could cause stagnation

The ICRA team is now ready to issue an ICRA permit – not too dissimilar from a building permit that authorizes the precautions contractors are to use during their work. An example of the ICRA 2.0 form is on the next page. It documents the type/extent of the work, patient risk groups, specific types of precautions, consideration of adjacent areas, and detailed plans for precautions needed for the project.

The ICRA permit is developed by the team, then signed and issued by the IP. Often the state authority having jurisdiction that reviews construction plans will also request a copy of the ICRA permit. The permit is then posted at the main entrance to the construction area. It is a key point of reference for precautions needed and available for contractors but also for the facility

ICRA 2.0 Infection Control Risk Assessment and Permit

ICRA 2.0 Infection Control Risk Assessment and Permit	Project Name:		
	ICRA Number:	Requested by	
Location of Work Activity		Project Start Date	
Estimated Duration		Completion Date	
Foreman/Supervisor		Phone	
Contractor Performing Work		Phone	
Approving Authority		Phone	

Please note that the above signature is approval of the work activity as described and assessed documented here.
Should the scope of work change or the discovery of additional toxic or biological substances.
STOP WORK and seek additional approval and guidance before proceeding.

1. Type of Activity	Explain this reasoning for this assessment
◯ Type A: Non-invasive	
◯ Type B: Small-scale, short duration	
◯ Type C: Large-scale, longer duration	
◯ Type D: Major demolition, construction	

2. Patient Risk Area	Describe key patient risks
◯ Low: Non-patient care areas	
◯ Medium: Patient care support areas	
◯ High: Patient care areas	
◯ Highest: Invasive, sterile or highly compromised care	

3. Class of Precautions

	Type A	TYPE B	TYPE C	TYPE D
Low	◯ I	◯ II	◯ II	◯ III
Medium	◯ I	◯ II	◯ III	◯ IV
High	◯ I	◯ III	◯ IV	◯ V
Highest	◯ III	◯ IV	◯ V	◯ V

4. Surrounding Area

	Below:	Above:	Lateral:	Behind:	In Front:
Unit					
Risk group					
Contact					
Phone					
Controls	☐ Noise ☐ Vibration ☐ Dust ☐ Ventilation ☐ Pressurization	☐ Noise ☐ Vibration ☐ Dust ☐ Ventilation ☐ Pressurization	☐ Noise ☐ Vibration ☐ Dust ☐ Ventilation ☐ Pressurization	☐ Noise ☐ Vibration ☐ Dust ☐ Ventilation ☐ Pressurization	☐ Noise ☐ Vibration ☐ Dust ☐ Ventilation ☐ Pressurization
Systems impacted:	☐ Data ☐ Mechanical ☐ Med Gas ☐ Hot/Cold Water ☐ Other	☐ Data ☐ Mechanical ☐ Med Gas ☐ Hot/Cold Water ☐ Other	☐ Data ☐ Mechanical ☐ Med Gas ☐ Hot/Cold Water ☐ Other	☐ Data ☐ Mechanical ☐ Med Gas ☐ Hot/Cold Water ☐ Other	☐ Data ☐ Mechanical ☐ Med Gas ☐ Hot/Cold Water ☐ Other

Were there discoveries in surrounding areas that would serve as cause to increase the class of precautions and necessitate additional controls? If so, please summarize.

Construction

Strategies Perioperative Professionals Can Use to Support Infection Prevention & Control

As highlighted, construction projects that involve the restricted area carry the highest risk to patients if there are any gaps or lapses in use of ICRA precautions. Below are some important parameters that perioperative professionals can monitor, support adherence to, and notify leadership about if these are compromised.

Air pressure relationships:

- ORs are kept at positive pressure in relation to corridors in the restricted area outside the main point of entry.

Containment of the work zone:

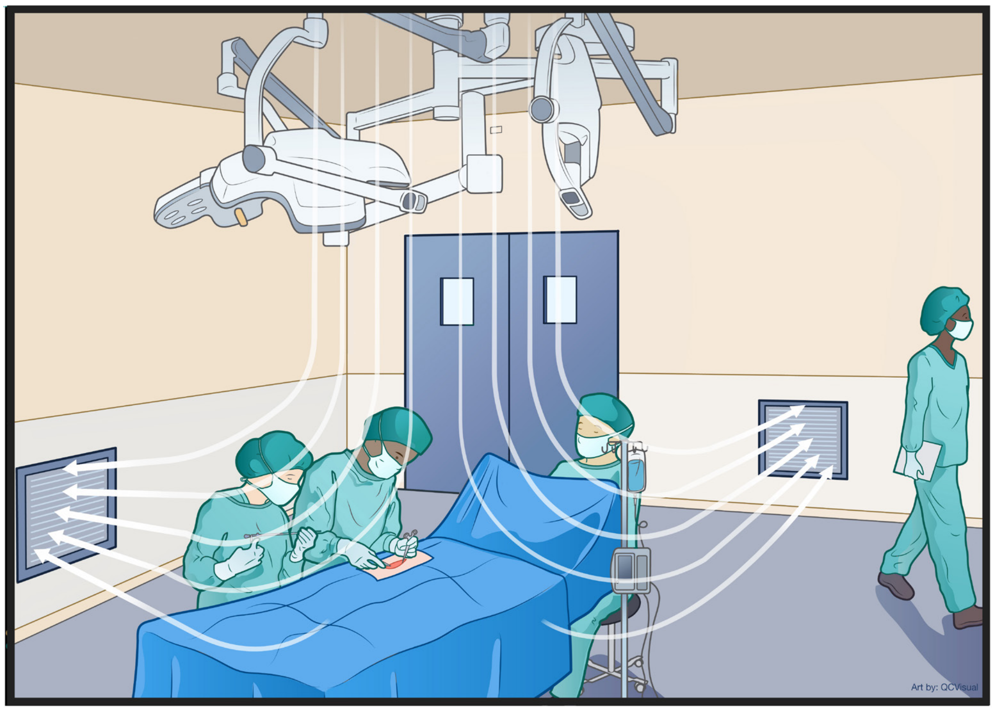
- The active construction zone has effective containment barriers, and visual indicator(s) show the construction area is in negative pressure with respect to adjacent spaces / corridors.

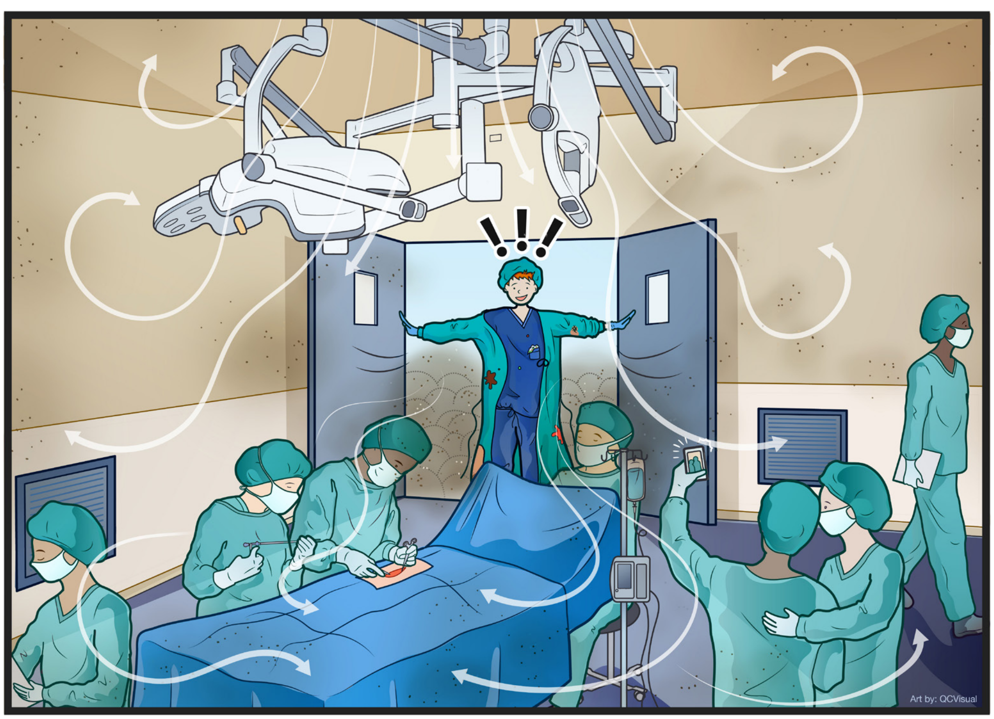
Cleanliness:

- Observe cleanliness of corridors adjacent to the construction work zone. Are adhesive walk-off mats present and effective? Is there visible dust and or soil? If so, additional environmental cleaning is needed.

Traffic Flow Hazards:

- What steps should be taken to decrease traffic flow hazards?
  - » During all phases of construction, be sure the surgical team is familiar with the new traffic patterns, if applicable.
  - » Use signage to indicate appropriate environmental controls and required surgical attire.
  - » Actively monitor all contractor activities to ensure safety and infection control requirements are met. Because the construction workers may not be familiar with the stringent requirements for ORs, perioperative professionals can reinforce the need to ensure they are following all required procedures (eg, not entering the restricted zone without protective attire).
- Keep doors closed and keep traffic in or around the surgical suite to a minimum.
- Utilize a dust collection system, such as during finishing of gypsum wallboard partitions.
- Create special construction-related traffic pathways, entrances, and exits if indicated



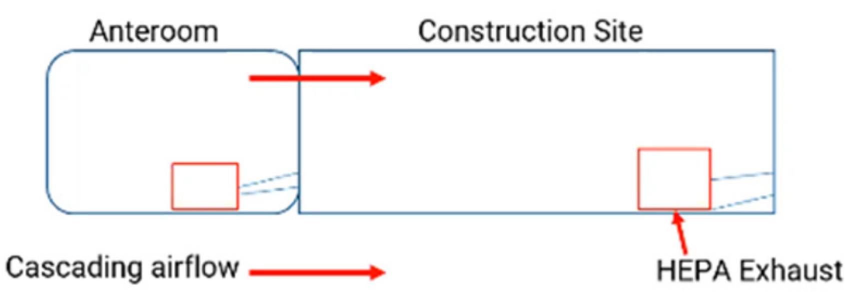


Containment & Infection Prevention

Monitoring During Construction

Effective isolation and containment of areas under active construction are critical for protection of patients, personnel, and others. The following are select components of Class V precautions that typically apply to projects in the surgery suite:

1. Construct and complete critical barriers that meet NFPA 241 requirements.
2. All (plastic or hard) barrier construction activities must be completed in a manner that prevents dust release.
3. Plastic barriers must be effectively affixed to the ground and ceiling and secure from movement or damage.
4. Construct an anteroom large enough for equipment staging, cart cleaning, and workers. The anteroom must be constructed adjacent to the entrance of the construction work area.
5. Personnel will be required to wear disposable coveralls at all times during Class V work activities. Disposable coveralls must be removed before leaving the anteroom.
6. A negative airflow pattern must be maintained from the entry point to the anteroom and into the construction area. The airflow must cascade from outside to inside the construction area. The entire construction area must remain negatively pressurized.
7. Maintain negative pressurization of the entire workspace using HEPA exhaust air systems directed outdoors. Exhaust that is at least 25 ft away from air intakes does not require use of portable HEPA devices in the construction area.
8. Install a device on the exterior of work containment to continually monitor negative pressurization. To ensure proper pressure is continuously maintained, it is recommended that the device(s) have a visual pressure indicator.
9. Contain all trash and debris in the work area.
10. Nonporous/smooth and cleanable containers (with a hard lid) must be used to transport trash and debris from the construction areas. These containers must be damp-wipe cleaned and free of visible dust/debris before they leave the contained work area.
11. Install an adhesive (dust collection) mat at the entrance of the contained work area, based on facility policy. Adhesive mats must be changed routinely and when visibly soiled.
12. Consider collection of particulate data during work to monitor and ensure that contaminants do not enter the occupied spaces.



In addition to these strategies, perioperative professionals working in areas where construction is underway need to support monitoring of the adjacent areas and verify with their supervisor whom to contact if any variation from ICRA class precautions are observed or the work area is in need of supplemental cleaning.

Figure 1. Image of a hallway in a hospital where construction is taking place. Warning signs on the doors act as barriers to contain dust and debris.

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