MANUAL 2:
Design in Depth

Design & Construction

AORN | TOOL KIT

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Introduction

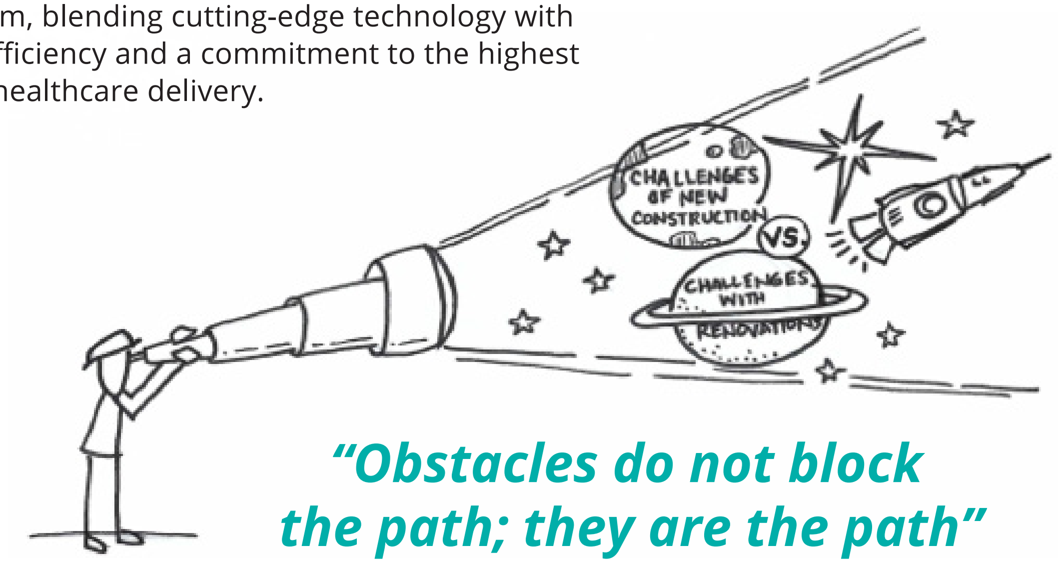
In the early stages of crafting a cutting-edge operating room, a meticulous approach involves integrating building systems and equipment seamlessly into the comprehensive team strategy. This multifaceted team encompasses architects, healthcare professionals, technologists, administrators, and experts in building systems. Recognizing the critical role of building systems, specialists are brought into the collaborative process at the onset to address key components such as Heating, Ventilation, and Air Conditioning (HVAC), lighting design, power distribution, the intricate network of medical gas systems, and equipment coordination.

The inclusion of building systems experts ensures that the operating room environment not only meets but surpasses regulatory standards, offering optimal conditions for patient care and surgical procedures. Collaboratively addressing the intricate interplay of these systems early in the design phase fosters a holistic strategy. This strategy not only anticipates future technological advancements but also ensures the adaptability of the operating room to the evolving landscape of healthcare delivery.

Moreover, the early integration of building systems specialists allows for a proactive stance on sustainability, energy efficiency, and the creation of an environment that prioritizes the well-being of both patients and healthcare staff. By embracing this comprehensive and integrated approach, the design process becomes a cohesive endeavor that sets the stage for an innovative operating room, blending cutting-edge technology with operational efficiency and a commitment to the highest standards of healthcare delivery.

MANUALS IN TOOL KIT:

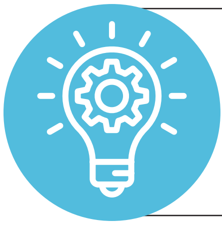
1. How we begin - Developing the Team
2. **Design in Depth - building codes, room types, terminology.**
3. Construction Projects Steps
4. Reading construction Documents
5. Design Guide for SPD
6. Infection control and prevention



"Obstacles do not block the path; they are the path"

- Zen Proverb

Phases of a Project



VALIDATION

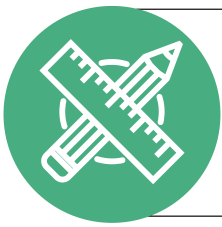
Big Picture

- 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

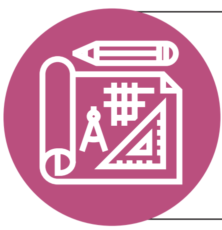
- Department adjacencies and locations
- Critical flows (review and improve)
- Site plan layout
- Building footprint/massing
- Capture future space needs
- Confirm scope and costs
- Opportunities for innovation



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

The icons on this page are distributed throughout the manuals and provide a quick reference to the phase of the project. Each icon will provide the reader with a quick reference and understanding of the current phase of the project and what decisions should be made or should have been made leading up to that moment.

The six phases of a construction project begin with **Initiation and Concept**, where initial planning and stakeholder discussions define the project's purpose and feasibility. This is followed by **Planning and Design**, involving the development of detailed plans and blueprints, and securing necessary permits. **Pre-Construction** includes site analysis and finalizing contracts, setting the stage for **Procurement**, where materials and labor are acquired. **Construction** is the phase where the building takes shape, with site preparation and the installation of systems and finishes. Finally, **Close-Out and Handover** ensures the project is completed to specifications, with a final inspection and transfer of the completed project to the client.

Medical Equipment

What considerations should go into ordering equipment?

When ordering equipment, consider the time that is required between ordering and delivery, the length of the bid process, and the date the building is projected to be ready for the install. Some equipment may have to be installed before the building is completed. If the equipment arrives too early or too late,then additional storage may be required or construction may have to be put on hold until the equipment arrives, resulting in additional expense.

Consider the challenges around design-deferred equipment specifications. Designed-deferred equipment planning is a planning option chosen for selected large projects when construction documents need to be completed in advance of final equipment specifications. "Best guess" architecturally significant equipment specifications are provided to the architect or planner when required for initial construction documents. Adequate contingency funds should be allocated to modify plans at an agreed upon date, and the project schedule should be developed to allow for revisions as required

Lead Time Awareness: Consider the time required for ordering and delivery, factoring in lead times for equipment procurement.

Bid Process Duration: The bid process duration impacts the overall timeline, and understanding it is crucial for seamless equipment procurement. Synchronization with Building Readiness: To avoid storage challenges or construction delays, synchronize equipment orders with the projected building completion date.

Installation Timing: Some equipment may need to be installed before the building is completed, requiring careful coordination to prevent disruptions.

Storage Needs: Early or late arrivals may necessitate additional storage or construction delays, leading to additional expenses.

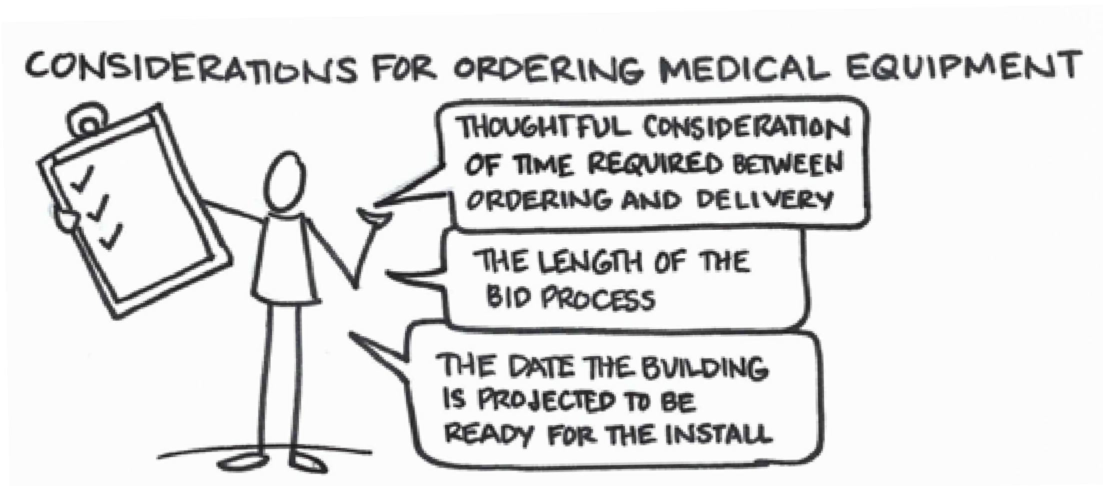
Challenges with Design-Deferred Equipment Specifications: It's a planning option for large projects where construction documents are completed before final equipment specifications. Initial "best guess" specifications are provided to the architect.

Architectural Significance: These specifications are crucial for architectural considerations and need to be provided to the architect or planner during the initial construction document phase.

Contingency Fund Allocation: Adequate contingency funds should be allocated to accommodate potential modifications to plans at an agreed-upon date.

Project Schedule Flexibility: The project schedule should allow flexibility for revisions as required, ensuring adaptability to evolving equipment specifications.

In summary, thoughtful consideration of lead times, bid processes, building readiness, installation timing, and potential challenges in design-deferred equipment planning can significantly contribute to the success and cost-effectiveness of a new surgical suite design phase.



Buiding Code Requirements

What are building codes, and what codes apply to this project?

Building codes prescribe requirements for various building elements. The architect should refer to local building codes, other relevant laws, and national standards including the:

- Americans with Disabilities Act,
- NFPA 101 (Life Safety Code),
- NFPA 99, and the
- International Building Code.
- The Facility Guidelines Institute (FGI)
- Guidelines for Design and
- Construction of Hospitals and
- Outpatient Facilities are adopted as the code for clinical-related requirements in many states.

The FGI Guidelines provide the minimum building requirements for health care facilities and are an important reference for the entire team (See Table 1 for the FGI and ASHRAE minimum standards as they apply to the operating room). In some locations, the city building codes differ from the county codes, which differ from the state codes. When there is a conflict in requirements, the most stringent will generally take precedence. The design team should be aware of the applicable building codes that will be enforced by the authority having jurisdiction in their locale.

Examples of code requirements for surgery department design:

- Corridor width: 8 ft 0 inches where patients are being transported
- Door widths: Minimum 36 inches recommended in rooms and minimum 88 inches for cross-corridor door configurations
- Door locking: Certain doors that are locked for security reasons must have locks that release upon activation of the fire alarm system
- Quantity of electrical and medical gas outlets
- HVAC room air changes and pressurization

Responsibilities

Every state health department has a building regulation department, a valuable resource for your construction project. To obtain information, visit the website and search for terms like hospital building requirements or ASC building regulations. You can also call the department with any questions to get directed to the right person.

A vital website that will provide information on building requirements is CMS.gov. Use the search bar in your browser to find the CMS .gov website. Once on the website, use the search bar to find answers to your questions. Hospitals and ASCs follow Conditions of Participation (CoPs) and Conditions for Coverage (CfCs) to remain compliant and a part of the Medicare and Medicaid program. CMS has building regulations that you must follow as a participant in these programs. Note CMS does not always follow the latest building codes from NFPA and FGI. Knowing what version of codes you are to follow is essential.

The National Fire Protection Association (NFPA) website is an essential resource for your building project. Its website address is https://www.nfpa.org. The older NFPA regulations are accessible on the website, but the newer codes must be purchased.

The Facility Guidelines Institute (FGI) develops building guidelines. AORN has a voice in the guidelines for perioperative settings. The organization has guidelines for hospitals and ambulatory surgery centers. You can purchase the guidelines. The organization's website is fgiguidelines.org. Not all states use the FGI guidelines. Know what your state requires in building codes for a healthcare facility.

EXAMPLE OF FGI

Describe the changing criteria and making sure to align with current standards **(watermark with year of publication)**

Table 1: FGI[1,2] and ASHRAE Minimum Standards[3]*

Inpatient OR	**Requirements**
Square footage	400 sq ft
Clearance	Clear dimension of 20 ft
Waste anesthesia gas removal system	1 required
Electrical outlets	24 with 16 convenient to table placement and 2 on each wall
Medical air outlets	1 required
Vacuum outlets	5 required
Emergency staff assistance station	1 required
Oxygen outlets	2 required
Code call station	1 optional
Outpatient OR	
OR where anesthetics will not be administered using an anesthesia machine and supply cart	255 sq ft with clearance of (i) 6 ft (1.83 m) on each side (ii) 5 ft (1.52 m) at the head and foot
OR where anesthetics will be administered using an anesthesia machine and supply cart	270 sq ft with clearance of (i) 6 ft (1.83 m) on each side (ii) 6 ft x 8 ft (1.83 m x 2.4 m) at the head. This shall result in an anesthesia work zone with a clear floor area of 48 sq ft (4.46 sq m) (iii) 5 ft (1.52 m) at the foot
OR where surgery that may require additional staff and equipment will be performed	400 sq ft with clearance of (i) 8 ft 6 inches (2.59 m) on each side (ii) 6 ft (1.83 m) at the head. This dimension shall result in an anesthesia work zone with a clear floor area of 48 sq ft (4.46 sq m) (iii) 7 ft (2.13 m) at the foot
Waste anesthesia gas removal system	1 required where inhalation anesthesia will be administered.
Electrical outlets	18 with 12 convenient to table placement and 2 on each wall
Medical air outlets	1 required (may be supplied by a portable system)
Vacuum outlets	3 required
Emergency staff assistance station	1 required
Oxygen outlets	2 required
HVAC Requirements for Inpatient and Outpatient ORs	
Air exchanges per hour	20
Outdoor air changes per hour	4
Temperature	68° F to 75° F (20° C to 24° C)
Relative humidity	20% to 60%
Pressure relative to all surrounding areas	Positive
Air recirculated by means of room units	No

References

1. *Facility Guidelines Institute, American Society for Healthcare Engineering.* Guidelines for Design and Construction of Hospitals. *Chicago, IL: American Hospital Association; 2018.*
2. *Facility Guidelines Institute, American Society for Healthcare Engineering.* Guidelines for Design and Construction of Outpatient Facilities. *Chicago, IL: American Hospital Association; 2018.*
3. ANSI/ASHRAE/ASHE Addendum h to ANSI/ASHRAE/ASHE Standard 170–2013: Ventilation of Health Care Facilities. *Atlanta, GA: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc; 2016. https://www.ashrae.org/File%20Library/docLib/StdsAddenda/170_2013_h_20160523.pdf. Accessed October 3, 2018.*

*** The FGI Guidelines, which are minimum standards, are reviewed and revised every 4 years, and national and local regulations change periodically. The team should make certain to reference the documents adopted within the state of application. The current standards may be able to be used as a guide for the construction project but, remember, they are minimum standards and can be exceeded but not decreased from the edition adopted in that jurisdiction.**

Construction Type

The selection of construction products for building projects depends on various factors, including the type of construction, intended use of the facility, and compliance with building codes. Here's an overview of potential construction products and considerations for inpatient and outpatient surgical facilities:
Wood Framing: Suitable for various building types but may have limitations in structures with strict fire-resistance requirements.

Concrete Frame: Non-combustible and often used in structures where fire resistance is a crucial consideration.

Steel Frame: Common in commercial and industrial construction, offering fire resistance and design versatility.

Masonry Construction: Offers durability and fire resistance, suitable for various building types.

Metal Stud Framing: Lightweight, non-combustible, and suitable for partition walls.

Glass and Glazing: Used for aesthetic appeal, natural light, and energy efficiency.

Insulation Materials: Essential for energy efficiency and comfort.

Roofing Materials: Depends on climate, aesthetic preferences, and performance requirements.

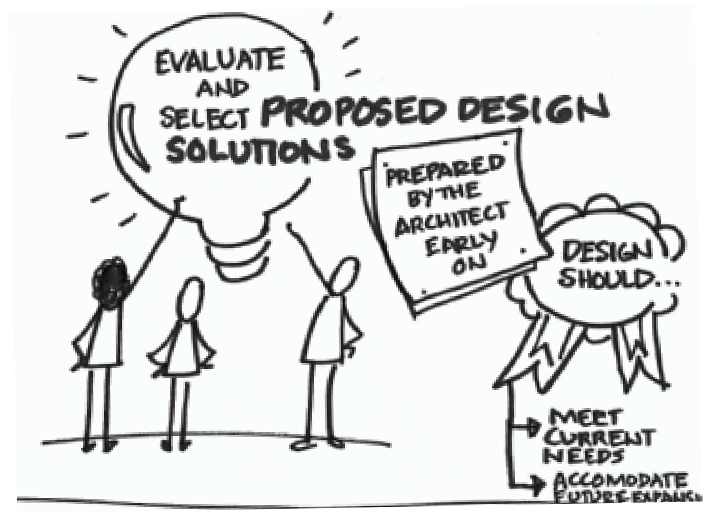
Flooring Materials: Varies based on the function of the space and infection control requirements.

HVAC Systems: Crucial for maintaining a comfortable and sterile environment, especially in surgical suites.

Fire-Retardant Materials: Critical in meeting fire safety regulations, especially in healthcare facilities.

Inpatient surgical suites, due to their critical nature, often require more stringent construction types to ensure safety and compliance with healthcare regulations. Outpatient surgical facilities, while also prioritizing safety, may have more flexibility in construction types based on their specific needs and regulations.

To determine the appropriate construction materials and types for a specific location, consulting local building codes and regulations is essential. These codes define and classify construction grades, providing guidance on the materials that can be used based on safety and structural requirements. A vetted and qualified design partner will help the team understand the pros/cons of the facility needs.



MANUALS IN TOOL KIT:

To enhance the environmental friendliness of a construction project, several steps can be taken, with a primary focus on conducting an environmental impact assessment and making informed decisions regarding construction materials and design features. Here are key actions to promote sustainability in construction:

Perform an Environmental Impact Assessment

Select Sustainable Building Materials

Energy-Efficient Design

Water Efficiency

Waste Management Plan

Green Certifications and Standards

Life Cycle Assessment

Local Sourcing

Community and Stakeholder Engagement

Continuous Monitoring and Improvement

By integrating these actions into the construction project, the overall environmental impact can be minimized, contributing to a more sustainable and eco-friendly built environment.

Ideal Future State (EBD)

Efficient staff and material flow in an operating room (OR) is crucial for ensuring patient safety, optimizing surgical procedures, and maintaining a sterile and organized environment. Here are key considerations for staff and material flow in an operating room:

STAFF FLOW:

Entrance and Exit Points: Clearly define entry and exit points for the OR staff. Separate clean and dirty areas to minimize the risk of contamination.

Changing and Scrubbing Areas: Design dedicated spaces for staff to change into surgical attire and scrub before entering the OR. These areas should be well-organized and equipped with sinks and necessary supplies.

Traffic Patterns: Establish clear and efficient traffic patterns within the OR to prevent congestion. Designate specific pathways for different roles, such as surgeons, nurses, and anesthesiologists.

Sterile Core Zone: Create a sterile core zone within the OR where only sterile personnel and equipment are allowed. This helps maintain aseptic conditions during surgery.

Staff Communication: Implement effective communication systems, such as intercoms or digital displays, to facilitate communication among staff without compromising sterile conditions.

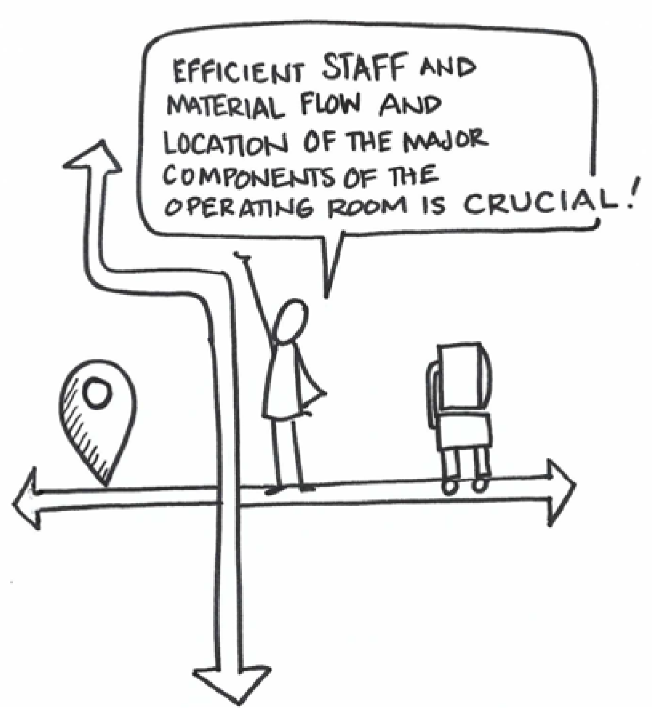
Wellness: Consider staff wellbeing

Storage for Personal Items: Provide designated storage for personal items to prevent clutter in the OR. Staff should have easy access to essential personal belongings without compromising sterility.

Accessibility to Equipment: Ensure that staff have easy access to necessary equipment, tools, and supplies. The layout should minimize unnecessary movements and enhance workflow efficiency.

Emergency Exit Routes: Clearly mark emergency exit routes and ensure that staff are familiar with them. This is crucial for swift evacuation in case of emergencies.

Ideal Future State (EBD)



MATERIAL FLOW:

Central Supply Area: Designate a central supply area within or near the OR for easy access to sterile supplies and equipment. This minimizes delays during surgery.

Just-In-Time Delivery: Implement a just-in-time delivery system for supplies to avoid overstocking and clutter. This ensures that necessary items are readily available without excess storage.

Sterile Processing Department (SPD) Connection: Establish a direct connection or proximity between the OR and the Sterile Processing Department to facilitate the timely delivery of sterilized instruments and equipment.

Storage Solutions: Design storage solutions, such as cabinets and shelving, to organize and store supplies efficiently. Implement a logical arrangement based on the frequency of use.

Disposable Waste Management: Establish a seamless process for managing disposable waste during and after surgery. Clearly label bins and containers for proper disposal.

Equipment Accessibility: Ensure that equipment is strategically placed for easy access by surgical staff. This includes positioning anesthesia machines, monitors, and other devices in convenient locations.

Integration of Technology: Utilize technology, such as electronic tracking systems, to monitor and manage inventory. This can enhance the efficiency of material flow and reduce the risk of shortages.

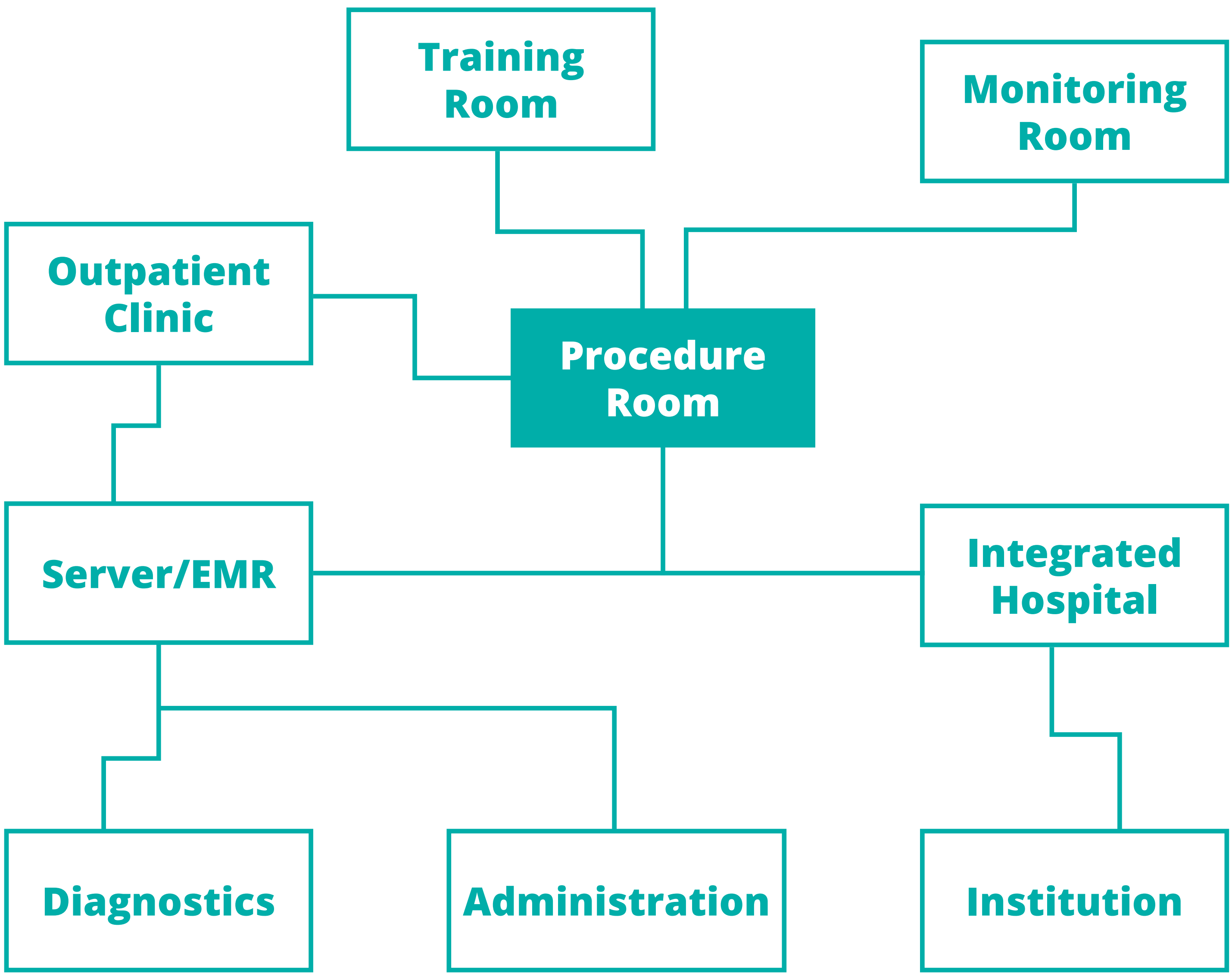
Regular Audits and Reviews: Conduct regular audits of material flow processes to identify areas for improvement. Engage staff in regular reviews to gather feedback and implement changes accordingly.

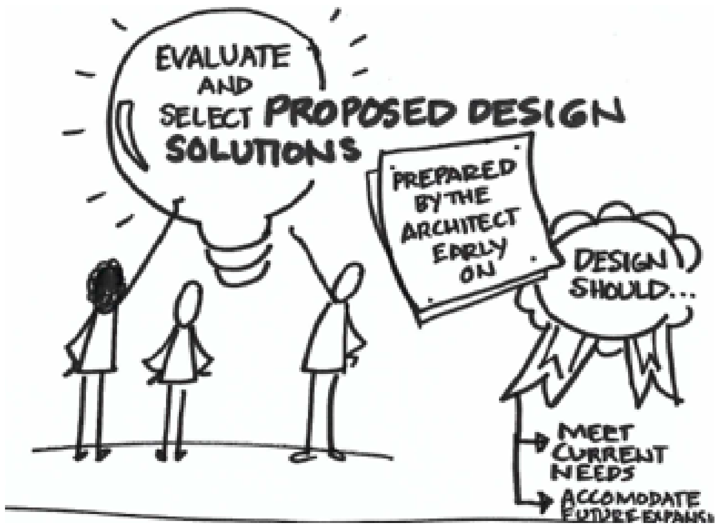
By carefully considering staff and material flow in the operating room, healthcare facilities can enhance efficiency, reduce the risk of errors, and create a safer and more streamlined surgical environment. Regular training and communication are essential to ensure that staff are familiar with the established flow protocols.

TECHNOLOGY CONSIDERATIONS AND INTEGRATION:

An (AI supported) Integrated Operating System for operating rooms combines medical devices, communication systems, electronic health records, and surgical navigation to streamline workflows. It integrates with PACS for image management, incorporates smart OR technology, and facilitates data and video management. The system optimizes surgical processes, from scheduling to post-operative care, enhancing efficiency and patient safety. Security measures protect sensitive data, and integration with telemedicine enables remote collaboration. With instrument tracking and advanced technologies, the integrated system aims to create a connected and efficient surgical environment, improving outcomes and providing a technologically advanced patient-centered experience. Specific features may vary based on facility requirements.

Early consideration of an Integrated Operating System in a project is essential for comprehensive planning, efficient workflow design, and effective integration of technologies. This proactive approach sets the foundation for a successful implementation, optimal resource allocation, and improved healthcare.





Considering an Integrated Operating System early in a project is crucial for several reasons:

System Integration Planning: Early consideration allows for comprehensive planning of how various components and technologies will integrate seamlessly. This ensures that the infrastructure and design can support the chosen integrated system.

Infrastructure Design: The physical layout of the operating room, including power sources, network connectivity, and equipment placement, needs to be planned to accommodate the integrated system. Addressing these considerations early avoids costly retrofits later in the project.

Budget Planning: Early consideration allows for accurate budgeting. Understanding the costs associated with the integrated system, including hardware, software, and implementation, helps in allocating resources effectively.

Workflow Optimization: Planning early enables the optimization of surgical workflows. Designing the physical and digital environment to enhance communication, accessibility, and efficiency contributes to better patient care.

Customization to Facility Needs: Different healthcare facilities may have specific requirements. Considering the integrated system early allows for customization to meet the unique needs and preferences of the facility and surgical teams.

Vendor Selection: Early consideration facilitates thorough research and selection of vendors that align with the facility's goals and requirements. This ensures a smooth procurement process and effective collaboration with chosen suppliers.

Technology Advancements: The field of healthcare technology is dynamic. Considering the integrated system early allows for the incorporation of the latest technological advancements, ensuring that the system remains cutting-edge throughout the project and beyond.

Training and Familiarization: Planning early enables the development of training programs for medical staff. Familiarizing them with the integrated system in advance ensures a smooth transition to new technologies and minimizes disruptions during implementation.

Regulatory Compliance: Healthcare systems must adhere to regulatory standards. Considering the integrated system early allows for alignment with regulatory requirements, ensuring that the facility operates within compliance from the outset.

Patient Safety and Care: An integrated system contributes to improved patient safety and care. Early planning ensures that patient-centric features are incorporated, contributing to a more seamless and efficient surgical experience.

Room Types

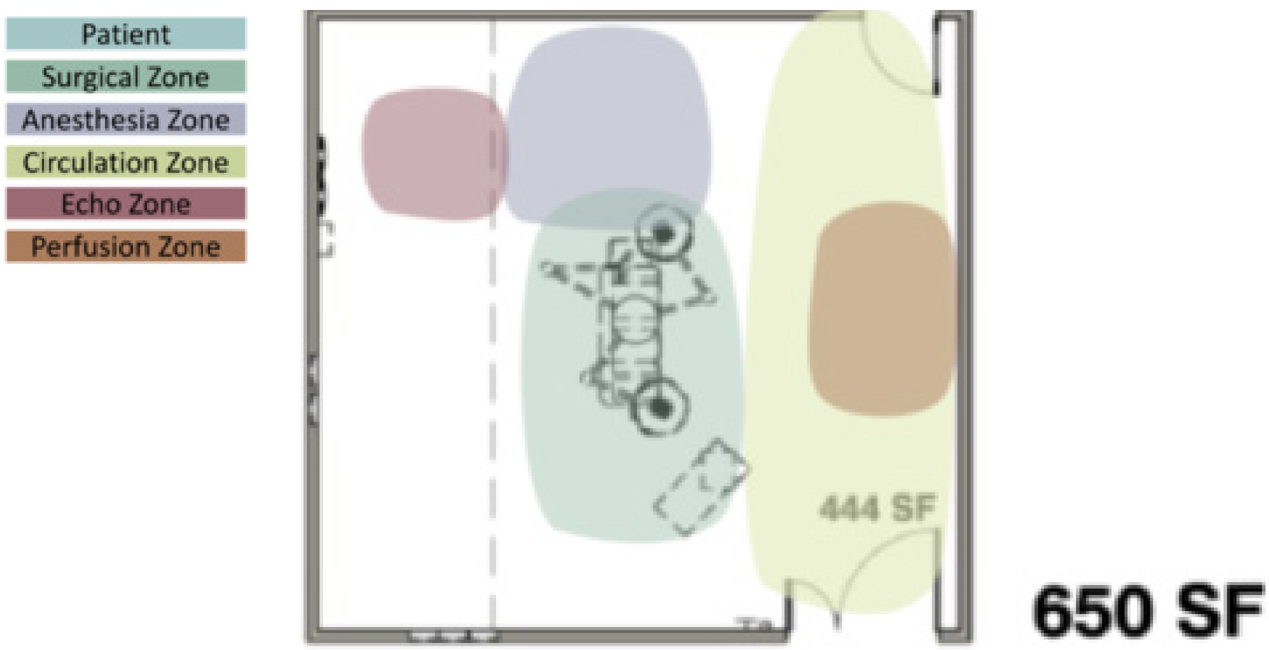
GENERAL ROOM TYPE

Typically, these rooms will include an integrated video suite with equipment booms and anesthesia booms. Anesthesia gases should be located such that the head of the bed can be turned in any direction. This may be accomplished by having an anesthesia mobile boom at each end of the OR. As you enter the OR from the outside, one boom may be placed near the right-hand wall and one near the left-hand wall. These rooms usually contain two or three light heads and two 26-inch video monitors from the light base. The room may also have an in-room camera mounted on the wall and a large screen monitor mounted on the wall. There may also be an in-light camera. Typically, there is a stainless steel storage cabinet in the room for supply storage.

Recommended size: 400 to 700 sq ft based on the types of procedures performed in the room,including the type of equipment and the number of people present during the procedure.

OTHER CONSIDERATIONS

- Orientation of the OR:
  Where will the head of the bed be located?
  (eg, north to south, east to west, diagonal)
- Standardized workflow—same-handedness of all ORs, not mirror images
- Movable versus fixed supply storage cabinet
- Documentation station positioned so the RN circulator can see the patient at all times



Room Types

HYBRID ROOMS

These are very complex rooms that are created by adding a fixed imaging modality to an operating room. The fixed imaging modality may be radiation based (eg, fixed C-arm), a magnetic resonance imaging (MRI) scanner, or a computed tomography (CT) scanner. The hybrid OR has three components: the OR, a control room, and a system component room. The control room is the area in which the person controls the imaging modality. The systems component room is where the electronic components of the modality are located.

In the hybrid room, there is frequently a large amount of equipment coming from the ceiling,including the lights (usually 3) and video monitors, frequently two 26-inch and one large monitor that is on its own boom that can swing from the right side of the patient to the foot and then to the left side. This monitor is frequently at least 60 inches and able to capture at least six to eight images at the same time.

The imaging modality may be ceiling mounted or floor mounted, and some are fitted with robotic C-arms for advanced imaging. There is usually a large amount of cabinet space to hold long catheters and other surgical supplies.

Recommended size: 900 sq ft minimum. This does not include the control room or the system component room. The specifications for the OR, including the size, should be driven by the type of procedures and medical equipment required to perform surgeries and number of personnel required to provide care.

OTHER CONSIDERATIONS

- When a hybrid OR is to be included in the construction or renovation project, the hybrid room should have the following characteristics:
- Sized to accommodate the equipment to be used based on the manufacturers' specifications (eg, booms, monitors, perfusion, anesthesia, lead shielding).
- Dialogue with equipment vendors about boom and imaging equipment placement should begin early because this will drive a successful design.
- Have radiation protection based on the type and amount of protection required for the type of imaging modality used.
- Include the space or square footage for the imaging modality control room and systems component room.
- Have, at a minimum, the same traffic restrictions and ventilation system requirements as an OR. The imaging vendor will have requirements stating how cool the room must be kept if it exceeds the OR requirements.
- If this room will also be used as a “standard” OR, evaluate the OR bed location.
- If using a fixed OR bed that is included in the imaging package, assess the bed position.
- If using a standard OR bed, determine whether it may be used for non-imaging cases.
- Determine whether this room and/or imaging modality require an uninterrupted power supply source to maintain functionality during electrical interruptions.
    - Consider the no fly zone because light booms, equipment booms, and monitors frequently hang from the ceiling, and lead shields may hang from a boom or from the imaging modality.

Room Types

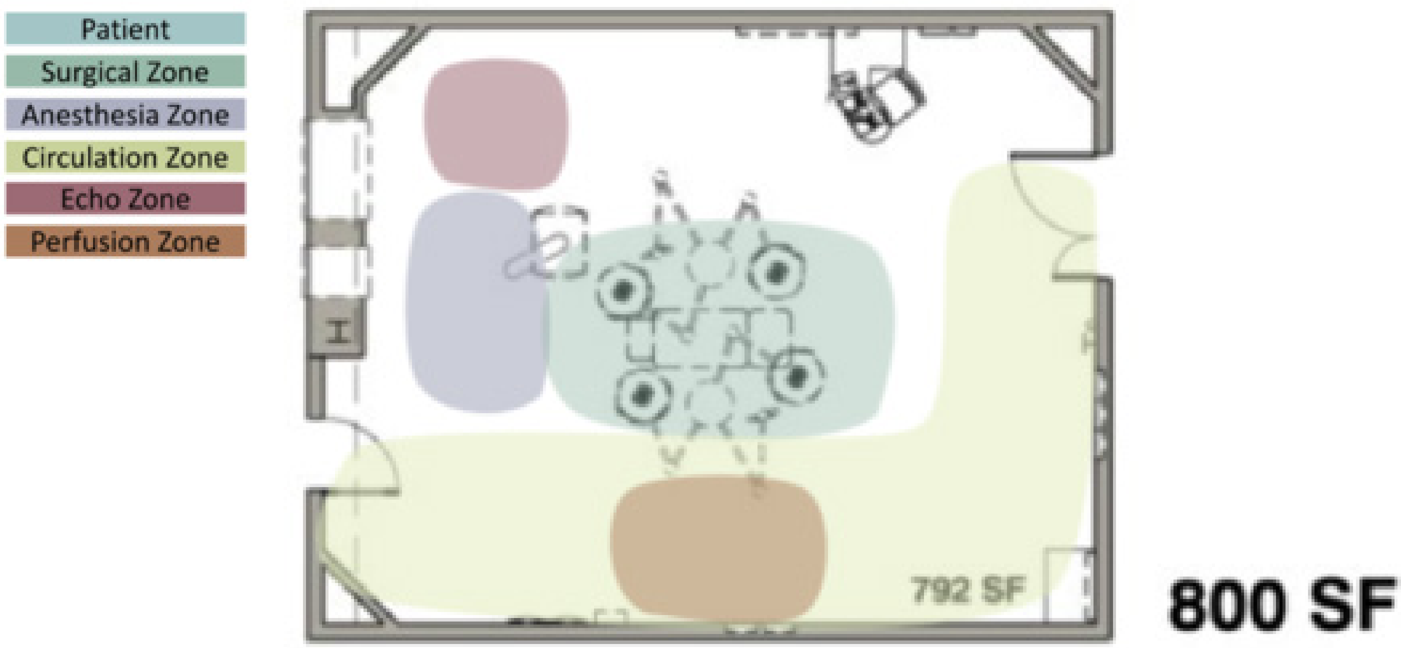
HYBRID MRI ROOMS

These are a combination of a general purpose inpatient OR and an MRI suite. These may be built so that the MRI can be used for inpatient or outpatient studies when not in use by the OR. This is done by having a large door that can be opened so the OR patient can be moved into the magnet from the OR next door. This also requires that the MRI suite have access to a main corridor for inpatient access. In some designs, the magnet maybe located between two ORs and moved into the OR where it is needed.

Recommended size: Minimum 1600 sq ft for the OR and MRI suite, control room, and equipment room.

OTHER CONSIDERATIONS

- If the MRI suite will be used for other patients while the OR is in operation, assess the sound proofing required to minimize sound in the OR.
- When a hybrid MRI room is being designed, the team should determine MRI safety precautions (eg, identify equipment that is compatible with MRI, how the OR will communicate with the MRI suite, when it's appropriate to move patients or open the door to move patients between the OR and MRI suite)
- If there is to be a shared door, it must be determined who will control the door, the location of door control, and the method of communication.
- Determine whether this room and/or the imaging machine requires an uninterrupted power supply source to maintain functionality during electrical interruptions.



Room Types

ELECTROPHYSIOLOGY (EP) LAB

Frequently built as rectangle shape with a control room at the short end wall by the entry door. These rooms are built with vascular imaging equipment that includes a floor- or ceiling-mounted C-arm. An imaging table is usually fixed to the floor. There is the same equipment from the ceiling as in the hybrid suite. Light booms, equipment booms, and lead shields often hang from a boom, and monitors hang from the ceiling.

Recommended size: 650 sq ft with an additional 150-sq-ft control room.

OTHER CONSIDERATIONS

- May have a combination of x-ray and MRI

CATHETERIZATION LAB

Very similar to the EP Lab with slightly different imaging equipment.

Recommended size: 650 sq ft with an additional 150-sq-ft control room

INTERVENTIONAL RADIOLOGY LAB

Same as the EP lab.

Recommended size: 650 sq ft with an additional 150-sq-ft control room

OTHER CONSIDERATIONS

- May be considered an OR depending on the types of procedures performed.

LABOR & DELIVERY/ CESAREAN DELIVERY ROOM

May be located in the surgical suite or in the obstetric suite. Usually built in rectangle shape with a medical gas station near the door for the infant resuscitation area. These rooms frequently contain two OR light heads and stainless steel supply storage cabinets.

Recommended size: 550 sq ft including an additional 80-sq-ft infant resuscitation area

OTHER CONSIDERATIONS

- Most cesarean delivery rooms have wall gas/suction outlets for the baby area placed at the mother's shoulder level near the head of the bed so the infant can be seen by the mother.
- Consider including two computer stations that provide a location for the neonatal RN and the RN circulator to chart.
- Any OR that is large enough to accommodate the necessary people and equipment can be used as a cesarean delivery

ROBOTICS OR

A robotics suite should be an integrated video suite with two monitors and two surgical lights from the ceiling. Additional space may be needed in a teaching hospital. In a teaching hospital, the room should be designed so that it can accommodate two physician consoles. There are some interesting special designs for teaching hospitals with the consoles located in a room between two OR suites. Thought should be given to whether the robot will be stored in the room and, if so, what space is required for its storage.

Recommended size: 900 sq ft minimum

OTHER CONSIDERATIONS

- Consider mounting the robot onto a boom and turning the bed.
- Consider having a dedicated circuit and uninterruptible power source system.
- Consider using retractable cables built into the wall.

Room Types

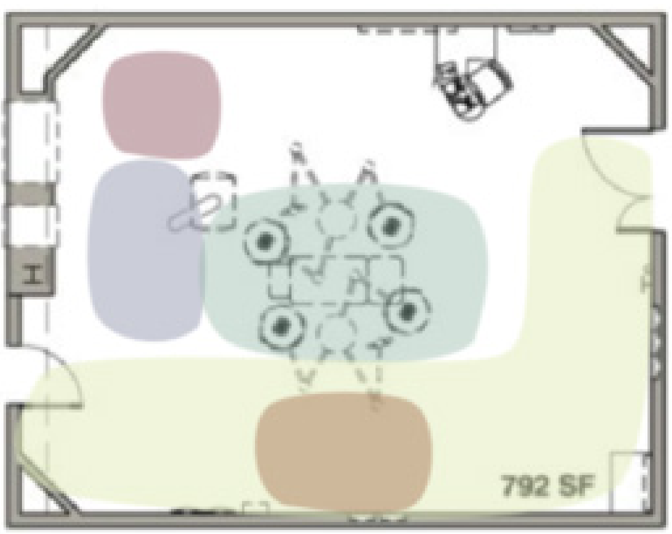
CARDIAC/TRANSPLANT OR

Very similar to the general purpose OR except larger and may have additional gas and vacuum lines. These rooms usually have a room somewhere nearby where the perfusion equipment and supplies are stored.

Recommended size: 800 sq ft. The perfusion room should be 250 to 300 sq ft, depending on the number of perfusion machines stored.

OTHER CONSIDERATIONS

- If intraoperative dialysis capability will be required, this requires specific plumbing capabilities.
- Include a boom for perfusion gases and other needs.

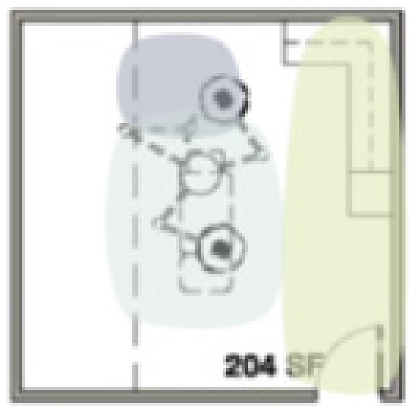


800 SF

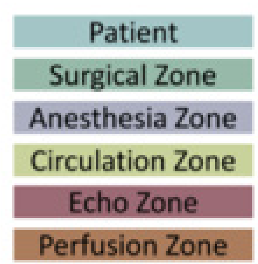
PROCEDURE ROOM

These are usually located near the OR but do not have to be. They are typically used for “lump and bump” type cases that require just local anesthesia and no anesthesia personnel. Typically, there is a sink and cabinets for supply storage. Remember that a surgical procedure that requires the restricted environment of an operating room cannot be performed in a procedure room.

Recommended size: 200-400 sq ft. Size needs to be increased if general anesthesia will be administered in this room.



320 SF



FIRE SAFETY SYSTEMS

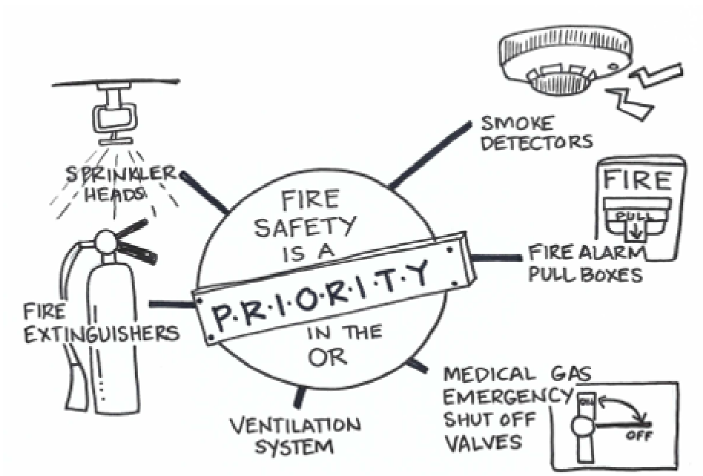
What is needed in an OR for fire safety?

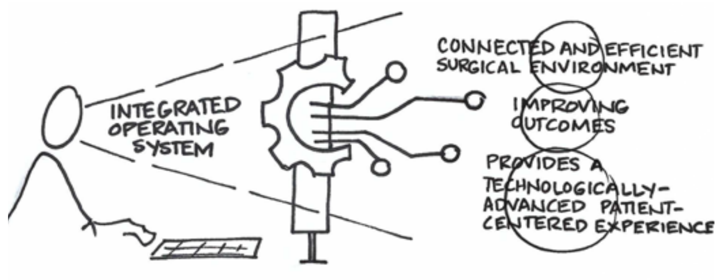
Fire safety is a priority in the OR. Smoke detectors, sprinkler heads, fire alarm pull boxes, fire extinguishers, and medical gas emergency shut-off valves are essential fire safety elements. The ventilation system will help maintain OR pressure in the event of a fire.

HVAC SYSTEMS

What is included in an HVAC system, and are there special settings that apply to an OR?

Guidelines for HVAC systems include the recommended ventilation rates, humidity levels, pressurization, and temperatures for operating rooms. The biomedical engineering department will monitor the HVAC systems to ensure ventilation and air exchange rates meet recommended standards. HVAC systems must be connected to the emergency power system in the hospital as required by the NFPA Standards for Healthcare Facilities and the National Electric Code (NEC). In all cases, avoid singlesource HVAC systems because there is a risk of having a non-functioning department on loss of the single HVAC unit. Where possible, provide multi-stage units or units with multiple fans so that if one component fails, the system is not lost. There are myriad options for air supply to an OR, including laminar airflow and air curtains. A risk/benefit/cost analysis should be performed during the planning phase to determine the appropriateness of a unidirectional/ultraclean system. If a unidirectional/ultraclean airflow is to be used, the analysis should include the direction of the airflow (eg, from ceiling to floor, lateral).





An additional consideration for the HVAC system is whether a ventilation setback strategy will be used for periods when the OR is unoccupied. A ventilation setback strategy provides a cost savings by allowing the amount of air supplied to an OR to be reduced when the room is not in use. An HVAC system setback that reduces the number of air changes per hour may be used if the temperature and humidity settings are maintained within HVAC system design parameters and the positive-pressure relationship of the OR to the adjacent area is maintained. A risk/benefit/cost analysis should be performed during the planning phase to determine the feasibility of such a system. The analysis of ventilation system setback should include:

- actual or projected usage
- the needs, preferences, and perceptions of the system's users
- local climate
- facility type (eg, hospital, ambulatory surgery center)
- applicable local building code requirements
- existing ventilation system design
- cost of system maintenance
- energy savings
- necessary components of the system (eg, occupancy sensor, manual control, timed control, combined control)

The area of highest pressure is the OR, and all areas around the OR are negative compared to the OR. Another way to say this is: if the OR doors are open, the air always flows out of the OR.

LIGHTING SYSTEMS

What is included in the lighting system for an OR, and what are alternative lighting arrangements?

The OR lighting system should provide light for monitoring the patient, illuminating the surgical field, and performing other patient care tasks. The system should have a low operating and maintenance cost and be on a separate electrical circuit. Dimmable lighting should be considered if there is a need for this feature, such as during minimally invasive surgery. Battery-powered emergency lighting must be installed in each room.There are numerous types of lighting fixtures on the market and all have some benefits and some disadvantages. LED fixtures have come down substantially in price and have become the lighting type of choice due to long lamp life and the ability to brightly illuminate and also dim the lighting with one fixture.

The surgical field lighting system should:

- be positioned to ensure that surgeons have adequate lighting for procedures
- cause minimal interference with air circulation
- cause minimal interference with other ceiling-mounted equipment
- provide the ability to focus and control the spot size
- generate only minimal heat
- require minimal time and effort for lamp replacement
- provide the desired color and temperature
- Address eye fatigue with green and brown light
- limit the amount of shadow produced
- be easy to clean
- require a low amount of energy for movement and focusing
- provide the ability to control settings at the sterile field

There are lighting fixtures available that have built-in ability to provide a level of disinfection, such as ultraviolet lights. A risk/benefit/cost analysis should be performed during the planning phase to assist in determining whether ultraviolet light will be used. The risk/benefit/cost analysis should include the design of the light system to be used (eg, within the duct work, upper room, downward pointing, portable), the safety measures required (eg, protective clothing, eyewear), and room downtime and other use restrictions

ELECTRICAL POWER

What is included in the electrical power system for an OR?

What is a universal power source and is one required for an OR?

Abundant electrical capacity is a must to be able to adapt to current equipment and user needs. The main electrical lines, panels, and other components should be sized for the future needs of the surgical department and their location ideally planned to accommodate easy access for maintenance and future expansion.

Electrical power can be provided to the OR by standard grounded power, ground fault circuit interrupters (GFCIs), or isolated power. Isolated power circuits are isolated from ground by an isolation transformer. In the event of a fault, the power is not interrupted, and the OR can continue to function safely. A wall-mounted line isolation monitor is required.

Essential electrical systems have at least two sources of power: normal power to run all electrical operations and additional sources, such as a generator, to continue power when the normal power is interrupted. By code, facilities are required to maintain certain components associated with life safety, even on the loss of normal power. In a surgical suite, there are additional items that would ideally be powered, even if this is not code required. The number and size of emergency generators is a key consideration. In instances where one or more generators are out of service, redundancy (ie, having other generators to assume the electrical load) is suggested and in many cases required by code.

Paralleling gear is also a good idea because it connects and synchronizes multiple generators. Although expensive, the paralleling gear gives the greatest flexibility.

An uninterrupted power source (UPS) system which consists of battery units that provide temporary power may be considered. These are particularly useful for imaging equipment in a surgery department.

The UPS provides an intermediate power supply to bridge the time period between the loss of power and activation of the emergency generators.

To determine the need for UPS backup for computer-based medical equipment:

- Evaluate new equipment with battery backup capability.
- Evaluate new equipment requiring UPS.
- Determine UPS requirements for mission-critical equipment, (eg, in high-tech ORs including hybrid OR and/or iMRI OR).
- Consider full-room UPS.
- Consider equipment-only UPS.

Determine UPS for mission-critical equipment in sterile processing areas (eg, washer/disinfector and sterilizers)

ELECTRICAL OUTLETS

How many electrical outlets are required and where should they be placed?

Guidelines state the minimum number of receptacles or outlets required in each OR. Electrical outlets can be located on walls, dropped from the ceiling, and mounted on booms or columns. Outlets should be placed strategically around the room, near likely locations of equipment. If electrical outlets are placed on equipment booms, an assessment of the electrical requirements of the equipment that will be attached to the boom should be performed to determine the number of electrical circuits that are required.

PLUMBING

What should be considered for plumbing?

Floor drains should not be installed in the OR nor should drain pipes be installed in the ceiling of the OR. No sinks of any kind should be installed in an OR.

Boilers will supply heating, hot water, and steam sterilization to support the operating rooms. There should be more than one boiler to provide continuous service during maintenance and service of a boiler. If intraoperative dialysis is planned, a closed plumbing system is required. Every OR requires a scrub sink but the scrub sink can be shared by two ORs if it is located close to the entrance of both.

PIPED GASES

What is required for gas piping, and what gases should be in the OR?

Guidelines specify the number of oxygen and vacuum outlets for operating rooms. The team's anesthesia provider should be able to help determine the number of outlets for gases that need to be piped into the OR. Options for determining how the gas connections will be configured into the room include wall outlets,

fixed columns, multi-service articulated arms (booms), and hose drops from the ceiling. Each option should be evaluated for its advantages and disadvantages regarding cost, ease of installation, safety, flexibility, and maintenance.

NURSE CALL SYSTEM

What is required for nurse call systems?

Guidelines specify that an emergency assistance system for personnel to call for help will be located in each OR. The system should signal visually and audibly and be compatible with the nurse call system used in the rest of the facility. Ensure that the call system includes communication between the control area and each room. The system may include the ability to call the waiting area from each OR.

SECURITY SYSTEM

Is a security system needed for a surgical suite?

Each facility should include a system to control access to the OR and its support areas. Protections need to be in place to ensure that personnel, medical supplies, medications, and equipment are accessible only to authorized personnel. Comprehensive security management systems may include a host computer for data gathering, remote panels for alarm monitoring, video cameras for surveillance, intercoms and telephones for client communication, and access control devices for prevention and deterrence.

COMPUTER SYSTEM

What should be considered for a computer system?

The electrical source and cabling for the computer system should address the planned and future information technology needs of the surgical suite. Be sure that the system can accommodate access to the internet and intranet and the preferred method for patient charting. The family waiting areas and conference and consultation rooms should also have access. A wireless system may also be considered.

WAYFINDING SYSTEM

What are wayfinding systems and why are they needed?

Wayfinding systems provide direction, information, and identification of restricted areas. Clear directive signs should illuminate emergency exits and emergency equipment. Signs are also needed to direct patients and family members to admissions, restrooms, waiting rooms, and recovery areas and to prevent unauthorized access into semi-restricted or restricted areas

FAMILY WAITING AREAS

What should be included in a family waiting room?

Sometimes the interior designer chosen for the project is not familiar with the guidelines for hospital/ patient care area furniture composition. This situation may require some education from a representative of the internal team. When designing family waiting rooms, consider loungers for seating, group seating, a children's activity center, and a media bar.

CONSULTATION ROOMS

What should be included in a consultation room?

Wireless internet and cell phone reception and a computer station should be included in the consultation room because surgeons are using electronics or operative images to explain procedures and outcomes to families in addition to addressing the patient experience in the consultation room.These rooms should be quiet, calm, and have less-harsh light, because negative news is given to some families. Physicians may desire to have capability to exit the consultation room without walking through the family waiting area.

PATIENT/PERIOPERATIVE TEAM TRACKING SYSTEM

What is included in a real-time location service tracking system?

A real-time location service tracking system allows a patient's progress through admission, the preoperative area, the OR, the postanesthesia care unit, and transportation to be observed on a tracking board by the family in the waiting room and on tracking boards located in the surgical suite. The system also allows surgical/support teams to know patient readiness, promoting more efficient turnover times. Software programs are being used by several facilities that notify the surgeon that the patient has left the OR, the room is being turned over, the patient is entering the OR, and other statuses.

PREOPERATIVE NURSES' WORKSTATIONS (between private rooms)

Where should preoperative workstations be placed?

The preoperative workstation may be placed next to the patient rooms to increase RNs' efficiency and effectiveness (eg, the corner of two adjoining patient room walls can be angled to create a desk/workspace outside the patient rooms with the RN's back to the hallway). A preoperative workstation may also be a mobile device.

PREOPERATIVE/POSTOPERATIVE CARE AREAS

What needs to be considered related to the patient/visitor experience?

In addition to considering the size and number of preoperative and postoperative areas, address the need to promote a positive patient experience (eg, prevent recovering adult patients from being agitated by children waking from surgery and crying next door, allow families to sit with waking patients while providing privacy for the patient on the other side of the curtain)

ANESTHESIA EQUIPMENT

How much space is required for an anesthesia machine?

An increase in space may be needed due to new, updated machines. Older machines required a 4-sq-ft footprint, but new-generation machines require a 7-sq-ft footprint because of folding extensions,including anesthesia documentation computers with keyboards where the operator stands and documents.

IT-INTEGRATED SYSTEMS

If you will be using real-time location systems, patient care boards, or systems for streaming cases over the network, then the design should include the details for these systems.

FLOOR-TO-FLOOR HEIGHTS/ CEILING HEIGHTS

Competition for above-ceiling space in a surgical suite is a key consideration. Where possible, a floor-to-floor height of 15 to 16 ft is recommended to allow adequate space for main duct lines, overhead structural support for equipment, surgical lights, and other items.

FINISHES

All surfaces (eg, floors, walls, ceilings, cabinets) should be durable, smooth, and withstand cleaning chemicals.

In semi-restricted and restricted areas, floors should have a cove base with no seams or with sealed seams. When selecting flooring, note the color in relation to the ease of finding dropped needles, and investigate the durability of the surface as it relates to the ease of moving heavy equipment and ease of cleaning. A slip-proof surface should be considered, especially around scrub sinks.

Walls should be smooth with no seams or with sealed seams.

Cabinets should be made of laminate, stainless steel, or glass. Absorbent materials, including exposed wood, should not be used for cabinets and other furniture in the semi-restricted and restricted areas.

Ceilings in semi-restricted areas may be either monolithic or have drop-in ceiling tiles. Ceilings in restricted areas should be monolithic; drop-in ceiling tiles should not be used in restricted area.

Glossary of Terms

Community and Stakeholder Engagement:
Involve local communities and stakeholders in the planning process. Seek input, address concerns, and ensure transparency in decision-making. Consider the cultural and social aspects of the project.

Continuous Monitoring and Improvement:

Establish a system for ongoing monitoring of environmental performance. Regularly assess energy use, water consumption, and waste generation. Use feedback to implement continuous improvements and optimize sustainability efforts.

Energy-Efficient Design:
Incorporate design strategies that minimize energy consumption. This includes optimizing building orientation, using energy-efficient lighting and HVAC systems, and integrating renewable energy sources like solar panels.

Green Certifications and Standards:
Aim for certifications such as LEED, BREEAM, or other relevant green building standards. Complying with these certifications ensures adherence to recognized sustainability criteria.

Life Cycle Assessment:
Assess the environmental impact of the project throughout its life cycle. Consider not only the construction phase but also operation, maintenance, and eventual decommissioning. This holistic approach aids in identifying areas for improvement.

Local Sourcing: Prioritize locally sourced materials to reduce transportation-related emissions. Supporting local suppliers also contributes to the regional economy.

Perform an Environmental Impact Assessment:
Conduct a comprehensive assessment to identify and evaluate potential environmental impacts associated with the construction project. Assess factors such as energy use, emissions, water consumption, and habitat disruption.

Select Sustainable Building Materials:
Choose materials with lower environmental impact. Prioritize those with recycled content, renewable resources, and environmentally friendly manufacturing processes. Consider the embodied energy and carbon footprint of materials.

Waste Management Plan:
Develop a plan to minimize construction waste and maximize recycling. Clearly define waste separation procedures on-site, encourage reuse of materials, and work with waste management services to ensure responsible disposal.

Water Efficiency:
Implement measures to reduce water consumption. This may involve using water-efficient fixtures, capturing and reusing rainwater, and employing landscaping practices that minimize irrigation needs.

References

ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers):
ASHRAE standards and publications are valuable for understanding HVAC systems in healthcare facilities.

Health Facility Guidelines and Standards:
Guidelines and standards published by health organizations, such as the Facility Guidelines Institute (FGI) in the U.S., provide insights into designing healthcare spaces.

U.S. Green Building Council (USGBC):
Website: USGBC
Resource: LEED (Leadership in Energy and Environmental Design) certification standards and resources for green building practices.

Green Building Initiative (GBI):
Website: Green Building Initiative
Resource: Green Globes certification and resources for sustainable building practices.

Energy Star for Buildings and Plants:
Website: Energy Star
Resource: Energy Star guidelines for energy-efficient building design and operations.

Whole Building Design Guide (WBDG):
Website: WBDG
Resource: Comprehensive information on sustainable building design, materials, and practices.

Environmental Protection Agency (EPA) - Green Building:
Website: EPA - Green Building
Resource: Information on sustainable building practices and resources for builders and developers.

BuildingGreen:
Website: BuildingGreen
Resource: Independent information on sustainable building products and strategies.

Construction Innovation Hub (UK):
Website: Construction Innovation Hub
Resource: Research and guidance on innovative and sustainable construction practices.

World Green Building Council (WorldGBC):
Website: WorldGBC
Resource: Global network promoting green building practices and resources.

GreenSpec:
Website: GreenSpec
Resource: UK-based directory of sustainable construction products and materials.

Smart Cities Dive - Construction and Building Design:
Website: Smart Cities Dive - Construction
Resource: News, articles, and trends related to sustainable construction and building design.

National Institute of Building Sciences (NIBS):
Website: NIBS
Resource: Research and resources on building sciences, including sustainability.

Green Building Councils (Worldwide):
Website: World Green Building Council - Members
Resource: Connect with local green building councils worldwide for region-specific guidance.