University of Al maarif

Department of Medical Instrumentation Techniques Engineering

Laboratory Medical Instrumentation I

Second Class

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Master of Medical Physics

Lecture five

Design of an Operating Room

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1. Design of an Operating Room

Introduction:

The design of an operating room (OR) plays a crucial role in ensuring patient safety, improving surgical outcomes, and enhancing the efficiency of healthcare professionals. A well-designed OR minimizes infection risk, optimizes space for equipment and personnel, and allows for smooth workflows during surgeries.

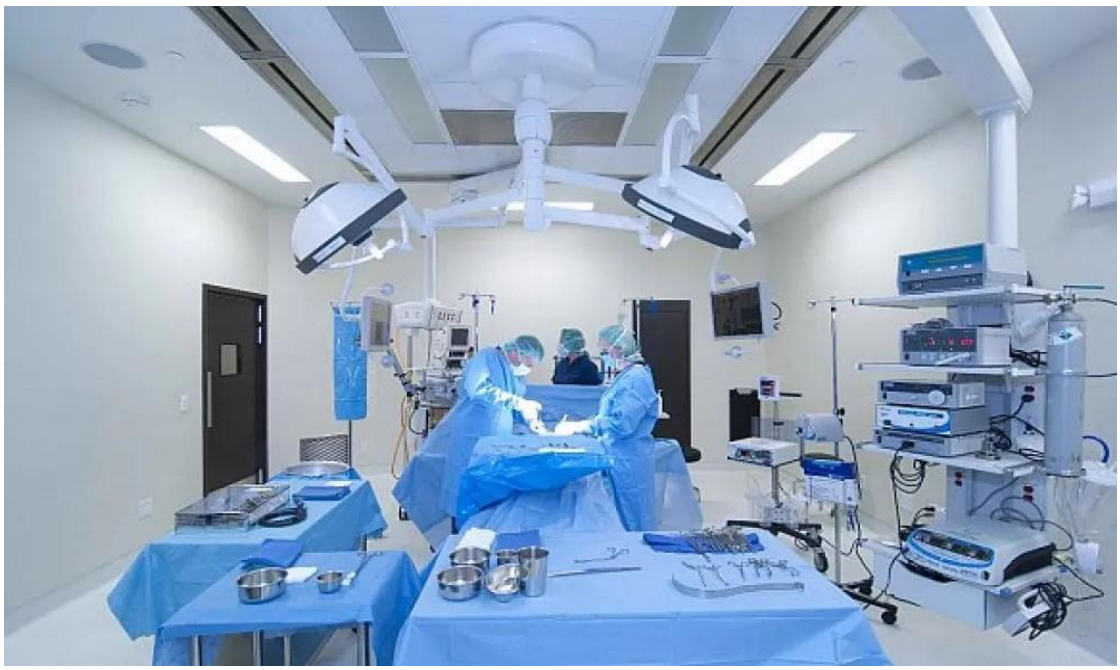

Figure 1: operation room

1. Design Principles:

a. Infection Control:

The primary objective in OR design is to maintain a sterile environment to prevent infection. This involves the use of materials and layouts that are easy to clean, non-porous, and resistant to microbial growth. Airflow management is crucial, with the use of laminar air flow systems that provide a continuous flow of filtered air, typically from the ceiling, to reduce airborne contaminants.

b. Workflow Efficiency:

The layout of the OR should enable seamless movement of the surgical team, equipment, and supplies, minimizing delays and interruptions. Strategic placement of equipment and instruments ensures easy access without cluttering the space.

The location of sinks, sterilization areas, and supply storage should be optimized for minimal disruption to sterile processes.

c. Safety:

The design should accommodate quick and easy access for staff, including wide doors for moving patients on stretchers and wheelchairs. Electrical outlets, oxygen lines, and medical gases must be safely positioned and easily reachable. Emergency exits and clearly marked pathways for quick evacuation are essential.

2. Essential Features of an Operating Room:

a. Size and Layout:

An OR must be spacious enough to accommodate surgical teams, anesthesia equipment, monitors, and all necessary tools while maintaining a sterile field. A minimum space of 400 square feet (approximately 37 square meters) is recommended for general surgeries, with specialized ORs, such as those for cardiothoracic surgery, requiring even larger spaces.

b. Lighting:

Adequate, shadow-free lighting is essential for precision during surgery. Surgical lights should be adjustable,

providing high-intensity, focused light over the surgical site without causing glare or excessive heat. Ambient lighting in the room should be soft and adjustable to maintain visibility while keeping the focus on the patient.

c. Ventilation and Air Quality:

The ventilation system is vital for maintaining a sterile environment. High efficiency particulate air (HEPA) filters are commonly used to filter out airborne contaminants. Air change rates of 15 to 20 changes per hour are ideal to keep the air clean and fresh, preventing stagnation. The temperature and humidity levels must be adjustable for the comfort of both patients and staff, generally kept between 20-23°C (68-73°F) with a humidity level between 30 60%.

3. Considerations for Modern Operating Rooms:

a. Technological Integration:

Modern ORs increasingly rely on digital technology, including integrated systems that allow for monitoring, recording, and displaying vital information during surgeries. Systems that control lighting, temperature, and air quality can be managed from a central control panel.

b. Acoustics and Noise Control:

Noise levels in the OR can be disruptive and stress-inducing for the surgical team. The use of sound-absorbing materials on walls and ceilings can help to minimize noise and improve concentration.

4. Zones and Sterility Considerations:

a. Restricted and Unrestricted Areas:

The OR should be located in a part of the hospital with restricted access to maintain sterility. Staff and patients enter through preparation rooms where they scrub in and don sterile garments. There should be a clear division between sterile zones (immediate operating area) and non-sterile zones (support spaces such as control rooms, supply areas).

b. Anesthesia and Support Areas:

The anesthesia workstation should be positioned in a way that allows easy access to the patient while maintaining clear visibility of vital signs and monitors. Support areas like sterile storage, utility rooms, and scrub areas should be adjacent to the OR to facilitate quick access to supplies without disrupting the sterile environment.

5. Future Trends in OR Design:

a. Hybrid Operating Rooms:

Hybrid ORs, combining traditional surgery with advanced imaging capabilities (such as CT, MRI, or angiography), are becoming more common, especially in cardiovascular and neurological surgeries. These rooms require larger spaces and additional shielding to accommodate high-tech equipment.

b. Robot-Assisted Surgery:

The rise of robotic surgery has introduced the need for ORs to accommodate robotic arms and control consoles.