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2nd Edition

LAPAROSCOPIC THEATER MANUAL

Empowering OT Nurses for Safe and Advanced Minimally Invasive Surgery

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Forewords
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JAYPEE

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CHAPTER 1

Laparoscopic Theater Design



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INTRODUCTION

An operation theater (OT) complex is the heart of any major surgical hospital. It is the most critical area where lifesaving surgical procedures are performed under sterile and controlled conditions. An operating theater, also known as an "Operating Room (OR), Surgery Suite, or Surgical Center", is a specialized environment designed to support a wide range of surgical interventions with utmost precision and safety.

The establishment and functioning of an OT demand specialized planning and execution, extending far beyond simple civil construction. It represents a civil–mechanical–electrical–electronic–biomedical integration—a coordinated effort that revolves around the needs, preferences, and safety of the surgical and anesthetic teams.

Hospital-acquired infections (HAIs) account for nearly 20% of hospital admissions in many developing countries.[1] Therefore, meticulous attention to the maintenance of the OT environment, heating, ventilation, and air conditioning (HVAC) systems, and sterilization of medical and nonmedical equipment is essential. Personnel involved in sterilization and disinfection must adhere strictly to aseptic protocols and infection-control practices.[2,3]

A laparoscopic theater is structurally similar to a conventional open surgery theater but demands additional design

and technological considerations to accommodate laparoscopic imaging, energy sources, and precision instruments. Strategic investment in a well-planned laparoscopic OT yields long-term benefits—ensuring safety, efficiency, and smooth workflow for both patients and surgical teams.[4]

This chapter outlines the essential design features, functional requirements, and organizational standards for establishing an ideal "Laparoscopic Operation Theater" in accordance with modern surgical and National Accreditation Board for Hospitals (NABH) guidelines.[5]

INFRASTRUCTURE AND ENGINEERING CONTROLS

Key elements influencing the functionality and sterility of a laparoscopic OT include:

- Proper architecture and planning of hospital and OR complex
- Zoning inside the OT complex
- HVAC system (air quality, cooling, pressure, and particulate count to maintain ISO Class 5–6 cleanroom standards)[6]
- Disinfection process of the OR and equipment
- Sterilization process of instruments
- Validation of sterilization process
- Biomedical waste (BMW) management.

RECOMMENDED FLOOR FOR OPERATION THEATER PLACEMENT

Traditional Recommendation—First Floor

Traditionally, the first floor is preferred because:

- OPD is usually on the ground floor.
- Easy access from emergency and critical care areas
- Minimal vertical movement for patients

Modern Trend—Top Floor Operation Theater Complex

In contemporary hospital design, many institutions prefer placing the OT complex on the top floor because:

- Air handling units (AHUs) can be placed conveniently on the terrace.
- Space inside the OT complex is not consumed by AHU rooms.
- Vibration, dust, and noise from lower floors are minimized.
- Structural layout allows optimal airflow and ducting design.

This design enhances HVAC performance—an essential factor for maintaining sterility in modular OTs.

Theater Zones

A modern OT complex is divided into functional zones to maintain asepsis and streamline workflow. These zones restrict the movement of personnel and materials, minimizing the risk of infection.[7,8]

Unsterile Zone

This is the outermost area of the OT complex, allowing free and unrestricted movement. No change of attire is required here. It serves as the transition zone between the hospital corridor and the OT suite.

Protective Zone

- Peripheral area through which patients, staff, and supplies enter.
- Regular clothing permitted.
- Includes patient's reception, staff changing, and clean material transfer.

Clean Zone

- Transitional area between protective and aseptic zones

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- Theater attire (scrubs, caps, and masks) mandatory
- Pretransfer preparation of patients occurs here.

Sterile Zone

This is the highest sterility area, exclusively reserved for surgical procedures. Entry is strictly limited to scrubbed and essential personnel. All sterile instruments, consumables, and equipment are opened and handled within this zone to maintain asepsis.

Disposal Zone

- Exit pathway for used instruments, specimens, and waste.
- Facilitates safe removal without cross-contamination of clean zones.

Types of Operating Rooms

Based on hospital requirements and technological advancements, several types of OTs are available:

- Simple room OT
- Prefabricated modular OT
- Semimodular OT
- Full modular OT
- Hybrid OT

Below is a brief description of each type.

Simple Room Operation Theater

A simple room OT is a basic operation room with minimal provisions for sterility and environmental control.

Key features include:

- Walls finished with plaster and washable paint or glazed tiles
- Plastered ceiling or POP false ceiling
- Flooring made of marble or glazed tiles
- Air-conditioning provided via split AC units
- Fixed OT light in the center of the room
- OT table positioned at the center
- No specific size requirements.

This setup is economical but lacks advanced infection-control and airflow standards and is *not recommended.*

Modular Operation Theater

A modular OT is the most widely used modern operation room design, providing optimal sterility, environmental control, temperature and humidity regulation, air exchanges, airflow pattern control, and positive pressure maintenance **(Fig. 1)**.

Recommended dimensions:

- *OT size:* 20 × 20 ft (Minimum acceptable: 16 × 12 ft)
- *Plenum size:* 8 × 8 ft

Plenum: A box-like structure suspended from the ceiling containing HEPA filters that deliver unidirectional and laminar airflow directly over the sterile field.

Control panel: A recessed digital console located near the OT entrance that controls multiple OT functions, including:

- OT lights and peripheral lights
- Plenum light
- Elapsed time and digital clock
- Hands-free intercom
- Medical gas pressure indicators
- Music system
- Temperature and humidity display.

Anesthesia pendant: Suspended from the ceiling on the patient's left side, equipped with:

- Medical gas outlets
- Electrical and communication ports
- Service tray and drawers
- Provision for IV rods.

Surgeon pendant (GEM recommendation): At GEM Hospital, we recommend using a

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Fig. 1: Modular OT at GEM Hospital.

surgeon pendant due to our preference for 55-inch 4K monitors. These larger monitors require safe and stable mounting, and the pendant can be positioned for optimal ergonomics during laparoscopic and robotic procedures.

Heating, Ventilation, and Air-conditioning System

Air quality inside an OR is governed by temperature, humidity, air pressure, and particulate count. To achieve ISO Class 6 cleanroom standards,[9] the HVAC system should include:

- Air handling unit **(Figs. 2 to 4)**
- Pre-HEPA (3–5 µm) filters and terminal HEPA filters (0.3 µm)
- Laminar air flow (LAF) plenum
- Pressure gradient between zones.

Placing the AHU and terminal LAF plenum close together minimizes duct length, thereby reducing compressor strain and improving airflow efficiency.[10]

Gas Supply and Suction Systems

A reliable "Central Gas Management System" ensures uninterrupted supply of oxygen (O_2), nitrous oxide (N_2O), carbon dioxide (CO_2), and medical air to all theaters.[11]

- Centralized pipelines eliminate cylinder clutter and enhance safety.
- Central suction system (minimum 5 HP) ensures effective aspiration during laparoscopic surgery.
- Gas manifold and control panels must comply with HTM 02-01 and NABH standards.

Power Supply and Electrical Safety

Stable and uninterrupted electrical supply is crucial for laparoscopic surgery.[12]

- *UPS backup:* Minimum 5 kVA per OT to support critical systems.
- *Outlets:* At least three walls equipped; positioned 4 feet above floor level.
- *Earthing:* Separate earthing to prevent image flicker and electrosurgical interference.

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Fig. 2: Air handling unit (AHU).



Fig. 3: Inspection of filters in air handling unit (AHU).

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- *Circuit protection:* MCB and ELCB installations for personnel safety.

Washing Area

Each washing area should cater to three operating rooms to maintain efficiency.[13]

- Facilities for hot/cold water and pressurized jets for precleaning laparoscopic and robotic instruments.
- Surfaces should be nonporous and disinfectant-resistant.

Table-laying (Instrument Preparation) Room

This room should be adjacent to each OT, maintaining positive pressure and temperature control similar to the OT.[14]



Fig. 4: Macrofilter cleaning.

- Dedicated for aseptic instrument preparation and quick reprocessing.
- Cidex/OPA trays may be used for between-case disinfection.
- Use of HEPA filtration is strongly recommended to maintain near-sterile conditions.

Central Sterile Supply Department

A robust central sterile supply department (CSSD) ensures continuous supply of sterile materials.[15]

- Segregation into dirty, clean, and sterile zones with unidirectional flow.
- Autoclaves, ETO sterilizers, and plasma systems should be validated periodically.
- Direct linkage between CSSD and OT via sterile lift or corridor enhances efficiency.

CONCLUSION

A well-designed laparoscopic theater promotes efficiency, safety, and asepsis. Attention to detail—from zoning and layout to utilities and support systems—directly improves surgical outcomes and minimizes infection risk. For theater nurses, understanding these design and operational principles is essential to sustaining a safe and productive environment for minimally invasive surgery.

AT GEM

The operation theater (OT) is the heart of any hospital, and its design has a direct impact on patient's safety, workflow efficiency, and surgical outcomes. It must be constructed in accordance with all recommended infrastructure standards and regulatory guidelines.

At GEM Hospital, we follow established norms for OT construction, with a strong preference for modular OTs due to their superior sterility, ease of maintenance, and long-term durability. We typically situate our OT complex on the top floor, which allows optimal placement of air handling units (AHUs) on the terrace and ensures better utilization of interior space.

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LAPAROSCOPIC THEATER MANUAL

Empowering OT Nurses for Safe and Advanced Minimally Invasive Surgery

With over three decades of pioneering experience in minimally invasive surgery, this landmark second edition is an essential guide for transforming operating theater practice.

Laparoscopic Theater Manual is crafted to empower operation theater (OT) nurses and healthcare teams with the knowledge, precision, and confidence required in today's advanced surgical environment. From designing an efficient laparoscopic operating complex to implementing seamless workflows and standardized protocols, this book bridges the gap between theory and real-world practice.

Rich in practical insights, it offers clear guidance on instrument handling, care, and maintenance—ensuring safety, reliability, and optimal performance in every procedure. A strong focus on structured training equips nursing staff to actively contribute to complex and evolving minimally invasive surgeries.

Trusted, practical, and forward-looking, this edition is more than a manual—it is a step toward safer surgeries, stronger teams, and excellence in patient care.

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ISBN 978-93-7202-691-7

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