The WHO recommends minimum specifications for a general-purpose ultrasound scanner.

- The scanner should be able to operate from the local electrical power supply.
- Servicing should be available locally.
- It must be possible to store the unit safely under adverse conditions.
- When scanning children, at least two different MHz transducers (sector and linear array) are desirable.
- Doppler techniques are included on all modern ultrasound sound, such that exclusion of a deep venous thrombosis, for example, should be possible.
- Some form of archived permanent hard-copy record is recommended for patient follow-up, and in the interests of teaching and training in general.

Additional points

- Mobile ultrasound scanners can be operated at the bedside or in the Emergency Department.
- Abdominal and pelvic ultrasound has a well-established role in the assessment of adolescent gynaecological conditions and paediatric emergencies.
- Sonography plays a major role in the management of pregnancies, from dating the age of the fetus to identifying multiple pregnancies, ascertaining the position of the placenta and generally identifying potential problems, thus allowing the clinician to plan safe delivery.
- Sonography can quite simply resolve mass lesions from organomegaly.
- It is noteworthy that hydronephrosis is the commonest abdominal mass in the neonate and infant, and this is easily diagnosed with ultrasound scanning.
- Evaluation and drainage of pleural effusions or ascites is relatively straightforward, particularly with ultrasound guidance.
- Ultrasound scanning can be a useful tool for guiding other interventions, such as drainage of larger abscesses or an image-guided biopsy of a solid mass.
- Alternatively, evaluation of solid mass lesions and cysts should at least be possible, to aid patient referral to larger regional centres.
- Sonography of the infant brain is easily performed at the bedside, and can provide useful information in the infant who is febrile, unconscious or has seizures.
- In trauma patients, abdominal ultrasound scanning can prevent unnecessary surgery.
- Finally, ultrasound studies frequently reduce the need for plain abdominal radiographs and yield more diagnostic information.

### 1.5 Essential operating-theatre resources

#### Design of the operating theatre (OT)

- Ideally it should be located next to the labour ward.
- It should be of adequate size (minimum 7 m × 7 m) for the placement of essential equipment and the unobstructed movement of staff.
- It should not be used for storing purposes, for which a separate side room should be available which can also be used for hand washing.

#### Essential equipment

- Ordinary OT table with a facility for the lithotomy position and lowering and raising the height of the table, preferably mechanically operated.
- A good focusing OT light is very important.
- A simple anaesthetic machine suitable for the resources available in the country (e.g. Diamedica-Glostavent, for resource-limited countries), with an uninterrupted oxygen and nitrous oxide supply, is the most essential item of equipment for the anaesthetist. Reserve cylinders for both oxygen and nitrous oxide should always be available. If nitrous oxide is not available, the patient can be maintained on ether or halothane, but the level of anaesthesia has to be deep, requiring more intensive post-operative monitoring.
- The suction machine (which should have both electrical and manual functions, in case of electrical failure) should be periodically emptied and cleaned with antiseptic solution after every individual patient. It must be constantly checked.
- A fumigation machine is essential for the sterilisation of the OT.
- Anaesthetic equipment and supplies (see Section 1.22 for a list of essentials).
- All emergency drugs (e.g. lignocaine, adrenaline, atropine, sodium bicarbonate, 25% dextrose, morphine, etc.), with syringes, should be readily available in the OT (see Section 1.22).
- A boiler is essential for sterilisation if an autoclaving facility is not available. A heater of some kind is also essential for warming up crystalloid infusions to be used during surgery to prevent hypothermia.
- Monitoring equipment (see Section 1.22 for a list of essentials).
- Room heaters are essential, especially for surgery on infants. The OT temperature should be in the range 28–32°C to prevent hypothermia in babies. Hot-water bottles can provide heat for infants and are inexpensive, but it is essential to be vigilant about safety. Radiant warmers, incubators and electric blankets are helpful if they are available. Equally, air conditioning is also required in hot countries to ensure appropriate working temperatures for patient and OT staff.
- A cautery machine is useful for reducing blood loss.
during surgery. An ordinary unipolar cauter will suffice for most procedures. A probe that has been heated with a Bunsen burner until it is red hot can provide thermocoagulation on touching the bleeding sites. This is a low-cost and effective method when a cauter machine is not available.

- Adequate supply of linen, towels, gowns and gloves.
- The minimum supply of instruments required for minor surgery are as follows:

  **Artery forceps:**
  - Mosquito
  - Kelly’s

  **Towel clips:**
  - Bulldog

  **Scissors:**
  - Metzenbaum
  - Mayo’s

  **Thumb forceps:**
  - Tooth
  - Non-tooth

  **Intestinal clamps:**
  - Non-crushing

  **Martin artery forceps**

  **Right-angled forceps**
  - Needle holders (paediatric) which can hold 3.5 to 5.0 sutures

  **Retractors:**
  - Right-angled
  - Zerneys
  - Devers
  - Malleable

  **Suction tip**

  **Eye goggles for protection of staff from splashing**

Durbin (formerly ECHO) (www.durbin.co.uk) provides complete instrument kits, which are particularly relevant for Caesarean section and laparotomy.

- A whiteboard and pens with which to document the use of swabs and needles, aiming to ensure that none are left in the patient when surgery ends.

**Operating-theatre staff**

Apart from the surgeon, an adequately trained doctor or nurse anaesthetist is essential.

- **Nursing staff** should be adequately trained in the care and handling of instruments and equipment in the OT. They should be made responsible for the proper functioning of all equipment, and trained in the sterilisation of the OT and the instruments used.

- **OT assistants** are important for transporting patients to and from the OT. They should be aware of the function of the equipment in the OT. They should also be counselled about the hazards of contact with blood and other patient body fluids, and especially made aware of the risks of infection with HIV and hepatitis B and C.

- **OT cleaners** should also be aware of the threat of these communicable diseases. It is essential to clean the OT between one case and the next to prevent nosocomial infections.

**Practices and procedures to reduce the risk of infection in the OT**

- The floors, walls, table and all equipment in the OT should be cleaned and disinfected at least once a day, and also after every case involving infection.

- Auto-claving is the standard method of sterilisation, but if it is not available, boiling for 1 hour should be used instead.

- Spirit flaming of all the instruments (whereby the instruments are placed in a kidney tray, spirit is poured into the tray and a matchstick is used to flame it) can be undertaken where minimal equipment is available.

- There must be restricted entry to the OT, and this should only be permitted after a complete change of clean clothes (except for underwear) and shoes, and with the wearing of a proper clean head covering and mask (these items should be used only once before discarding or washing). Hand and forearm washing for at least 5 minutes before gowning and gloving up, using an antiseptic soap solution, will reduce the incidence of infection.

- The OT should be situated in the most inaccessible part of the hospital so that there is minimum encroachment by the general hospital patients.

- Ideally there should be an air-purifying/air-conditioning system in the OT.

- All tubing (suction, oxygen, anaesthetic) should be regularly cleaned and disinfected according to the individual manufacturer’s instructions, in order to reduce the risk of nosocomial infection.

- Proper waste disposal bins for clinical and non-clinical waste from the OT are essential.

**Set-up of the recovery room**

- The recovery room should be adjacent to the OT so that the surgeon and the anaesthetist have immediate access to the patient.

- Nursing care, oxygen, suction and emergency medicines should be available, as should resuscitation and monitoring equipment (see Sections 1.12 and 1.13).

- An adequately trained doctor or nurse anaesthetist, who is proficient in resuscitative measures and critical care management, should be present whenever patients are in the recovery room. Frequent evaluation and monitoring of surgical patients should be undertaken during the first 24 hours following a major operation. This should include observations/measures of hydration, urine output, output from drains, soarking from the wound, pulse, respiratory rate and blood pressure. Post-operative pain management is most important, and a relatively ‘pain-free’ patient has a better outcome (see Section 1.15).

**Further reading**


World Federation of Societies of Anaesthesiologists (WFSA) Guide to Infrastructure, Supplies and Anaesthesia Standards at Three Levels of Health Care Facility Infrastructure and Supplies: www.ncbi.nlm.nih.gov/pmc/articles/PMC2957572/table/Tab1

Lifebox: www.lifebox.org