Intensive Care Unit at University Hospital, Copenhagen

J. Rosen and O. Secher

In establishing an intensive care unit one should consider: (1) location in the hospital, (2) function, and (3) dimensions.

We believe the unit should preferably be situated on the same floor and close to the operating theaters. The unit should not, for reasons of asepsis, be placed within the operating unit because this would limit its function only to short-term postoperative treatment of patients.

The functions of such a unit are dependent upon the structure and size of the hospital. In a fairly small hospital in a single building, if size allows, the unit may function as: (1) a postoperative treatment area, short-term or long-term, (2) a treatment area for other patients in poor surgical or medical condition, and (3) a treatment area for poisoning cases and the like. In larger hospitals, especially those with several pavilions, a delimitation of the functions of the unit is more difficult. The number of surgical departments and the number of patients, the distribution of responsibility, effective surveillance and nursing care of the patients are some of the problems to be faced.

The dimensions of the unit are determined by one of two factors: (1) often a certain area is assigned, which must be adapted as best as possible, or (2) more rarely, the area required can be estimated in advance according to the number of beds in the hospital. It is important that the space assigned for beds in the unit should equal the space for working area and utility rooms. A small unit will require a relatively larger non-bed area than a larger unit. In a four bed unit, for example, 8 to 9 square meters are required per bed. Twice this space is needed in isolation areas. The more intensified and specialized the treatment, the larger must be the area per bed. It may, therefore, be reasonable to divide the unit into two sections: (1) one for patients who are to stay for a short time, such as for post-anæsthetic recovery, and (2) another for the patients who are to remain for a longer period of time.

At Rigshospitalet (University Hospital), in the unit to be described, these stated standards have not been met because the area assigned was too small. The unit accommodates no more than 11 beds, a small number, indeed, for a hospital of 1,200 beds. If an area is assigned in already existing facilities, it is inadvisable to crowd as many beds as possible within this area. It is better to calculate in advance the space per bed which affords the best chance of effective treatment of the patients to be cared for when the number of beds can be determined, the utilization of the beds available will be regulated accordingly.

General Requirements

In the planning of a recovery unit there are certain basic requirements.

(1) Partitions made of glass or with windows to allow supervision by the staff.
(2) Few or no doors to conserve space.
(3) Ample cupboard space.
(4) Ample number and variety of electrical outlets, with provision made for exclusion of electrical "noise" by appropriate grounding or screening.

Accepted for publication July 18, 1963. Dr. Rosen is Chief Anaesthetist, Rigshospitalet (University Hospital), and Dr. Secher is Lecturer in Anaesthesia at the University of Copenhagen and Chief Anaesthetist, Rigshospitalet (University Hospital), Copenhagen, Denmark.
Fig. 1. Plan of office and bed section of the intensive care unit (drawing 1:100): 21-24, offices; 25, kitchen; 26, operating theater; 27, soiled-linen room; 28, lift; 29, archives; 30, bathroom; 32, lavatory; 38-39, cubicles for four patients each; 40-41, isolation cubicles; 33-35, cleaning rooms and observation cubicle; 36, office and supply; 37, cooling unit for patients.

(5) Prior insertion of conduits from each bed site to the central nurses’ desk to facilitate subsequent electrical installation for central recording of such parameters as pulse rate, temperature, electrocardiogram, and blood pressure.

(6) Conductive flooring.

(7) Outlets for oxygen and suction at each bed. Nitrous-oxide and compressed-air installations are also desirable.

(8) Adequate lighting is essential. Each bed site requires a ceiling-light in addition to the ordinary lighting, and mounting of extra lamps must be possible. Ceiling illumination should be divisible into sections, and switching over to night lighting should be possible. The color of the light is very important for proper observation of patients. Light giving a bluish tinge should be avoided.

(9) Communication and alarm systems should be installed.

(10) Sound insulation is required.

(11) Ventilation and air conditioning must be effective. In the isolation of patient with sepsis there must also be provision for negative-pressure ventilation within the rooms or positive-pressure ventilation outside.

(12) A store room for movable equipment.
(13) Clean-up rooms divisible into clean and soiled areas.

(14) Offices for staff separate from the bed unit.

(15) Warming and cooling of patients through the heating and cooling of ceilings will doubtless be an important factor in future unit construction.

(16) Ionization of the air has within recent years been found to have a great influence on the personal comfort. This is in a large measure determined by the materials and the paints used. There can be no doubt that this must be taken into account in future.

The Unit at Rigshospitalet
(University Hospital)

General Plan of the Unit. As seen in the diagram (fig. 1), the unit consists of an office section, and a bed section.

(1) The office section contains offices for the chief anaesthetist, secretaries, doctors, and nurses. On the opposite side of the passage there are a bathroom and lavatory for the staff, an archives room, a staircase leading to the operating theaters below, a lift to and from the operating unit, and a small soiled-linen room.

(2) The bed section consists of:
(a) A bed unit containing two sections of four beds each, two isolation cubicles, and a room for cooling patients.
(b) A combined clean-up and sterilization room for the management of which a nurses' desk has been placed in the middle of the unit.
(c) A combined store room and office.
(d) An operating theater for minor procedures.
(e) A kitchen that supplies food for patients and staff.

Special Installations. The installations at the beds are among the most unique features of the unit. The apparatus required for the

Fig. 2. Bed section of anesthetic unit with accommodation for 11 patients. The photograph shows the two cubicles which can accommodate four beds each. To the left is seen the central observation desk which projects into the passageway. There are no doors within the unit, except that into the store room. The glass walls between the cubicles and the windows are provided with Venetian blinds. All ordinary equipment for treatment of the patients is suspended on the walls, leaving the floors uncluttered.
Fig. 3. Close view of the bed-stand. On the wall are seen the two rails on which apparatus can be mounted. To the left of the nearer bed is the panel for gases and vacuum, to the right the electrical panel. The white screens on the wall to the left and right can be swung from the wall and placed so that the patients cannot observe each other. The shelf at the middle of the upper rail is intended for records and roentgenograms.

Fig. 4. Detail of the panel with outlets for O₂, N₂O, atmospheric air, and vacuum. The apparatus is connected by a rapid coupling system. A reservoir bag and a breathing valve for ventilation of the lungs is seen fastened to the upper rail at the extreme right. In the background the central observation desk is seen.
treatment of the individual patient may vary greatly and take up considerable space. In our unit, the mode of suspension of equipment is "flexible" by a simple arrangement. Apparatus not in use may be easily removed, so that it does not occupy space, and cleaning and maintenance are facilitated. Change of apparatus is likewise simple.

Flexibility is accomplished by fixing two rails to the wall for the full breadth of the bedstead, one 140 cm. above the floor and the other 55 cm. (figs. 2, 3, 4, 5, 6). All apparatus may be mounted on these rails by means of loose guideways easy to apply and remove, and movable along the rails. The guideways can be fixed to the rails by tightening an eccentric lever. Fixation by means of screws was avoided, because these are always damaged when used by many persons. Each instrument is provided with a plate that fits into the guideway, or with a special mount having such a plate (fig. 6, top).

The photographs show that this method of mounting is employed for timers (fig. 6), blood pressure measuring instruments (fig. 6), lamps, shelves for records and roentgenograms (fig. 5), \(O_2\) flowmeters and humidifiers, flowmeters for \(N_2O\) and \(O_2\), flowmeters for atmospheric air, angle valves and reservoir bags, and suction tubing. The lower rail is used for mounting bottles, for suction cathi-
Fig. 7. The apparatus in a cupboard suspended on rails in the same way as at the bed side.

Fig. 8. Top: Clean apparatus, connecting tubes, and catheters are hung up to dry as shown. Catheters are fixed on a "hedgehog," while reservoir bags, tracheal tubes, and masks are fixed in their slip joints. Bottom: Close-up of the "hedgehog" with its conical quills. These are provided at the top with openings, allowing the water to run off easily when the catheters are hung up to dry. The "hedgehog" can be removed and cleaned.

eters, and for a frame that holds a tray, which acts as a table at each bed. All unused equipment is suspended on rails in a cupboard in the same way as at the bed side (fig. 7).

At one side of each bed there is a panel for $O_2$, $N_2O$, atmospheric air, and vacuum (fig. 3). The apparatus is connected with these outlets by means of couplers. The length of the tubing from outlets to apparatus varies according to the freedom of movement required. The tubes are marked with the international standard colors. In the vacuum outlet the unit with the regulating valves and suction traps have been screwed on to the outlet itself by means of a screw cap, allowing a choice between strong or weak suction.

The electrical panels for each two beds are situated on both sides of the screen (fig. 5) between the beds. The electrical plugs can thus supplement one another if one bed should require more than the two sockets found in each panel. In the isolation area there are four sockets and two vacuum outlets for each bed. In addition to the sockets, the electrical panel is provided with patient call system and an alarm call system for the attendant. Cables have been led to each bed for temperature measurements which can be read centrally at the nurses' desk (fig. 4). There are also two unused conduits at each bed intended for future central installations such as pulse recording and electrocardiography.

The bed steads are separated by screens constructed of acrylic material. They hang on hinges on the walls, so that they can be turned aside if patient care requires more
room (figs. 2, 3, 4 and 5). They slip back to the midposition by means of a garden-gate arrangement. They can easily be taken off by removing the pawl in the upper hinge. This arrangement contributes towards better utilization of the space and towards facilitating passage between beds. The screen hangs at a level which allows the staff on duty to survey the patient at all times.

The partitions and the outer wall are covered below by smooth plates, which are easy to keep clean. Above, the partitions consist of double glass panes with Venetian blinds between. By suitable adjustments these render free supervision from the central observation cubicle (figs. 2, 4 and 5). The partitions between the bed units are raised about 10 cm. above the floor and stand 26 cm. from the outer wall to facilitate cleaning. A wash basin with disposable towels is adjacent to each bed section.

The eleventh room of the unit is intended for cooling patients. As it is almost impossible for attendants to remain in a cold room a disposable cooling tent of plastic is hung around the bed and discarded after use. The tent consists of a single piece of plastic reaching from ceiling to floor. It is fastened to the ceiling by fixation in a groove, and to the floor by means of a metal frame. The air, which is cooled (or warmed) by a large cooling (or warming) machine, is blown down over the patient and sucked through the floor back to the machine. The tent can accommodate only one bed and a respirator. All the connections to the apparatus can, by special arrangement, be passed through the ceiling.

The nurses' desk is situated in the center of the unit, raised about 40 cm. above the floor. It projects slightly into the passage way to facilitate supervision (figs. 2, 4). Here are found the central electrical thermometer, telephone and intercommunication systems, and, behind, the medicine cabinets and refrigerator.

The rinsing and sterilization room has the ordinary equipment for these purposes. There are drying racks for catheters and tubes. These resemble "hedgehog" over which the catheters and tubes can be slipped after cleaning (fig. 8). Tubes from anaesthetic apparatus, masks and reservoir bags are suspended on racks fitting the slip joints.

The department described herein has now been in use for two years, and we have discovered very few mistakes that we were not aware of beforehand. The system for mounting the apparatus has been extremely useful and can be highly recommended. It should be emphasized that the planning of the unit was carefully considered and that every person concerned was asked for suggestions.

Summary

A brief discussion of the requirements and necessary installations for an intensive therapy unit has been presented. A detailed description of the intensive therapy unit at the Rigs hospitalet (University Hospital), Copenhagen, is provided, wherein the special arrangements for attaching equipment to the wall are given particular mention.