

Planning and Design of a Surgical Intensive Care Unit in a New Regional Hospital

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Abstract

Critical care unit design has profound effect on work efficiency, infection control and psychology of patients and staff working in the area. A multidisciplinary team was involved in the design and planning of a surgical intensive care unit (SICU) in a new regional hospital. A Workgroup consisting of clinicians, nurses, engineers and hospital administrators were involved in its planning. The Hospital Planning Committee oversaw the activities of the Workgroup to ensure co-ordination and integration of the unit plan with the hospital plan. The issue on "single room" versus "open unit" patient room design was much debated. "Single room" concept was adopted and the cubicles were arranged radially facing a central station. Access of patients from the operating theatres and wards to the SICU was an important consideration. The design and facilities of various rooms in the SICU are described. New technology such as the automated guided vehicle, pneumatic tube system, floor mounted power column and closed circuit television were some of the useful assets available in the unit.

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Introduction

The Changi General Hospital is a new regional hospital in the eastern part of Singapore catering to a population of about 750 000. Planning of the hospital started since 1987 and construction began in 1992. The hospital received its first patient in December 1996.

The hospital is designated to be an acute hospital and provides secondary level of health care. It provides services such as General Surgery, Medicine, Orthopaedic Surgery, Accident and Emergency, Ear, Nose and Throat, Eye, Geriatric and Psychiatric Medicine. Special services such as Neurosurgery, Cardiac Surgery and Burns Unit are not available. There are 801 beds. It was planned for the hospital to have separate medical and surgical intensive care units. Each intensive care unit is self-contained with high dependency and intensive care beds. The surgical intensive care unit (SICU) was geared to cater for major trauma and perioperative patients with sepsis and complications.

Intensive care is an expensive medical service. Medical and nursing involvement in the early stage of design planning is important. The design of intensive care unit could affect the function, cost and resource utilisation of the unit.

The experience gained in the planning and design of the SICU shows that by adopting a multidisciplinary approach, "blind spots" which are deceptive may be spotted by another discipline and alterations made before construction of the unit. This article describes our experience in the planning and design of a SICU.

Planning Committee and Workgroup

The Hospital Planning Committee was headed by the Chief Executive Officer (CEO) of the hospital and comprised chiefs of departments, engineers, architects and nursing administrators. Major issues regarding the single discipline ICU, the location and the size of ICU were decided by the Committee. Some members of the Committee made visits to various hospitals in the United States and Japan in the early stage of the planning. The overseas visits helped in the formulation of concepts and plans.

The SICU Workgroup consisting of clinicians, nursing staff, engineers and administrators was appointed by the CEO in January 1995. The Workgroup met regularly and communicated with the administrators and the architects regarding needs and requirements before the actual construction. Ideas from visiting intensive care physicians were sought and further modifications

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were made. Changes in late stages of construction would cause delay and incur additional cost to the construction.

Number of SICU beds

It was decided by the Planning Committee that the SICU should have 10 ICU, 8 high dependency (HDC) and 1 isolation rooms. The SICU beds would constitute 3.6% of all surgical beds or 1.2% of total hospital beds.

The definitions of intensive care and the activities of the hospital are the main factors that determine the size of the ICU.¹ The number of ICU beds ranges from 1 to 4 per 100 beds in hospitals in United Kingdom to 10% to 15% in USA and Scandinavia.²⁻⁶

HDC beds are distinguishable from ICU beds and subspecialties such as Neurosurgery, Cardiac Surgery, Paediatric and Burns Unit are not present in this hospital. These subspecialties will generate an appreciable number of patients who require intensive care. A multidisciplinary ICU was thought not feasible due to shortage of full time intensivists in this region. Ten ICU beds in each medical and surgical discipline are considered more manageable.

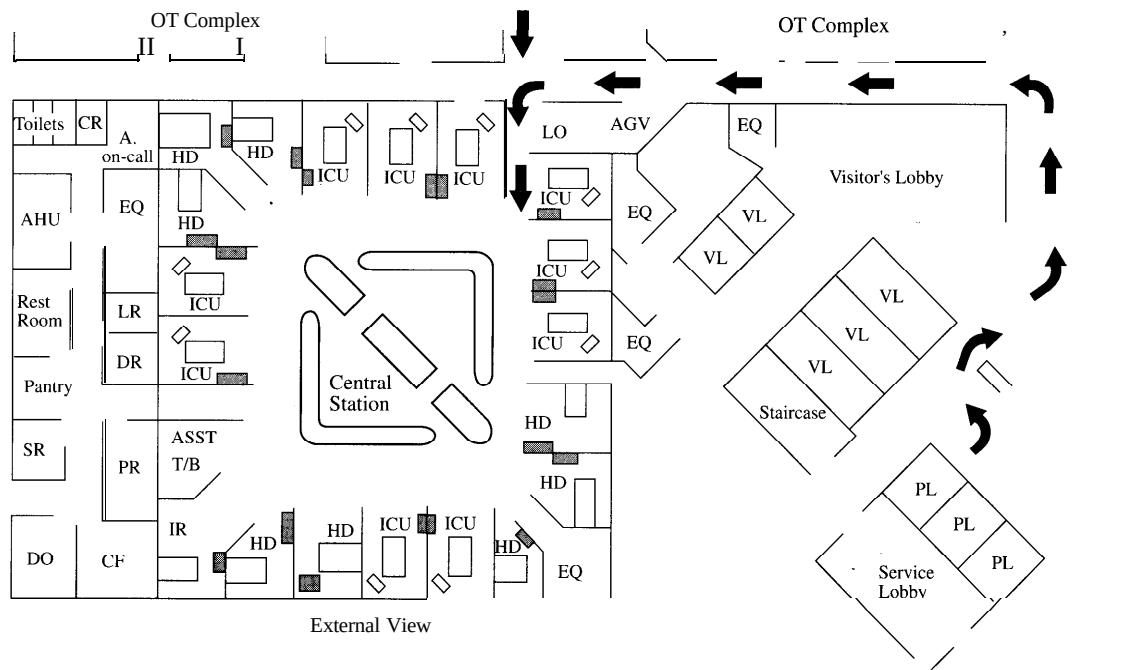
Location of the SICU

The SICU occupies a total surface area of 879.29 m². It is situated on the third level of the hospital building and is adjacent to the operating theatre complex. The SICU is served by 2 sets of lifts (Fig. 1). One public lift leads to the visitor's lobby situated immediately outside the unit.

Patients from Accident & Emergency Department and Surgical wards could be brought to the ICU through a dedicated patient lift without passing through public area. There is a direct route communicating between the operating theatre complex and the SICU. The computed tomographic scan room, however, is located at the basement of the Hospital. There is considerable distance between the SICU and the X-ray department and patient transportation poses some problems.

Single Room Design (Fig. 1)

Advantages and disadvantages of "single rooms" versus an "open unit" concept were much debated. The single room concept was subsequently adopted. The considerations for adopting this concept were: limitation of cross-infection and noise, and provision of privacy for the patient. Sliding and foldable glass doors,



CR Cleaners's Room
AHU Air Handling Unit
SR Sister's Room
DO Doctor's Room
A. on-call Anaesthetist on-call Room
EQ Equipment Room
LR Linen Room

DR Disposal Room
PR Preparation Room
CF Conference Room
HD High Dependency Bed
ICU Intensive Care Unit Bed
Asst T/B Asst Toilet & Bath
IR Isolation Room

□ : Power Column
LO : Last Office
AGV : Automated Guided Vehicle
VL : Visitor's Lift
PL : Patient's Lift
■ : Wash basin

Fig. 1. Physical layout of the Surgical Intensive Care Unit, Changi General Hospital.

glass windows and closed circuit television (CCTV) were incorporated to reduce problems of medical and nursing surveillance associated with single room design. However, single rooms incur higher running costs, as more staff are required for monitoring and nursing.

Each room has an area of 15.75 m² and is rectangular. Patient beds are arranged to face the central station to facilitate patient transport and observation. Patients in the HDC rooms have their beds arranged parallel to the windows. There are windows with external views and natural daylight for rooms along one side of the unit.

Facilities in Each Patient's Room (Fig. 2)

Each patient's room was designed to be spacious with enough area around the bed for activities and good accessibility to the head end of the bed for certain procedures. Ohmni intensive care service columns (Ohmeda, BOC) were installed for all critical care beds. The power column allows free access to the head of the bed which would otherwise be restricted by oxygen and suction line and monitor leads taken from the wall mounted outlets. The floor column stands at an angle to the left of

the head end of the bed. At each column, there are provisions for 2 oxygen, 2 air and 4 vacuum outlets. It also incorporates 12 electrical sockets and a nurse call code blue button. A six-channel coloured physiological monitor (Hewlett Packard) is mounted on the column. The modules for the monitors are interchangeable with those in the operating theatres. Four more electrical socket outlets are located on the wall. Therefore, there are a total of 16 electrical outlets. There are no built-in cabinets in the room. Built-in cabinets occupy floor space and they are more difficult to maintain than mobile trolleys.

Baskets and shelves for storage of consumables are provided for at the back panel of the floor column. Drugs and accessories for infusion and injection are stored in a mobile trolley in each room.

Each room is illuminated with a general overhead lighting. A ceiling-mounted light with swivelled arm provides light source for emergencies and bedside procedures. An elbow controlled non-splash wash sink is located in each room for ease of hand washing. One X-ray view box is mounted on the wall of each room.

Isolation Room

One isolation room with capability of positive and negative pressure airflow is available. Building and maintenance cost of this room is high. It will be used for reverse barrier nursing of immunocompromised patients with aplastic anaemia and prolonged granulocytopenia.⁷ The need of this room for these cases is less when compared to that in the medical intensive care unit (MICU). Two isolation rooms were built for the MICU.

Central Station (Figs.1 & 3)

The central station provides a spacious and comfortable area for the clerical and nursing staff. All bedside monitors are linked to a central monitor located at the station. Activities of patients could be viewed via a



Fig. 2. Facilities available in the patient's room.



Fig. 3. Central station of the Surgical Intensive Care Unit.



Fig 4 Visitor's lobby.

closed circuit camera. An audio-visual intercom system is installed at the visitor entrance. Shelves and file cabinets for medical record, forms, X-rays, unit protocols and other reference materials are located here.

Two crash carts and defibrillators are placed at strategic positions. An X-ray viewing box is also located there for viewing. A central drug cabinet, a lockable cabinet for controlled drugs and a drug refrigerator are also sited there.

A pneumatic system is located in the station for rapid transport of specimens and light documents.

Communication with patients could be done via a comprehensive nurse call console at the central station.

Visitor's Lobby (Figs. 1 & 4)

A large waiting area of 140 m² is located immediately outside the SICU. Rows of sofa seats and coffee tables are provided. Other facilities available include television, vending machines, newspapers and magazines, public telephones and toilets.

There is a single entry and exit door for visitors to the SICU. Visitors need to press a bell to get assistance for the door to the SICU to be opened. An assistant is available at the counter facing the visitor corridor to answer visitors' enquiries.

Storeroom and Equipment Room (Fig. 1)

Store area should be half of the total bed area³ or 25% to 30% of all the patient and central station areas.⁴ It is because large amounts of disposable, bulky and mobile equipment are used in an intensive care unit.

Three additional store areas next to the SICU visitor's lobby were included in the last stage of the planning.

Preparation and Disposal Room (Fig. 1)

There is no direct access from the preparation to the disposal room. The preparation room is an area where nurses prepare the trolley for procedures and sterile items stored. Dirty and soiled linens and materials are collected in the disposal room for disposal.

Offices and Conference Room (Fig. 1)

Two separate offices are provided for the doctors and nursing officers. Computers and code blue alarms are linked to each office. The conference room is equipped with book cabinets, white boards, overhead projector and a projector screen. Medical and nursing staff could use the conference room for reading when it is not utilised for meeting.

Staff Pantry and Rest Room (Fig. 1)

A microwave oven and an ice-making refrigerator are provided in the pantry. Next to the pantry is the staff rest room. Toilet facilities and locker cabinets are provided.

Bedroom for Medical staff (Fig. 1)

A doctor is on duty in the SICU throughout the day and night. A sleeping area for the doctor on night duty is provided. It offers a private, comfortable environment with bed, desk, cabinets and wash basin.

Last Office (Fig. 1)

It is located at the periphery of the unit. A wash basin is available.

Automated Guided Vehicle (AGV)

The AGV station is situated outside the corridor of the Last Office. It helps to transfer bulky supplies such as linen and food.

Interior Design

A professional interior designer was involved in the selection of the colour scheme. Colour of an intensive care unit should ideally be of soft pastel and offer atmosphere of calm and relaxation. Ceiling design, material and texture are issues that clinicians tend to overlook. They are important considerations for infection and noise control.

Conclusion

Early active involvement and participation of the clinicians and nursing staff in the planning process is important.

Important considerations were size, choice of location of the SICU and its physical layout. A radial design was selected. The basis for this selection was that it allowed almost equal surveillance of the patients and patients could see that medical and nursing assistance were present.

The most difficult decision was to choose between an "open unit" versus a "single room" design. The advantage of an open unit is that it made moving surveillance easier. The advantage of a single room is provision of patient's privacy, limitation of cross-infection and reduction of noise. These later considerations were considered more important and "single room" design was used. CCTV, glass doors and glass windows were installed to facilitate nursing surveillance.

The unit was opened in January 1997. Generally, most staff feel comfortable and convenient working in the area. Feedback from visitors, patients and their relatives has also been positive.

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