

ICU Planning and Designing in India – Guidelines 2010

Guidelines Committee ISCCM

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Background

ICU is highly specified and sophisticated area of a hospital which is specifically designed, staffed, located, furnished and equipped, dedicated to management of critically sick patient, injuries or complications. It is a department with dedicated medical, nursing and allied staff. It operates with defined policies; protocols and procedures should have its own quality control, education, training and research programmes. It is emerging as a separate specialty and can no longer be regarded purely as part of anaesthesia, Medicine, surgery or any other speciality. It has to have its own separate team in terms of doctors, nursing personnel and other staff who are tuned to the requirement of the speciality (1,2,57,58,75) .

In India the scenario of ICU development is fast catching up and after initiatives, promotion, education and training programmes of ISCCM during last 15 yrs, there has been stupendous growth in this area but much needs to be done in area of infrastructure, human resource development, protocol, guidelines formation and research which are relevant to Indian circumstances. An acceptable and logistically feasible no compromise can be made on quality and health care delivery to critically sick, yet an acceptable guidelines can be adopted for making ICU designing guidelines which may be good for both rural and urban areas as also for smaller and tertiary centres which may include teaching and non teaching institutes .

There are pre-existing guidelines on the website of ISCCM, made in 2003. There has been a sea change since then and therefore need for new guidelines. The existing guidelines have been taken as base line for the present recommendations.

Following areas are covered. (4,5,6,7,9,18,35,38,77)

1 Initial Planning

- Team Formation and Leader/Coordinator
- Data Collection and analysis
- Beginning of the Process and decide about Budget allocation , aims and objectives

2 Decision About ICU Level, Number of beds, Design and Future Thoughts

- Planning level of ICU like I, Level II or Level III or Tertiary Unit
- Number of beds and number of ICUs as needed for the institution
- Designing each bed lay out and providing optimum space for the same
- Modulation according to various types of space availability
- Free hanging power columns Vs head end panel facilities

3 Central Nursing Station designing and planning

- Location, space, Facilities

4 **Equipmentation**

- Will depend on number of beds, target level of the ICU
- Most important decisions will be No of Ventilated beds and Invasive monitoring
- ICU Vs HDU
- Collecting information about various equipments available with specifications

5 **Support System Recommendations**

- Storage
- Communication
- Computerisation
- Meeting needs of Nursing and Doctors
- Meeting needs of relatives and Attendants
- Relationship and Coordination with other areas like ER and other super speciality ICUs

6 **Environmental Planning**

- Effective steps and planning to control nosocomial infections
- Flooring, walls, pillars and ceilings
- Lighting
- Surroundings
- Noise
- Heating/ AC/Ventilation
- Waste disposal and pollution control
- Protocol about allowing visitors, shoes etc inside ICU

7 **Human Resource development**

Doctors , Nurses , Respiratory Therapist , Computer Programmer , and support staff like Clerks ,X-ray technician, Lab technicians , Cleaning staff who are trained to the needs of ICUs . This is a very Critical area and turn over is very high because of big gap between demand and supply and can put a lot of stress on the team and patient outcome.

8 **Other areas like**

- Research
- Data Collection
- Documentation
- Record keeping

Team Formation

Team may consist of following -

- Intensivist
- Administrator
- Finance officer
- Architect and Engineers
- Nurse
- Any other person if is relevant

Who should Co-ordinate/lead the team ?

Coordinator is the most important person who coordinates with every one involved.

Intensivist/In-charge is best suited to be the Co-ordinator because –

- He has technical skill and knowledge to plan and guide
- He will prevent mistakes to bare minimum
- He can suggest changes during the development phase itself if finds problems
- However, in some countries or some set ups particularly public sector hospitals administrators are usually the coordinators of such project implementation process since they can coordinate with all the major individuals and groups whose inputs/help are needed in achieving the target in time and quality, It may be difficult for Intensivist to spare so much of time needed and coordinate with others.

Aims and Objectives, Budget allocation and other target settings

It is important to decide about priorities based on inputs from Team members and should answer following questions –

- Budget available
- Level of ICU needed
- Location
- Number of Beds needed
- Designs
- Human Resource Development
- Engineering and designing constraints
- What type of Case mix the ICU team is likely to deal with and therefore help in prioritise equipment type
- In Case of existing facility being upgraded or relocated, then the review of past mistakes
- Patient safety and prevention of infection programme
- Transition in case of relocation during reconstruction of the existing ICU

Following thoughts may help in making decisions and implementation easier (88s)

- Features that must be adopted
- Features that should be adopted
- Features that can be adopted
- Features that should not be adopted
- Features that must not be adopted.

When every thing has been put in writing and approved by the whole team, the process must be began in the earnest and a time frame work should be fixed and all efforts must be made to accomplish the implementation within the stipulated time unless there are unforeseen circumstances.

Budget and Human Resource (Residents and Nurses) are the most important limiting factors. Engineering related problems like drainage systems, leaks, slopes etc are easily overlooked. It is advised that engineering work be done in a manner so that repairing when ever needed should be easily possible without jeopardising patient care. Therefore, least concealed or over-the-false roof pipelines, wires should be avoided.

Designing ICU/Level/No of ICUs/No of Beds and Individual Bed

Following ICU Levels are proposed

Level I

- It is recommended for small district hospital, small private Nursing homes, Rural centres
- Ideally 6 to 8 Beds
- Provides resuscitation and short-term Cardio respiratory support including Defibrillation.
- ABG Desirable.
- It should be able to Ventilate a patient for at least 24 to 48 hrs and Non invasive Monitoring like - SPO₂, H R and rhythm (ECG), NIBP, Temperature etc
- Able to have arrangements for safe transport of the patients to secondary or tertiary centres
- The staff should be encouraged to do short training courses like FCCS or BASIC ICU Course.
- In charge should be preferably a trained doctor in ICU technology and knowledge
- Blood Bank support
- Should have basic clinical Lab (CBC, BS, Electrolyte, LFT and RFT) and Imaging back up (X-ray and USG), ECG
- Some Microbiology may be desirable
- At least one book on Critical Care Medicine as ready reckoner

Level II (Recommendations of Level I Plus)

- Recommended for larger General Hospitals
- Bed strength 6 to 12
- Director be a trained/qualified Intensivist
- Multisystem life support
- Invasive and Non invasive Ventilation
- Invasive Monitoring
- Long term ventilation ability
- TC Pacing
- Access to ABG, Electrolytes and other routine diagnostic support 24 hrs
- Strong Microbiology support with facility for Fungal Identification desirable
- Nurses and duty doctors trained in Critical Care
- CT must & MRI is desirable
- Protocols and policies for ICUs are observed
- Research will be highly recommended
- Should be supported ideally by Cardiology and other super specialities of Medicine and Surgery
- HDU facility will be desirable
- Should fulfil all requirements for IDCC Course
- Resident doctors must be exposed to FCCS course/BASIC course/Ventilation workshops and other updates
- Blood banking either own or outsourced

Level III (All recommendations of Level II Plus)

- Recommended for tertiary level hospitals
- Bed strength 10 to 16 with one or multiple ICUS as per requirement of the institution
- Headed by Intensivist
- Preferably Closed ICU

- Protocols and policies are observed
- Have all recent methods of monitoring, invasive and non invasive including continuous cardiac output, SCvO2 monitoring etc
- Long term acute care of highest standards
- Intra and inter-hospital transport facilities available
- Multisystem care and referral available round 24 hrs
- Should become lead centres for IDCC and Fellowship courses
- Bedside x-ray, USG, 2D-Echo available
- Own or outsourced CT Scan and MRI facilities should be there
- Bedside Bronchoscopy
- Bedside dialysis and other forms of RRT available
- Adequately supported by Blood banks and Blood component therapy
- Optimum patient/Nurse ratio is maintained with 1/1 pt/Nurse ratio in ventilated patients.
- Protocols observed about prevention of infection
- Provision for research and participation in National and International research programmes
- Patient area should not be less than 100 sq ft per patient (>125 sq ft will be ideal). In addition there is optimum additional space for storage, nursing station and relatives
- The unit is assisted by an Ethical Committee which formulates policies about DNAR, Organ donation, EOLS etc
- Doctors, Nurses and other support staff be continuously updated in newer technologies and knowledge in critical Care

There is regular sharing of knowledge, mishaps, incidents, symposia and seminars etc related closely to the department and in association with other specialties

Human Resource for ICU

(1,2,3,4, 5,55,88)

Human resource development is one of the most important task and component of the whole programme. Dedicated, highly motivated, ready to work in stress situations for long periods of time are the type of personal needed. They include

- Intensivist/s
- Resident doctors
- Nurses,
- Respiratory Therapists,
- Nutritionist
- Physiotherapist
- Technicians, Computer programmer,
- Biomedical Engineer, and
- Clinical Pharmacist
- Other support staff. Like cleaning staff, guards and Class IV.

Not only they have to be qualified but have to be trained and have to be a team person Scarce availability of these qualities all in one has made their availability extremely difficult and the turn over is high.

Team Leader

It is important to have a good team led by an Intensivist (who spends >50% of his time in ICU). He should be a full timer particularly for tertiary centres. He should be qualified and trained and able to lead the team. Experience is absolutely essential to lead the ICU team .

Resident Doctors (only MCI endorsed)

- Post graduates from Anaesthesia, Medicine or Respiratory Medicine or other allied branches even surgical specialties. Other residents may be graduates depending upon total Bed strength of ICU.
- Though need of resident doctors per number of patient has not been prescribed in literature, however, it is understood and recommended that one doctor cannot take care of more than five patients who are critically sick on ventilator and/or undergoing invasive monitoring with MOFS.
- Therefore, it is suggested that one PG resident with one graduate resident may be good for an ICU of 10 to 14 beds with 1/3 of the pts may be falling into above category. Total no of residents should include who will relieve those going on leave or have to take sudden offs.

Nursing staff (only NCI Endorsed) (34,35,36,37,38,39)

- Nursing – 1/1 nursing for Ventilated or MOFS patients is desirable but in no circumstance the ratio should be < 2 /3 (Two nurses for 3 such patients).
- This will affect the outcome immensely.
- 1/2 to 1/3 nurse patient ratio is acceptable for less seriously sick patients who do not require above modalities.

Other staff

- **Respiratory Therapist** looks after the patients being ventilated respiratory physiotherapy, this takes away lot of load off the duty doctor and the nurses **Physiotherapist** help in mobilisation, and **Technicians** who can perform simple procedures like taking samples and sending them to proper place in proper manner makes the task easy and less stressful.
- **Computer person** can prepare reports, enter data and bring out print outs as and when needed. He can also maintain library, Internet and protocols practiced in ICU.
- **Biomedical engineer** within the campus makes the job of ICU less frustrating when snags creep in within sensitive ICU equipment. He can be correct them fast.
- **Nutritionist** is also a very important professional who can contribute to outcome of patient. They have to be trained in desired practices and should be more inclined towards enteral feeding than TPN.
- **Cleaning, class IV and Guards** are also important to ICU particularly when they understand needs of ICU and its patients. They have a huge role to play in prevention of Nosocomial infection, keeping ICU clean and protect from overcrowding.
- One person should be responsible for observing protocols of Pollution and Infection control. Such person should act in close collaboration of Microbiology personnel
- In addition the ICU should be ably supported by clinical Lab staff, Microbiology and Imaging staff who can understand the protocols of ICU and act within discipline of ICU protocols.
- Having professionals from Clinical Lab, Microbiology, Imaging, Pharmacy for support whenever needed will be desirable.

How many ICUS and Beds are needed (81,82,83)

- Brain storming sessions should be held as to decide how many ICU beds are needed and how many ICUs should be made which may include Advanced ICU, HDU, PICU and Speciality related ICU like Neurointensive care, Cardiac Intensive Care and Trauma.
- The number of Intensive Care beds will depend on the data available from the hospital and current/future requirements of the hospital.
- Some ICUs particularly in Private set ups in our country may be main speciality in the hospital and they should be very careful in deciding about the number of beds and budgetary provisions and viability issues are very important in such cases.
- Numbers of ICU Beds recommended in a hospital are usually 1 to 4 per 100 hospital beds
- ICUs having <6 beds are not cost effective and also they may not provide enough clinical experience and exposure to skilled HR of the ICU. At the same ICU with bed strength of >24 are difficult to manage and major problems may be encountered in management and outcome.
- Recommendations suggest that efficiency may be compromised once total number of beds crosses 12 in ICU.
- The Canadian Department of National Health and Welfare has developed a formula for calculating the number of ICU beds required based on the average census in the existing unit and the desired probability of having an ICU bed immediately available for a new admission.
- Therefore, it is recommended that total bed strength in ICU should be between 8 to 12 and not <6 or not >14 in any case

Location/entry/exit points of ICU in Hospital

- Safe, easy, fast transport of a critically sick patient should be priority in planning its location, therefore, ICU should be located in close proximity of ER, Operating rooms, trauma ward.
- Corridors, lifts & ramps should be spacious enough to provide easy movement of bed/trolley of a critically sick patient.
- Close/easy proximity is also desirable to diagnostic facilities, blood bank, pharmacy etc.
- No thoroughfare can be provided through ICU.
- There should be single entry/exit point to ICU, which should be manned.
- However, it is required to have emergency exit points in case of emergencies and disasters.

ICU Bed Designing and Space Issues (1,2,3,8,10,11,12,13,14,15,16,17,19, 20,21,22,24,34,36,37,39,46, 47,66,67,69,70,73,75,78,79,80,88)

- Space per bed has been recommended from 125 to 150 sq ft area per bed in the patient care area or the room of the patient. Some recommendation has placed it even higher up to 250 sq ft per bed. In addition there should be 100 to 150% extra space to accommodate nursing station, storage, patient movement area, equipment area, doctors and nurses rooms and toilet.
- However, in Indian circumstances after reviewing and feed back from various ICUs in our country it may be satisfactory to suggest an area of 100 to 125 sq ft be provided in patient care area for comfortable working with a critically sick patient where all the paraphernalia including monitoring systems, Ventilators & other machines like bedside X-ray will have to be placed around the patient. Bedside procedures like Central lines, Intubation, Tracheostomy, ICD insertion and RRT are common.
- It may be prudent to make one or two bigger rooms or area which may be utilised for patients who may undergo big bedside procedures like ECMO, RRT etc and has large number Gadgets attached to them.
- 10 % (one to two) rooms may be designated isolation rooms where immuno-compromised patients may be kept, these rooms may have 20% extra space than other rooms.
- The planners may think about, if they are thinking of introducing newer technologies in their ICU like ECMO, Nitric Oxide and Xenon clearance etc. Do they need Lamellar flow for specific patient population in their ICUs. This will be highly specific for High end up ICUs and is not recommended in routine Provisions may be kept open for such options in future.

Partition between two room and maintaining privacy of patients

- It is recommended that there should be a partition/separation between rooms when patient privacy is desired which is not unusual.
- Standard curtains soften the look and can be placed between two patients which is very common in most Indian ICUs, however they are displaced and become unclean easily and patients privacy is disturbed
- Therefore, two rooms may be separated by unbreakable fixed or removable partitions, which may be aluminium, wood or fibre. However permanent partitions takes away the flexibility of increasing floor space temporarily (In Special circumstances) for a particular patient even when the adjoining bed/room may not be in use.

- There are also electronic windows which are transparent when the switch is off and are opaque when the switch is on, Although expensive now, the cost of this option may come down over time,

Pendant vs Head End Panel

One of the most important decisions is to how to plan bedside design

Two approaches are usually practised

- 1 Head wall Panel
- 2 Free standing systems (power columns) usually from the ceiling Each can be fixed or moveable and flexible can be on one or both sides of the patient.
 - Flexibility is usually desirable,
 - Panels on head wall systems allow for free movements
 - Adaptable power columns can move side to side or rotate,
 - Mounts on power columns are also usually adjustable,
 - Flexible systems are expensive and counterproductive if the staff never move or adjust them,
 - Head wall systems can be oriented to one side of the patient or to both sides,
 - Some units use two power columns, one on each side of the patient,
 - Other units use a power column on one side in combination with some fixed side wall options on the opposite side,
 - Ceiling mounted moveable rotary systems may reduce clutter on the floor and make a lot of working space available, However, this may not be possible if the weight cannot be structurally supported
 - Power columns may not be possible in smaller rooms or units.
 - Each room should be designed to accommodate portable bedside x-ray, Ultrasound and other equipment such as ventilators and IA Balloon pumps; in addition, the patient's window view (If available) to the outside should be preserved.

Height of Monitoring System

Excessive height may be a drawback to the way monitoring screens are typically well above eye level and display more parameters. Doctors and nurses may have chronic head tilting leading to cervical neck discomfort and disorders, Therefore, the levels of monitors should be at comfortable height for doctors and nurses

Keep Bed 2 ft away from Head Wall

- A usual problem observed in ICU is getting access to the head of the bed in times of emergency and weaving through various tangled lines. And at the same time patient also should not feel enclosed and surrounded by equipment and induced uncalled for fear
- About 6 inches high and 2 ft deep step(Made of wood) usually temporary/removable (which would otherwise would stay there only) is placed between the headwall and the bed It will keep the bed away from the wall and automatically gives caregivers a place to stand in emergencies without too much of problems.
- Lines may be routed through a fixed band of lines tied together.

Provision for RRT

Two beds should be specially designated for RRT (HD/CRRT) where outlets should be available for RO/de-iodinated water supply for HD machines. Self-contained HD machines are also available (Cost may be high)

Isolation Rooms

10% of beds (1 or 2) rooms may be used exclusively as isolation cases like for burns , serious contagious infected patients .

Alarms . music . phone etc

- Each group should decide if they want to provide the patient access to music (audio), telephone etc.
- However an alarm bell which has both indicators by sound and light must be provided to each patient and he be taught about it, how to use it when needed

Oxygen/Vacuum/ Compressed air outlets and No of Electric female Plugs

For tertiary center

Summary of key Recommendation for Minimal standards in ICU

Standards	AIA/AAH (1)	IEEE	SCCM (2)
O2 outlets	2 to 3	2	2 to 3
Vacuum outlets	2 to 4	3	2 to 3
Compressed air outlets	1 to 3	1	1 to 2
Electric outlets	7	8	11 to 12
Room size (sq ft)	132	-	150 to 250
Isolation room	150	-	250
Anteroom	20	-	20
Unit size	-	-	12 beds

Adopted from Don Axon DCA FAIA Losangeles

Recommendations for Indian ICUs

We recommend following for Level I and Level II Indian ICUs Unit size 6 to 12 beds

- Bed space- minimum 100 sq ft (Desirable) >125.
- Additional space for the ICU (Storage/Nursing stn/doctors/circulation etc) 100 % extra of the bed space (Keep the future requirement in mind)
- Oxygen outlets 2
- Vacuum outlets 2
- Compressed air outlets 1
- Electric outlets 12 of which 4 may be near the floor 2 on each side of the patient. Electric outlets/Inlets should be common 5/15 amp pins. Should have pins to accommodate all standard International Electric Pins/Socket. Adapters should be discouraged since they tend to become loose.

Utilities per bed as recommended for Level III Indian ICUs

3 oxygen outlets, 2 compressed air, 2 vacuum (adjustable), 12 to 14 electric outlets, a bedside light one-telephone outlets and one data outlet. (88,89,90,91,92)

Central Nursing stn (1,2,3,4,11,34,39,40,46,56,60,61,64,70,77,78,79,88)

- This is the nerve centre of ICU, despite lots of development, the old standard of a central station is still holds good and endorsed by most guidelines and regulations regardless of today's practice needs.
- All/near-all monitors and patients must be observable from there, either directly or through the central monitoring system. Most ICUs use the central station, serving six to twelve beds arranged in an L or U fashion,
- Patients in rooms may be difficult to observe and therefore may be placed on remote television monitoring, These monitors may satisfy regulatory requirements but do not really provide adequate patient safety if the clarity of the picture is poor.
- Some ICUs have unit pods of about four or five beds, each served by a separate workstation, Nurses assigned to patients in the pod form a team,
- A monitor technician is required,
- The unit Nursing clerk and the supervising nurse will usually work together to oversee the efficient interaction among the staff and with support services,
- Careful consideration of what level or type of activity will occur in the central station will insure adequate space planning, New equipment purchased over the next decade will probably increase the amount of desk and shelf space required.
- At times of high use the number of people in the central station can increase several fold. Having enough space and chairs to meet needs during such times should be provided for.
- The space should accommodate computer terminals and printers. A large number of communication cables may be required per bedside to connect computers and faxes to other departments, as well as to other institutions and offices,
- Adequate space for charting on the platform is absolutely important.
- Patients must be easily visible from the charting area whether the nurse is sitting or standing, taller chairs are often necessary.
- In case of space constraint, Collapsible desktops or shelves that can flip up off the wall can be planned
- Space allotted for storage of the previous charts of patients currently in the unit should also be provided
- It is also important that a storage space is provided for equipment, linen, instruments, drugs, medicines, disposables, stationary and other articles to be stored at the Nursing station must be provided. All these cupboards should be labelled
- The latest generation of monitoring systems allows access to patient data from any bedside; This means that the doctor who is busy caring for one patient can monitor others without leaving that bedside.
- Consoles can be programmed to automatically display critical events from one bedside at several sites without personnel calling for it. There is need for more effective alarming system with less noise, which can send signals to CNS as well as remote pager carried by the caregiver.
- Ideally in Indian ICUs, there are over bed tables with each bed. These tables may be so deigned of stainless steel to have a broad top to accommodate charts and cupboards enough in number and size to store medicines, disposables investigations and records of the patient.

- The CNS has in charge nursing, duty doctors/s, clerk/computer guy, machines, store attached and monitors and spare machines/spares, linen and other ancillaries

List Of Equipment (12 Bedded ICU and 8 Bedded HDU) (88, 89)

Sr No	Name of equipment	Number	Specification
1	Bedside Monitors (For ICU)	One per Bed	Modular -2 Invasive BP, SPO2,NIBP, ECG, RR, Temp Probes with trays
2	Monitors for HDU	Same	Same but without Invasive BP but upgradeable
3	Ventilators	6	With paediatric and adult provisions, graphics and Non-Invasive Modes (Two Ventilators should be with inbuilt Compressor. each should have a Fisher and Paykel Humidifier (These can be bought directly from F &P
4	Non invasive Ventilators	3	With Provision for CPAP and IPAP
5	Infusion Pumps	2 Per bed in ICU 1 Per Bed in HDU	Volumetric with all Recent upgraded drug calculations
6	Syringe Pumps	2 per bed in ICU	With recent up gradation
7	Head End Panel	1 Per bed	With 2 O2 Outlets, two vacuum, one compressed air and 12 electric outlets , provision for Music, Alarm, trays for two monitors, Two Drip stands, One Procedure light
8	Defibrillator	Two with TCP facility (one standby)	Adult and paediatric pads with Transcutaneous pacing facility
10	ICU Beds (Shock Proof) (Fibre)	One for each bed	Electronically Manoeuvred with all positions possible with mattress. Now beds are available which give lateral positions also
11	Over Bed Tables	One for each Bed	ALL SS with 6 to 8 cupboards in each to store Drugs Medicines, side tray for x-rays, BHT, on wheels
12	ABG Machine	One+One	facility for ABG and Electrolytes Second one as stand-bye
13	Crash/ Resuscitation trolley	Two for ICU + One for HDU	To hold all resuscitation equipment and Medicines
14	Pulse Oxymeter (Small Units)	Two	As stand bye units
15	Freeze	One + One for use of staff and doctors	With deep freeze facility
16	Computers	2 (for ICU), One for HDU, One for In charge	With laning, Internet facility and printer to be connected with all departments
17	HD Machines	2	User friendly so that even a Nurse can Operate
18	CRRT	One	High flow /Speed Model
19	CO, SVR, ScvO2 Monitor	One	As Described
20	Intermittent Leg Compressing Machine	Two	To prevent DVT
21	Airbeds	6	To Prevent Bed sores
22	Intubating Video scope	One	To make difficult Intubations easy
23	Glucometer	2 for ICU, one for HDU	

Sr No	Name of equipment	Number	Specification
24	ICU Dedicated Ultrasound and Echo machine	One	With recent advances to look instantly even at odd hours. Vascular filling, central lines, etc
25	Bedside X ray	One	
26	ETO sterilization	One	To sterilize ICU disposables regularly
27	Spinal Board	Two	For spine trauma patients
28	Rigid Cervical Spine collars	4	For stabilizing cervical spine
29	Ambu Mask different sizes	10 sets including two for Pediatric use	Silicon, ETO sterilisable
30	Pollution control buckets	One set for each Bed	
31	Trays for Procedures	For putting central lines, ICD, catheters etc	
32	I A Balloon Pump	One	
33	Fibroptic Bronchoscope	One	

This is major list of equipment for ICU, More Equipment can be added to meet the requirements of each unit. Each unit can modify this list as per their needs.

STORAGE (1,2,8,52,88)

It is important to decide what is to be stored

- By the bedside
- At the Nursing stn
- Nursing stores
- Remote central store
- Those supplies used repeatedly and in emergencies should be readily available and easy to find, Storing a large inventory can be costly, but so is wasting personnel time,. Making supplies more available may increase their use. Some over cautious or clever staff may decide to hoard or hide them. Cost effective and efficient designs are needed.
- Staff nurses can always give useful ideas about improvement of systems, which they develop while working with patients. Their opinion can be invaluable.
- When medications are kept at the bedside, JCAHO currently requires that the storage be lockable, these stores can store medicines, disposables, records, injections, tabs etc.
- Bedside supply carts that are stocked for different subsets of patients can make storage in the room more efficient, For example, surgical, medical, trauma patients, cardiac patients where needs are different. Staff nurses may be specifically trained for such care and work
- Determining what supplies are placed near but not at the bedside is based on the size of the unit, the grouping of patients and the patterns of practice, although many units organize supplies by the department that restocks them (central services, nutrition, pharmacy, respiratory therapy, etc.)
- it is worth considering grouping supply by activity, like Chest tray, Central line tray, skin care tray , catheterisation tray , Intracranial pressure tray etc. They may be labelled by name or colour code.

Environmental Requirements (1,2,3,8,13,14,26,30,45,60,69,70,72,73,77,79,80,88,90,91)

Heating, Ventilation and Air-conditioning (HVAC) system of ICU

- The ICU should be fully air-conditioned which allows control of temperature, humidity and air change. If this not be possible then one should have windows which can be opened ('Tilt and turn' windows are a useful design.).
- Suitable and safe air quality must be maintained at all times. Air movement should always be from clean to dirty areas. It is recommended to have a minimum of six total air changes per room per hour, with two air changes per hour composed of outside air. Where air-conditioning is not universal, cubicles should have fifteen air changes per hour and other patient areas at least three per hour.
- The dirty utility, sluice and laboratory need five changes per hour, but two per hour are sufficient for other staff areas.
- Central air-conditioning systems and re-circulated air must pass through appropriate filters.
- It is recommended that all air should be filtered to 99% efficiency down to 5 microns. Smoking should not be allowed in the ICU complex.
- Heating should be provided with an emphasis on the comfort of the patients and the ICU personnel.
- For critical care units having enclosed patient modules, the temperature should be adjustable within each module to allow a choice of temperatures from 16 to 25 degrees Celsius.
- A few cubicles may have a choice of positive or negative operating pressures (relative to the open area). Cubicles usually act as isolation facilities, and their lobby areas must be appropriately ventilated in line with the function of an isolation area (i.e. pressure must lie between that in the multi-bed area and the side ward).
- Power back up in ICU is a serious issue. The ICU should have its own power back, which should start automatically in the event of a power failure. This power should be sufficient to maintain temperature and run the ICU equipment (even though most of the essential ICU equipment has a battery backup). Voltage stabilisation is also mandatory. An Uninterrupted Power Supply (UPS) system is preferred for the ICU

Negative pressure isolation rooms (Isolation of patients infected/suspected to be Infected with organisms spread via airborne droplet nuclei $<5 \mu\text{m}$ in diameter) In these rooms the windows do not open. They have greater exhaust than supply air volume. Pressure differential of 2.5 Pa. Clean to dirty airflow i.e. direction of the air flow is from the outside adjacent space (i.e.. corridor, anteroom) into the room. Air from room preferably exhausted to the outside, but may be re-circulated provided is through HEPA filter NB: re-circulating air taken from areas intended to isolate a patient with TB is a risk not worth taking and is not recommended

Positive pressure isolation rooms (To provide protective environment for patients at Highest risk of infection e.g. Neutopenia, post transplant)

These rooms should have greater supply than exhaust air. Pressure differential of 2.5 – 8 Pa, preferably 8 Pa. Positive air flow relative to the corridor (i.e. air flows from the room to the outside adjacent space) . HEPA filtration is required if air is returned.

LIGHTING (1,8,15,21,23,36,42,88)

Light in room

- Natural Light – Access to outside natural light is recommended by regulatory authorities in USA,
- This may improve the Staff Morale and Patient outcome,
- Data suggests that synthetic artificial daylight use in work environment may deliver better results for night time workers
- It may be helpful in maintaining the circadian rhythm
- **Natural lighting in the unit can decrease power consumption and the electrical bill which is so relevant to Indian circumstances.**
- Access to natural light also means one may have access to viewing external environment which may be developed into green and soothing.

Light for Procedures

- High illumination and spot lighting is needed for procedures, like putting Central lines etc.
- They can descend from the ceiling, extend from the wall/ Panel, or be carried into the room.
- Recommended Spot lighting should be shadow free 150 foot candles (fc) strength.

Light required for general patient care-

- It should be bright enough to ensure adequate vision without eyestrain.
- Overhead lighting should be at least 20-foot candles (fc).
- Higher frequency fluorescent lights and coated phosphorus lamps may be good for assessing skin colour and tone
- Patients may need rest and quiet surroundings during the day, Blackout curtains or blinds or Individual eye may be used, These may be helpful when the staff requires a high level of lighting at the bedside while the patient is resting.
- Lights that come on automatically when cupboard doors or drawers are opened are useful.
- Floor lighting may be important for safety at the bedside and in the hallways at night and should be about 10fc.
- Glare created by reflected light should be diffused
- Light switches should be strategically located to allow some patient control and adequate staff convenience.
- A second remote control can be turned on/off by the nurses/doctors to observe patients intermittently at night without entering the room and disturbing the patient.
- Hall lights controls should be subdivided into smaller independent areas and dimmer switches may be desirable

The Illuminating Engineering Society of North America published useful guidelines on this subject.

Noise Control in ICU (1,8,26,27,44,45,78,88)

The international Noise Council recommends that the noise level in an ICU be under 45 dBA in the daytime, 40 dBA in the evening. and 20 dBA at night (dBA is a scale that filters out low frequency sounds and is more like the human hearing range than plain dB)

Standard examples are

A watch ticks at about 20 dBA,

A normal conversation is at about 55 dBA.

A vacuum cleaner produces -about 70 dBA

A garbage disposal-- about 80 dBA.

Noise level monitors are commercially available.

If the unit noise exceeds that level, a light comes on or flashes to remind the staff to decrease the noise level.

FURNITURE AND FURNISHINGS – (8,14,52,69,71,73, 76.88)

- The counters and furniture should be tough to withstand a lot of heavy use.
- Easy to clean and maintain,
- Connections should be made of metal—to—metal fasteners
- Cabinet-quality wood construction should also be tough and strong
- Surfaces for counters should be solid, non-porous and stain resistant,
- Fabrics should be durable, colourfast and flame and static resistant if possible
- Bedside clocks, calendars and bulletin boards help the conscious patient well oriented and in better moods
- Providing the patient with a place to keep a few small personal items of their own make the environment more familiar and personalized.
- Some finishing touches like some art work/décor/ sculpture may change the ICU atmosphere a great deal and has been recommended by the SCCM.

Chairs number and types –

- Individual units should decide about the number, usually enough number to accommodate the care giving staff/doctors and Nurses and additional chairs may be stored and used whenever needed.
- Individual Units should decide whether they want to allow the relative to sit by the side (Short or long time) of the patient in the ICU.
- However, a chair/sofa type chair on wheels with safety belt or vault is recommended for mobilising the patient. and making him sit during recovery
- Provisions must be made to accommodate an obese patient

FLOOR, WALL AND CEILING COVERINGS (8,14,17,73)

Floor –

- The ideal floor should be easy to clean, non slippery, able to withstand abuse and absorb sound while enhancing the overall look and feel of the environment,
- Carts and beds equipped with large wheels should roll easily over it.
- In Indian context Vitrified non-slippery tiles seem to be the best option which can be fitted into reasonable budgets, easy to clean and move on and may be stain proof
- Vinyl sheeting is another viable option, It can be non-porous, strong and easy to clean, However, the life of Vinyl flooring is not long and a small damage in one corner may trigger damage of entire flooring and make it accident prone. It may require frequent replacement making it to be inconvenient choice.

Walls – Should meet following criteria:

- Durability, ability to clean and maintain, flame retardance, mildew resistance, sound absorption and visual appeal.
- It has been very useful to have a height up to 4to5 ft finished with similar tiles as of floor for similar reasons.

- For rest of the wall soothing paint with glass panels on the head end at the top may be good choice.
- Wooden panelling has also found favour with some architects but costs may go high.
- Doorstoppers and handrails should be placed well to reduce abuse and noise to minimum; it helps patient movement and ambulation.

Ceiling

- It is the ceiling surface patients see most often, sometimes for hours on end, Over several days or weeks, In addition, bright spotlights or fluorescent lights can cause eye strain,
- Ceiling should be Soiling and break proof due to leaks and condensation.
- Tiles may not the most appealing or soothing surface, but for all practical purposes it is easier to remove individual or few tiles for repairs over ceiling in times of need. Ceiling design may be enhanced by varying the ceiling height, softening the contours, griddled lighting surfaces, painting it with a medley of soft colours rather than a plain back ground colour, or decorating it with mobiles, patterns or murals, to make it more patient and staff friendly.
- It is recommended that no lines or wires be kept or run over ceiling or underground because damages do occur once in a while and therefore, it should be easy to do repairs if the lines and pipes are easily explorable without hindering patient care

Waste Disposal and Pollution Control

- This is mandatory and a huge safety issue both for the patient and staff/doctors of the hospital and society at large
- It is important that all govt regulations (State Pollution control Board in this particular case) should strictly be complied with.
- It is mandatory to have four covered pans (Yellow, blue, Red, Black) provided for each patient or may be one set between two patients two save space and funds. This is needed to dispose off different grades of wastes.

Hand Hygiene and Prevention of Infection

- Every bed should have attached alcohol based anti-microbial instant hand wash solution source, which is used before caregiver (doctor/Nurse/relative/Paramedical) handles the patient.
- Water basin at all bedside has not proven popular and successful because of poor compliance by one and all and also for reasons of space constraints and maintenance issues.
- An operation room style sink with Elbow or foot operated water supply system with running hot and cold water supply with antiseptic soap solution source should be there at a point easily accessible and unavoidable point, where two people can wash hands at a time.
- This sink should have an immaculate drainage system, which usually may become a point of great irritation and nuisance in later yrs or months.
- All entrants (Irrespective of Doctors or nurses should don mask and cap in ICU and ideally an apron which should be replaced daily)
- No dirty/soiled linen/material should be allowed to stay in ICU for long times for fear of spread of bad odour, infection and should be disposed off as fast as possible. Dirty linen should be replace regularly at fixed intervals.

- All surroundings of ICU should be kept absolutely clean and green if possible for obvious reasons

Disaster Preparedness (1,2,3,35)

- All ICUs should be designed to handle disasters both within ICU and outside the ICU. Outside the ICU may include inside the hospital and in the city or state.
- Within ICU may be fire, accidents and Infection or unforeseen incidents.
- Similarly outside the ICU there may be major or minor disasters like fire, accidents, Terrorist acts etc.
- There must be an emergency exit in ICU to rescue pts in times of internal disaster. There should be provision for some contingency room within hospital where critically sick patients may be shifted temporarily.
- HDU may be the best place if beds are vacant.
- There should be adequate fire fighting equipment in side ICU and protection from Electrical defaults and accidents.
- ICU is location for Infection epidemics, therefore, it is imperative that all protocols and recommendation practises about infection control and prevention are observed and if there is a break out then adequate steps taken to control this and disinfect the ICU if indicated.
- **Meeting the needs of Care givers, other departments and relatives of Pts (1,2,3,8, 13,14,17,18,51,52,71,74,75,78,88)**

Needs of doctors and Nurses

- The space and facilities planned for them are often inadequate. Space is usually scarce and it is tempting to limit the support areas in favour of larger patient rooms.
- Multi-purpose rooms may be a solution which may be used for meetings, leisure, lectures, library, lounge and break areas with food services (microwave, coffeemaker, refrigerator),
- This is especially useful for night shift staff when the cafeteria is closed, Multipurpose seating, stackable or folding chairs and a wide variety of lighting options can increase flexibility.
- This should be in close proximity to the unit (within the same broader complex) and can even have windows with curtains, blinds, or one-way glass to allow those inside to continue to observe unit activity,
- Additional space is needed for staff lockers with areas to change clothes and, ideally, shower.
- Separate areas are required for men and women,.
- In Indian situation it is advisable to have separate change rooms for nurses and doctors.
- Whether or not lockers are provided, female staff tends to keep purses or bags near them at the bedside, (This should be discouraged like helmets of male staff cannot be allowed in main ICU). This can be addressed by providing a secure place for keeping their belongings in the unit.
- A couch with working table and broadband connected computer is quite handy.
- Optimum number of journals/books, stationary, view boxes should be provided.
- Enough no of restrooms be provided

MEETING THE NEEDS OF FAMILIES AND VISITORS

It is very important to value family members and take care of their needs.

Many features that ease the stress of facing threat of death because of critical illness may not be necessarily expensive. Identifying these needs by acting as a visitor of a patient in ICU may be useful. Some of these may be as follows:

Signages--Clearly marked and multilinguistic including English and Hindi + Local Language guiding them to correct desired location, Once they reach the unit, it should be easy for them to learn how to gain entry into the unit.

Waiting and seating space

- Many guidelines suggest that 1-1/2 to 2 seats per patient bed be provided in the waiting area, Despite using this ratio, many admit that their waiting area is still too small.
- In rural and semi-urban India, there are large and extended families, This should be reflected in the size of waiting rooms of institutions that commonly serve such populations,
- Designers can establish several small areas within a larger space with a variety of seating and lighting options, Large open rooms may be easier to achieve, but they are often noisy and lack the capability to provide areas for privacy, intimacy and rest,
- Minimally, a separate small room for grieving or private conferences should be provided near the unit with soothing decor and comfortable seating, This may be used for counselling the family members in times of need.
- One large TV should be provided for them
- Family members often go through periods when they spend several long hours in the waiting room, In such cases, recliners or even hideaway beds are greatly appreciated,
- Enough number of restrooms should be provided.
- Some institutions have their own hotels, motels, or guesthouses /Dharmshalas.
- Lockers be provided to families, that can allow them to bring things they need without having to drag them all with them whenever they come and go.
- Written information about dining facilities inside and outside the hospital should be available.
- Ideally, a café or tea counter with refrigerator, microwave, sink and/or vending machines can be provided in or near the waiting area,
- An information shelf having booklets or videos on diseases relevant to critical care are helpful.
- Pamphlets for the consumer on critical care and on advanced directives may be very useful.
- Trained volunteer or social workers can help families cope and to reduce their anxiety, keep them updated with compassion about condition, progress, procedures, expenses about the patient.
- SCCM has also recently published a manual in this regard

Communication (3,8,46,58,60,64,78,79)

A central communication area is also needed for unit, committee and hospital-wide announcements; newsletters and memos: and announcements of outside events and meetings.

Bulletin boards are necessary but often unsightly. It is better to plan them because they may be added after the fact in a less effective or appealing manner

HDU- (28,84,85,86,87,89)

- It is the area where patient care level is intermediate between ICU and Floors. It is usually located near the ICU complex or within ICU complex. The staff is also almost similar to ICU culture. Following type patients may be kept here
- Patients recovered from Critical Sickness.
- Patient who are less sick like single organ failure not requiring invasive monitoring or invasive MV
- Patients requiring close observation that are strong suspects of getting deteriorated.
- Size of such units should be at least 50 % of the main ICU.
- Doctor/Pt ratio and Nurse/Pt ratio may be much more relaxed
- 1/3 of these Beds may be used as palliative unit for patients who are terminally sick and DNAR is being observed.
- There are conflicting reports suggesting usefulness of such units. But in Indian circumstances and surveys indicate that HDU has helped in our circumstances. Possibly in following ways
- Cutting costs of patients and health service provider requiring close observation and not needing ICU
- Allows close observation of potentially critically sick patients both who are transferred from and to ICU
- Psychological relief to the family and patients that he is being observed meant for lesser sick patients.
- It may be handy to public hospitals where there is always shortage of ICU beds.

Summary

- ICU is a highly specialised part of a hospital or Nursing home where very sick patients are treated.
- It should be located near ER and OT and easily accessible to clinical Lab. Imaging and Operating rooms.
- No Thorough fare can be allowed through it
- Ideal Bed strength should be 8 to 14. More than 14 beds may put stress on ICU staff and may also have a negative bearing on patient outcome. <6 Bed strength will be neither viable or provide enough training to the staff of ICU
- Each patient should have a room size of >100 sq ft , However a space of 125 to 150 sq ft per pt will be desirable .
- Additional space equivalent to 100 % of patient room area should be allocated to accommodate nursing stn, storage etc.
- 10% beds should be reserved for patients requiring isolation.
- Two rooms may be made larger to accommodate more equipment for patients undergoing multiple procedures like Ventilation, RRT Imaging and other procedures.
- There should be at least two barriers to the entry of ICU
- There should be only one entry and exit to ICU to allow free access to heavy duty machines like mobile x-ray, -bed and trolleys on wheels and some time other repairing machines.
- At the same time it is essential to have an emergency exit for rescue removal of patients in emergency and disaster situations.
- Proper fire fighting /extinguishing machines should be there.
- It is desirable to have access to natural light as much as possible to each patient.

- Head end Panels are recommended over Pendants for monitoring, delivery of oxygen, compressed air and vacuum and electrical points for equipment use for these patients
- List of equipment and no of Oxygen, vacuum, compressed air outlets are listed in the guidelines
- Every ICU should have a qualified /trained Intensivist as its leader
- One doctor for five patients may be ideal ratio.
- 1/1 Nurse ideally but < 1/2 nurse –patient ration is recommended for ventilated patients and patients receiving invasive monitoring and on RRT
- Other personnel needed for ICU have been listed.
- ICU should practise given protocols on all given clinical conditions.
- Requirement of Furniture, storage, light, Noise, flooring, walls, ceiling air-conditioning, ventilation etc have been described in guidelines in details.
- Needs of doctors, Nurses and relatives of patients should be carefully observed
- Required standards and equipment for different levels of ICUs have been mentioned.

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Annexure

A survey was conducted and a questionnaire was sent across India to 100 ICUs. Almost 50 responded and they included ICUs from Level I to Level III. The summary of response is presented in tabulated form as under. Lot of personal communication was also obtained. This response has helped a great deal in forming these guidelines

ICU Survey Performa used and responses presented in %

How many minimum beds should be there in ICU	4	6 (>80%)	8	10	>10
How many maximum Beds should be there in a ICU	8	10	14	16 to 20 (>65%)	>20
Should the no Of ICU Beds be related to total Hospital Beds	Yes	No		50 /50	
What is the sq ft area you have per bed (working area in your ICU	<100 (35%)	100 to 125 (>50%)	125 to 150 (15%)	150 to 200	>200
What is the area in your ICU per bed in sq ft other than the pt care area	<50 % of the Total Pt care area (45%)	50 to 75% > than total pt care area (30%)	75 to 100% > total pt care araea (10%)	100 to 125% of total pt care area (5%)	>125% of the total Pt Care area
You have utility panel containing Monitors Oxygen, vacuum, compressed air etc	Head End Panel (90%)	Floor power column (2%)	Hanging Pendant from ceiling (8%)	Any other	
You have pt cabins divided by	All open 5 %	Divided by curtains (75%)	Divided by permanent partitions (20%)	Any other	
You have allowed shoes inside ICU	Only doctors 25%	Only inner shoes 20%	With shoe covers 50%	None	Any other pls mention

You have a separate HDU attached to your ICU	Yes if yes then how many beds 50%	No 50%			
Your ICU is	Closed 15%	Open 55 %	Mixed 35%		
Pt Nurse ratio for Non Ventilated pt	1/1 10%	2/1 20%	Any other 50%		
Pt Nurse ration for Ventilated Pt	1/1 50%	2/1 50%	Any other		
Pt/Nurse Ratio for Septic shock pt	1/1 35%	2/1 55%	Any other 10%		
You have separate Stand bye DG Sey Provision for your ICU	Yes (90%)	No (10%)			
You have minimum number of Barriers between Relatives area to ICU	1 20%	2 65%	>2 15%		
Your ICU is headed by a Full time Intensive Care specialist	Yes (90%)	No (10%)			
You run a ISCCM IDCC Course	Yes 45%	No (55%)			
Your unit will fit into which ICU Level	I 50%	II 40%	III 10%		
You are a IDCC course centre	Yes 20%	No 80%			
You are a ISCCM Fellowship Centre	Yes 10%	No 90%			
You are a DNB (Critical Care) Centre	2%	98%			
Any other information that you may like to give					
your ICU is Level					
Facilities in your ICU	A separate Note may be attached				