Recommendations

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Consensus Guidelines for Pediatric Intensive Care Units in India

Indian Society of Critical Care Medicine (Pediatric Section) and Indian Academy of Pediatrics (Intensive Care Chapter)

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The field of Pediatric Intensive Care is rapidly growing in India. The number of intensive care units providing care to infants and children is also progressing at a rapid pace. Currently there are no well defined guidelines for Pediatric Intensive Care Units (PICUs) in the Indian context, regarding unit design, equipment, organization and staffing or admission and discharge criteria for different levels of PICU care. The Indian Academy of Pediatrics (IAP) Intensive Care Chapter and Indian Society for Critical Care Medicine (ISCCM) Pediatric Section jointly took the initiative to develop such guidelines (members of the working group listed in *Annexure I*) which can serve as a reference for health care institutions wishing to establish a new PICU or to modify an existing PICU. After a great deal of discussion at conferences and through mailing and active criticism and feed back with listed members, the consensus was developed. These recommendations are to be considered as guidelines in the strict sense and by no means an established standard for PICUs in India.

As a resource, experience of those members who have worked extensively in western PICUs was also taken into consideration in addition to published guidelines in the medical literature. Care has been taken to adequately develop and adapt the guidelines to be applicable in the Indian context. A consensus PICU fellowship training curriculum is also being compiled to develop educational program for a formal training for pediatric medical staff to carry full responsibility for running a tertiary level PICU.

The following is a description of specific guidelines regarding: (*i*) Unit design; (*ii*) Equipment; (*iii*) Organization and staffing; (*iv*) Ancillary support services; and (*v*) Levels of PICU care and admission and discharge criteria. A list of drugs recommended to be stored in PICU is also provided (*Annexure II*).

1. Unit Design

PICU should be a separate unit from the Neonatal and Adult ICU dedicated to infants and children(1). Unit design should take into consideration future adaptability and expan-sion and must maximize the resource of space, equipment, and personnel in a most affordable way for individual institutions. No traffic to other departments should pass through the unit. The unit should be located near lift with easy access to emergency department and operation theatre, laboratory and radiology department.

The doctor duty room as well as intensivist duty room/office should be close to PICU with intercom facility. Other facilities nearby should include a staff area with locker cabinets, a family waiting area to provide for at least one (preferably two) person per admitted patient with bathroom, shower and telephone facility, as feasible.

1(a) Size of PICU

The ideal PICU size can not be stated but six to ten beds is desirable. PICUs with less than 4 beds risk inefficiency and PICUs with greather than 16 beds may be difficult to manage, if not properly divided(2). For the total pediatric ward, beds up to 25 and a PICU of six to eight beds is ideal. Additional beds may be required if specialized surgery such as heart surgery, neurosurgery and trauma surgery cases are routinely expected.

1(b) Room Layout and Bed Area

Room layout should allow actual visualization of all patients from central station. PICU cubicles should have sliding glass doors to allow full visibility. Patient area in open PICU should be 150 to 200 sq ft. In a cubicle, the minimum area should be 200 to 250 square feet with at least one wash basin for two beds. However, one for each bed is preferred. At least one, preferably two rooms should have an isolation capability with an area of 250 square feet with an ante room (separate area at least 20 square feet for

hand washing and wearing mask and gown) and separate ventilation. The area around the bed should allow enough space for performing routine ICU procedures such as central lines, chest tube placement, as well as for easy access for portable *X*-ray machine, portable ultrasound, electrocardiograph and portable electroencephalograph machine. An easy access to head end of the patient for emergency airway management is a must on all beds. Wall and ceilings should be constructed of materials with high sound absorption capabilities. Wall oxygen outlets (two), air outlet (one), two suction outlets, and at least ten electrical outlets per bed are recommended for various equipments(2,3). In rooms, windows are important to prevent a sense of isolation. Adequate lighting, child friendly wall papering or paintings with soothing colors and curtains are desirable.

1(c) Power Supply and Temperature Control

Unit should preferably be centrally air conditioned and should have central heating for temperature control. In case of lack of central heating system, over head warmers should be available. Unit should have an uninterrupted power supply by means of backup power sources such as invertors and generators in accordance with load of various equipments.

1(d) Beds

Beds should have ability to manouver head end and foot end as well as availability of two or more air/water mattresses to prevent bed sores. All beds must have a railing to prevent accidental fall of the child. Each bed should have an emergency alarm button to activate code system(3) in case of cardiac arrest or other emergencies so that additional help can be immediately mobilized. An intercom at each bed is desirable. A cart at the bedside is important to hold personal belongings and required patient items.

1(e) Crash Cart

A crash cart with emergency drugs and portable monitor/defibrillator should be readily accessible. Zones should be provided for medication preparation and cabinets should be available for the storage of medications and supplies.

A receptionist area is ideal to control visitation so that all visitors must go by this area before entering. This area should be monitored by security personnel.

1(f) Central Station(4)

A central station should provide visibility to all patient areas(4). It should have ample area to have capacity for all necessary staff functions. Patient records should be easily available.

Adequate space for computer, printers and central monitor is essential. Ample space for doctors to write on patient files and space for unit secretarial staff is essential. At least two telephoane lines should be available. A cordless telephone instrument is desirable. If possible, a telephone line dedicated to incom-ing calls only to facilitate critical care trans-port requests is desirable.

1(g) X-ray Viewing Area

A distinctive area in PICU should be chosen for viewing and storage of patient *X*-ray. An illuminated viewing box should allow viewing of several films.

1(h) Storage

Storage for vital supplies should be located within or closely adjoining to PICU. A refri-gerator is essential for some pharmaceuticals. An area must be provided for storage of large patient care equipment items not in active use. An area must be provided for stretchers and wheel chairs.

1(i) Clean and Dirty Utility Room

Clean and dirty utility rooms must be separate. The clean utility room should be used for the storage of clean linen. Dirty utility room must contain a separate sink. Covered bins must be provided for soiled linen and waste materials. An area for emptying and cleaning bed pans and urine bottles is also necessary.

1(j) Waste Disposal

Mechanism of disposal of contaminated waste (segregation of garbage and contami-nated medical waste) and adequate disposal of needles and sharp objects needs to be as per standard applicable pollution control guidelines.

1(k) Conference Room

A room for intensivist and staff for education, discussion of difficult cases and other necessary meetings related to quality improvement is desirable. This room should have a small library facility with ready access to important intensive care books, journals and policy manuals.

1(l) Stat Laboratory

A mini laboratory with arterial blood gas, electrolyte, blood sugar, urea, creatinine, prothrombin time, partial thromboplastin time, complete blood count and urine examination with Gram stain should be considered adjacent to the PICU. Twenty four hour availability of on site or in hospital arterial blood gas is essential. As an alternative to stat laboratory adjacent to PICU, a central main laboratory facility with a turn around time (reporting time) of less than one hour for stat laboratory test results is acceptable.

2. Equipments

The selection of equipment should be based on following criteria: Cost benefit analysis, accuracy and adaptability for pediatric population, ease of use for care givers, trouble shooting requirements, proven use on pediatric patients, maintenance requirements and biomedical support of the company and the hospital. The list of essential and optional equipments for a tertiary level PICU(2,5) is depicted in *Table I*.

Table I__*PICU Equipments*

Equipment	Essential	Optional
(a) Diagnostic equipments		
Otoscope/ophthalmoscope	×	
Portable EEG	×	
Portable X-ray	×	
12 lead portable ECG	×	
Blood gas machine	×	
Glucometer	×	
Portable ultrasound	×	
Portable echo-cardiogram	×	
(b) Procedural equipments		
Emergency cart	×	
Emergency drugs (see Annexure 2)	×	
Ventilators (volume/pressure/peep pressure support, low tidal volume capacity (30 to 50 ml) with nebulizer, humidification and alarms)	×	
Noninvasive ventilator		×

High frequency ventilation		×
Nitric oxide (once licenced		
in India)		×
Heliox		×
Microinfusion pumps	×	
Defibrillator/cardiovertor	×	
Portable suction	×	
Pediatric Ambu bag	×	
Mapleson anesthesia bag with circuit		×
T piece	×	
Pediatric laryngoscope (curved and straight blades)	×	
Endotracheal tubes (2.5–7 mm)	×	
Pediatric size masks	×	
Laryngeal mask airway	×	
Intubating flexile laryngoscope		×
Nebulizer	×	
Oxygen delivery devices	×	
Rebreather mask	×	
Nasal cannula	×	
Non rebreather mask	×	
Oxygen hood (head box)	×	
Oxygen (portable) cylinders	×	
Nasogastric tubes	×	
Heating and cooling blanket		×
Overhead warmer	×	
Procedure light (portable)	×	
Introsseous needles	×	
Multilumen central catheters		
(4,5,5.5,7 fr) 8 cm and 16 cm	×	
Cannulae for intravenous access		
and arterial lines (24,22 and 20 guage)	×	
General sterile trays (instrument set)		
and sets for:	×	
Chest tube		
Tracheostomy		
Cut down		
Suture removal		
Lumbar puncture		
Flexible bronchoscope		×
(c) Monitoring equipments		
Transducers	×	
Rectal thermometer probe	×	

Glass thermometer	×	
Noninvasive blood pressure monitor	×	
Oxygen analyzer	×	
Portable monitor	×	
Pulse oximeter	×	
End tidal CO2		×
Bed side monitoring with following		
capability:		
ECG	×	
Respiratory rate	×	
Temperature	×	
Arterial pressure	×	
Noninvasive blood pressure	×	
Central venous pressure	×	
Intracranial pressure		×
Arrhythmia alarms		×
Heart rate (high and low rate alarm)	×	
Apnea alarms		×
Memory, trends		×
Printout feature		×
(d) Miscellaneous equipments		
Phototherapy*	×	
Overhead warmer	×	
Bed side table	×	
Over bed table	×	
IV pole	×	
Bedside chair	×	
Procedure stool	×	
Clocks	×	
Television	×	
Toys	×	
Breast pump*	×	
Infant weighing machine*	×	

*****Some neonatal equipment is listed to facilitate care for small infants.

3. Organization and Staffing

3(a) Medical Director/Intensivist Incharge(5)

The medical director/intensivist incharge should be a pediatrician trained and experienced in critical care of children with following responsiblities: (*a*) Establishing policies and protocols with the help of a group of experts including but not limited to Pediatric consultants and subspecialists, nursing director, administration, laboratory and blood bank representatives; (*b*) Smooth functioning of PICU with

implementation of policies and protocols including admission and discharge criteria; (*c*) Quality assurance and improvement (membership of hospital audit/quality improvement committee); (*d*) Advise administration regarding equipment needs; (*e*) Establishing teaching and training system of medical, nursing and ancillary staff; (*f*) Maintaining PICU statistics for mortality and morbidity; and (*g*) Being member of infection control committee.

3(b) Staffing Requirements

3(b)1 Medical Staff

The medical staff should be round the clock post graduate level pediatrician in PICU with good airway and pediatric advanced life support skills and active PALS certification.

3(b)2 Nursing Staff

A ventilated patient needs one pediatric/ICU trained nurse by the bed side. A very unstable patient (hypotensive/hypoxemic patient despite moderate support) may require two nurses by the bed side. Other unventilated/relatively stable patients (such as post operative patients and ones admitted for overnight observation) may require only one nurse per 2-3 patients.

4. Ancillary Staff

All PICU must be regularly staffed by physiotherapists, dieticians and respiratory technicians for enhancing patient care. In addition, technicians, radiographers, and biomedical engineers should be available on a 24 hours (in hospital) basis for emergencies/problems that require immediate attention such as power failure, central gas supply problems, malfunctioning equipments, or need for urgent *X*-ray of chest in a patient with suspected pneumothorax. Secretarial/clerical staff is essential to carry out communication as well as paper work necessary for smooth functioning of the unit. It is also essential to have cleaning staff that is efficient and sensitive to urgent patient care needs. Presence of social worker is desirable to help support families emotionally as well as financially in stressful circumstances.

5. Levels of PICU Care and Admission and Discharge Criteria(6,7)

5(a) Levels of PICU Care

Two levels of PICU care are identified, level 3 and level 2. Level 3 (tertiary) PICU can be organized with level 2 (step down/high dependency) service in nearby but separate area. In small private setups, level 3 and level 2 care can be provided in one unit if facilities and equipment as well as personnel as described below is available.

Level 3 Care (tertiary level PICU)

(*a*) Defined admission, discharge policies; (*b*) Four to six ventilator beds; (*c*) More than 200 ventilated patients per annum; (*d*) Pediatric intesivist heading the unit; (*e*) One pediatrician with post graduate training and experience in critical care present in PICU at all times; (*f*) Minimum one to one nursing on ventilated patients; (*g*) High level of monitoring possible in all patients; (*h*) 24 hour access to blood bank, pharmacy, pathology, operating theatre, and tertiary level of imaging services; (*i*) Educational and research activities; and (*j*) Quality review/audit process in place.

5(b)1 Admission Criteria to level 3 Care PICU (6,7)

The usual admission criteria to level 3 care are: (*i*) All patients requiring mechanical ventilation; (*ii*) Patients with impending respi-ratory failure; (*a*) Upper airway obstruction; (*b*) Lower airway obstruction; (*c*) Alveolar disease; and (*d*) Unstable airway; (*iii*) All pediatric patients after successful resuscita-tion; (*iv*) Comatose patients; (*a*) Meningitis, encephalitis; (*b*) Hepatic encephalopathy; (*c*) Cerebral malaria; (*d*) Head injury; (*e*) Poisonings; and (*f*) Status epilepticus; (*v*) All types of shock/hemodynamic instability: (*a*) Septic shock; (*b*) Hypovolemic shock; (*c*) Bleeding emergencies such as gastrointestinal bleeding,

bleeding diathesis, disseminated intravascular coagulation; (*d*) Cardiogenic shock; myocarditis, cardiomyopathy, con-genital heart disease; (*e*) Neurogenic shock; and (*f*) Multiple trauma; (*vi*) Cardiac arrhythmias; (*vii*) Hypertensive Emergencies; (*viii*) Severe acid base disorders; (*ix*) Severe electrolyte abnormalities; (*x*) Acute renal failure; Patients requiring acute hemodialysis, hemofilteration and peritoneal dialysis; (*xi*) Post operative patients; (*a*) Requiring venti-lation; (*b*) Unstable patients; and (*c*) Post operative patients after open heart surgery, neurosurgery, thoracic surgery and other patients after major general surgery with potential for respiratory/heamodynamic instability; (*xii*) Patients requiring ECMO (Extra corporeal membrane oxygenation), nitric oxide therapy (if available); (*xiii*) Malignant hyperpyrexia; (*xiv*) Acute hepatic failure; and (*xv*) All post transplant patients (if applicable).

5(b)(ii) Admission Criteria to Level 2 Care (step down/High Dependency PICU)

The usual admission criteria to level 2 care are: (*i*) All ward patients requiring close moni-toring due to potentially unstable conditions; (*ii*) Croup (laryngotracheobronchitis) requir-ing oxygen; (*iii*) Asthma requiring hourly nebulization/getting tired with increasing oxygen requirement/mental status change; (*iv*) All patients requiring more than 50% oxygen to maintain saturations; (*v*) Closed head injury/skull fracture admitted for observation; (*vi*) Diabetes ketoacidosis with pH <7.2; (*vii*) Patients with episodes of apnea; (*viii*) Patients with significant abdominal trauma with suspected renal/splenic/hepatic injury; (*ix*) Severe dehydration with mental status change; (*x*) Post operative patients after major surgery with significant post operative pain/blood loss/stress; and (*xi*) Patients recovering from critical illness (level 3 care), but requiring close monitoring.

ANNEXURE i__*Drugs Recommended to be stored in PICU*

Acyclovir	Dopamine	Noradrenaline
Adenosine (if available)	Droperidol	Normal saline
Adrenaline	Fentanyl	Pancuronium
Albumin 5%, 10%, 20%	Fluconazole	Penicillin
Amiodarone	Flumazenil (if available)	Pentazocin
Amphoterecin	Phenobarbitone	Pethidine
Ampicillin	Hemeccel	Phenergan
Amrinone (if available)	Heparin	Phenytoin
Atracurium	HES (starch)	Potassium chloride
Atropine	Hydralazine	Propofol
Augmentin	Hydrocortisone	Propranolol
Calcium chloride	Insulin	Ranitidine
Calcium gluconate	Isolyte p	Ringers lactate
Captopril	Kayaxelate	Saline 3%
Cefoperazone	Ketamine	Sodium bicarbonate
Cefotaxime	Ketorolac	Sodium nitroprusside
Ceftazidine	Labetalol (if available)	Streptokinase
Ceftriaxone	Magnesium sulphate	Succinyl choline
Chlorpheniramine	Magnesium trisilicate	Sucralfate
Ciprofloxacin	Mannitol	Thiopentone
Cloxacillin	THAM (Tris hydroxy amino	Tiecoplanin (if available)
Desmopressin	methane)	Trinitroglycerine
Dexamethasone	Metronidazole	Trinitroglycerine
Dextran	Midazolam	Vancomycin
Dextrose (5%,10%,50%)	Morphine	Vasopressin
Dextrose saline	Naloxone	Vecuronium
Diazepam	Neostigmine	Vitamin K
Dobutamine	Nifedipine	Xylocaine

ANNEXURE iI__*Memb*

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