

NEONATAL INTENSIVE CARE UNIT (NICU)

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ABSTRACT

NICU is a very specialized unit where critically ill neonates are cared to reduce the neonatal morbidity and mortality. NICU is also considered synonymous with providing advanced life support (ALS) to critically sick babies with multisystem organ dysfunction. Those who weigh <1500 gms or <32 weeks of gestation. 3-5% of newborns would need these services depending upon conditions. The first American newborn intensive care unit, designed by Louis Gluck, was opened in October 1960 at Yale New Haven Hospital. NICU is typically directed by one or more neonatologists and staffed by resident physicians, nurses, nurse practitioners, pharmacists, physician assistants, respiratory therapists, and dietitians. Many other ancillary disciplines and specialists are available at larger units. The term *neonatal* comes from *neo*, "new", and *natal*, "pertaining to birth or origin".

KEYWORDS: NICU, Admission, Goals, Facilities, Staffing.

Definition: A neonatal intensive care unit (NICU), also known as an intensive care nursery (ICN), is an intensive care unit (ICU) specializing in the care of ill or premature newborn infants. Neonatal refers to the first 28 days of life. Neonatal care, as known as specialized nurseries or intensive care, has been around since the 1960s

CRITERIA FOR ADMISSION IN NICU

Indications for admission to the Neonatal Intensive Care unit are as follows.

- Low birth weight (<1500 gms)
- Large babies (more than or equal to 4kg)
- Birth asphyxia (apgar score less than or equal to 6)
- Meconium aspiration syndrome. If symptomatic/thick meconium seen in lab
- Severe jaundice
- Infants of diabetic mother
- Neonatal sepsis/meningitis
- Neonatal convulsions
- Severe congenital malformation/cyanotic congenital heart disease
- O₂ therapy/parenteral nutrition
- Immediate after surgery/cardiological investigation
- Cardio respiratory monitoring, if heart Rate and respiratory rate are unstable
- Exchange blood transfusion
- PROM/foul smelling liquor
- Mother of hepatitis 'B' carrier
- Injured neonate

AIMS/GOALS OF NEONATAL INTENSIVE CARE UNIT

- To improve the condition of the critically ill neonates.
- To reduce the neonatal morbidity and mortality.
- To provide continuing inservice training to medical and nursing personnel in the care of the new born.

GRADES OF NEONATAL CARE

Level I: Normal Neonatal Care.

Level II: Special care, Nursery.

Level III: Intensive Neonatal Care Unit.

ADMISSION PROCEDURE IN NICU

All babies admitted to the neonatal unit should have the following data recieved carefully within 24 hours of admission (if possible much sooner).

History and examination

- Maternal history
- Paternal history
- Previous obstetric history
- Details of present pregnancy
- Labour.
- Delivery
- Apgar score

On admission

- Notify the doctor and the nurse in charge.
- Resuscitate infant as necessary and maintain warmth.
- Check infant identification label.
- Quickly examine the infant from head to toe for obvious abnormalities if condition permits.

Record Weight, length and head circumference as soon as possible.

Transfer to warm environment as soon as possible.

Corrnnonest observations are :-

(a) Temperature - Infant normal temperature range 36°C to 37°C (b) Heart rate.

(c) Respiration

(d) Colour

(e) Activity.

- Explain to parents

- Hand over from transferring unit staff

Record keeping

- Birth history: Done in labour ward.

History

A. Ward history contains

- Apgar score and examination of new born infant, sheet.

- Neonatal weight and feed sheet, progress chart.

B. Compiled history contains

- Patient registration form.

- Progress 'sheet.

- Intra uterine growth chart.

- 02 flow sheets, fluid balance sheet etc.

INSTRUMENTS AND FACILITIES IN NICU

Apex institution or regional perinatal centre must be equipped with centralization supply, suction facilities, incubators/open care system, vital signs and transcutaneous ventilators and infusion pumps, which are mandatory to provide intensive neonatal care.

Physical Facilities

The neonatologist and the nurse in charge must be involved while planning the unit. The intensive care area should be localized preferably next labour ward and delivery rooms. For economizing the costs it would be preferably to it combined with level II facilities, through both the areas. There must have separate adequate staff and a single administrative control.

Temperature of the unit: In the case of controlling the environmental temperature, the NICU should not - be located on the top floor, but there must be adequate sunlight for illumination.

The unit must have a fair degree or ventilation of fresh air through central air conditioning is a must. The temperature inside the unit should be maintained at 28² 4. 2gC while the humidity must be above 50%.

In case the unit is responsible for picking up babies, referred from the regional hospitals, it should be within easy access for the ambulance entrance and should have a separate elevator.

Physical set up

The NICU can be a single area or it can be in multiple rooms with a capacity of 2-4: infants each.

Bed strength of NICU

One intensive care unit is generally required for 100 deliveries provided the prematurity ratio is around 8% and, hence for a population of one million, 30 intensive care units would be required for our country. These figures would require modification based on the growth rate, number of premature deliveries and the load of high risk population drains since the supportive services to be provided for it would be uneconomical to have a NICU of less than 6-8 bed.

Space between the patients

- For the patient care, 100 square feet is required for each baby as it is true for any adult bed.
- There should be a gap of about 6 feet between two incubators for adequate circulation and keep the essential lifesaving equipment's, space needed about 120 square feet.
- Each patient station should have 12-16 central voltage stabilized electric outlets.
- 2 to 3 oxygen outlets.
- 2 compressed air outlets.
- 2 to 3 suction outlets.
- Additional power plug point would be required for the portable x-ray machine close to the patient care area.

Water Hand washing

- The unit must have an uninterrupted clean water supply and each patient care area must also have a wash basin with foot or elbow operated tapes. Near wash basin, placing paper towel and receptacle.
- The unit should be equipped with laminar air flow system, however alternate air conditioned with multipore filters and fresh air exchange of 12 per hour should be provided.

Colour

The walls of the whole unit should be washable and have a white slightly off white colour for better colour appreciation of the neonates.

Lighting

- The lighting arrangement should provide uniform, shadow illumination of WO foot candles at the baby's level. In addition, spot illumination should be available for each baby for any procedure.
- A generator back up is mandatory where there are frequent power fluctuations/power failures.
- Sounds The Acoustic characteristics should be such that the intensity of noise kept well below 75 decibels.
- The unit should also have an intercom and a direct outside telephone line so that parent of the patient can have an easy access to the medical personnels in case of emergency.
- Rooms apart from patient care area including rooms for isolation and procedure there is need of space for certain essential functions, like a room for scrubbing and gown near the entrance, a side laboratory,

mothers room, adequate stores for keep consumable and non-consumable articles.

- A room for keeping the x-ray and ultra sound machines.
- One or two rooms each would be needed for doctors and nurses on day night duties.
- There is a space available for a biomedical engineer to provide essential period preventive maintenance of the costly equipments.
- Additional space will be required for educational activities and storing of database.

Ventilation

- Minimum of six air changes, 2 air changes should be outside filtering the inner air.
- Effective air ventilation of nursery is essential to reduce nosocomial infection.
- The air conditioning ducts must be provided with millipore filters- (0.5H) to restrict the passage of microbes.

Exaster

- Keep away from the baby.

Ventilated air

- A simple method to achieve satisfactory ventilation consists of vision of exhaust fan in a reverse direction near the ceiling for input of fresh contaminated air. Fixation of other exhaust fan in the conventional manner for air exit.

Infection control measures:- Hand Washing Facilities

- Each room should have a separate basin facilities, it can be used for children.
- Sinks are regularly cleaned by disinfection.

LABORATORY FOR NICU

- A micro chemistry laboratory attached to the unit and providing round the clock service, in preferable through under Indian conditions, this may not be mandatory.
- This should be well-equipped to provide quick and reliable hematocrit, blood glucose and total serum bilirubin.
- Facilities for total leukocytes counts and microscopic examination of peripheral blood films for evidence of infection.
- Equipment for measure of specific gravity of urine and calcium should be available.
- House X-ray machine and an ultrasound machine should be mandatory for modern day neonatal care units.

ADMINISTRATIVE SET UP

Medical staff

- The unit should be headed by a director who is full time neonatologist with special qualification and training in neonatal medicine.

- He should be responsible for maintenance of standard of patient care.
- Development of the operating budget.
- Equipment evaluation and purchase.
- Planning and development of education programme.
- Evaluation of effectiveness of perinatal care in the area.
- He should devote time to patient care services, research and teaching as well as co-ordinate with level I and level II hospital in the area.

Staff Requirements

- Neonatal physician 6-12 patient in the continuing care, inter mediate care and intensive: care areas.
- He should be available on 24 hours bases for consultation.
- A ratio of one physician in training to every 4-5 patient who requires intensive care ideal round the clock.
- Services of other specialists like microbiologist, hematologist, radiologist, and cardiologist and should be available on call.
- An anesthetist capable of administering anesthesia to neonate. 15addiatric surgeon and pediatric pathologists should be available.

Nurses Ratio

- Nurse patient ratio of 1:1 maintained throughout day and night.
- A ratio of one nurse for two sick babies not requiring ventilator support may be adequate.
- For an ideal nurse patient ratio, four trained nurses per intensive care bed are needed.
- Additional head nurse who is the overall incharge.
- In addition to basic nursing training for level II care, tertiary care require dedicated, committed and trained staff of the highest, qualify,
- Their training must include training in handling equipment, use of ventilator and use of mask resuscitations and even endotracheal intubation, arterial sampling and so on.

Experience

The staff nurse must have a minimum of 3 years work experience in special neonatal care unit in addition to having 3 months hands on training in an intensive neonatal care unit.

Other Staff

- There is a special need of motivated staff responsible for upkeep and cleanliness of the unit.
- Special attention must also be made to train and educate Other persons,their role in the patient care.
- One sweeper should be available round the clock.
- Laboratory technician.
- Public health nurse/social workers.
- Respiratory therapist.
- Biomedical engineer.
- Ward clerk can help in keeping track of the stores.



Equipments used in the NICU

Providers use lots of equipment in the NICU to help take care of baby. Each piece has a special purpose in baby's treatment. There are mechanical ventilators (breathing machines), oxygen, medications, and supplies for medical care. Furthermore, there is technology to monitor nearly every system of a baby's body including body temperature, heart rate, breathing, oxygen and carbon dioxide levels, and blood pressure. The following list includes some of the monitoring equipment often used in the NICU:

- **Apnea monitor** — A machine that detects when baby stops breathing for a few seconds. An alarm goes off to let NICU staff to know that baby has stopped breathing.
- **Arterial line** — A thin tube that goes into baby's artery to check his blood pressure and measure blood gases. An artery is a blood vessel that carries oxygen to all parts of baby's body. Blood pressure is the force of blood that pushes against the walls of the arteries. Blood gases are acid, oxygen and carbon dioxide in baby's blood.
- **Bililights** — Bright lights over a baby's incubator that treat jaundice. An incubator is a clear plastic bed that keeps baby warm. Jaundice is when a baby's eyes and skin look yellow. A baby has jaundice when his liver isn't fully developed or isn't working. Treatment with bililights is also called phototherapy. Babies can have this treatment for 3 to 7 days.
- **Blood pressure monitor** — A machine connected to a small blood pressure cuff wrapped around baby's arm or leg. The cuff takes baby's blood pressure at regular times and displays it on a screen. Blood pressure is the force of blood that pushes against the walls of the arteries.
- **Cardiopulmonary monitor** — A machine that tracks baby's heart and breathing rates. It's connected to baby's chest with small sticky pads called leads. Information from the monitor displays on a screen and can be printed out. If baby's heart or breathing rate becomes too fast or too slow, an alarm sounds.
- **Central line** — A small plastic tube that goes into a large blood vessel. Baby gets medicine and fluids through the tube, and providers can draw blood out through the tube. One kind of central line that's used a lot is called a peripherally inserted central catheter (also called a PICC line).
- **Continuous positive airway pressure (also called CPAP)** — A machine that sends air and oxygen to baby's lungs through small tubes in his nose or windpipe (also called trachea).
- **Cooling blanket or cap** — A blanket or cap used to lower baby's body temperature. They may help reduce or prevent problems that can happen if baby's brain doesn't get enough oxygen. The blanket or cap can cool baby's brain and body to about 92 F (33.5 C). Baby may get a cooling blanket or cap within about 6 hours of birth and can use it for up to 3 days. After that, baby is slowly warmed to a normal body temperature of 98.6 F (37 C) by increasing the temperature in the incubator.
- **Endotracheal tube** — A small plastic tube that goes into a baby's nose or mouth and down to the windpipe (also called trachea) that sends air and oxygen to the lungs. The tube is attached to a machine called a mechanical ventilator to help your baby breathe.
- **Extracorporeal membrane oxygenation (also called ECMO)** — A machine that takes blood out of baby's body, puts oxygen into the blood and then sends the blood back into the body.
- **Gastrostomy tube (also called g-tube or gastric feeding tube)** — A tube that goes into baby's stomach for feeding. Liquids go through the tube to feed baby. The tube is used for babies who can't take food by mouth and need long-term help with feeding.
- **High-frequency ventilator** — A machine that breathes for baby at a faster rate than other

ventilators. Oscillating and jet ventilators are examples of high-frequency ventilators.

- **Incubator** — A clear plastic bed that helps keep baby warm. We can touch baby through holes (also called ports) in the sides of the incubator. Kinds of incubators are Giraffe® and Isolette®.
- **Intravenous line (also called IV)** — A tube inserted with a needle into baby's vein. A vein is a blood vessel that brings blood back to the heart. Baby can get fluids, medicine and blood through an IV.
- **Mechanical ventilator** — A machine that helps baby breathe or breathes for him when he's not breathing on his own. It works by pushing warm air and oxygen into the lungs through a breathing tube called an endotracheal tube. The provider sets the amount of oxygen, air pressure and number of breaths per minute for baby.
- **Nasal cannula** — Small plastic tubes that go into baby's nose. Air and oxygen go through the tubes into baby's lungs.
- **Nasogastric tube (also called NG tube)** — A feeding tube that goes through baby's nose, down the esophagus and into the stomach. The esophagus is the tube in baby's body that carries food from the throat to the stomach. Baby can get breast milk, formula and medicine through the tube. When baby is fed breast milk or formula through an NG tube, it's called gavage feeding.
- **Orogastric tube (also called OG tube)** — A feeding tube that goes in baby's mouth, down the esophagus and into the stomach.
- **Oxygen hood** — A clear plastic box that fits over a baby's head and gives him oxygen. Providers use it with babies who can breathe on their own but still need some extra oxygen.
- **Pulse oximeter (also called a pulse ox)** — A small device wrapped around baby's foot or hand that measures the oxygen in her/his blood. It doesn't cause baby any pain. It helps providers know if baby needs more or less oxygen.
- **Radiant warmer** — An open bed with overhead heating to help keep baby warm. Providers may use a warmer instead of an incubator if baby needs to be handled a lot. An incubator is a clear plastic bed that helps keep baby warm.
- **Tracheostomy tube** — A curved plastic tube that goes in baby's windpipe (also called trachea) through a hole made in baby's neck. The trachea is part of the airway system that takes air to the lungs. Baby breathes through the tube instead of his nose and mouth. The tube doesn't go into baby's lungs.
- **Umbilical catheter** — A thin tube that goes into the arteries in baby's umbilical cord after the cord is cut after birth. Providers can give fluids, blood, medicine and nutrients, like vitamins and minerals, to baby through the tube. They also use the tube to take blood from baby. A small attachment to the tube lets providers check baby's blood pressure.

Blood pressure is the force of blood that pushes against the walls of the arteries.

- **Urinary catheter** — A thin tube that goes through the opening where urine passes out of baby's body and into his bladder. Providers use it to collect urine for testing.
- **Ultrasound-** Ultrasound uses high-frequency sound waves and a computer to create images of blood vessels, tissues, and organs. Ultrasounds are used to view internal organs as they function, and to assess blood flow through various vessels. In the NICU, ultrasound may be used to examine the heart, abdomen, and internal structures of the baby's brain. Ultrasound is painless and provides much information about a baby's health.
- **X-ray** - Portable X-ray machines may be brought to the baby's bedside in the NICU. X-rays use invisible electromagnetic energy beams to produce images of internal tissues, bones, and organs on film. X-rays are taken for many reasons including checking the placement of catheters and other tubes, looking for signs of lung problems, such as infant respiratory distress syndrome, and checking for signs of bowel problems.
- **Computed tomography (also called CT or CAT scan).** A CT scan is a diagnostic imaging procedure that uses a combination of X-rays and computer technology to produce horizontal, or axial, images (often called slices) of the body. A CT scan shows detailed images of any part of the body, including the bones, muscles, fat, and organs. CT scans are more detailed than general X-rays. CT scans also minimize exposure to radiation. CT scans are sometimes done to assess bleeding inside a baby's head. A CT scan is done in a special room and the baby may need a sedative medication so that he or she will be motionless for the examination.
- **Magnetic resonance imaging (MRI).** MRI is a diagnostic procedure that uses a combination of a large magnet, radio frequencies, and a computer to produce detailed images of organs and structures within the body. Like a CT scan, MRI is performed in a special area of the hospital. It is often done to examine a baby's brain stem, spinal cord, and soft tissues. The baby will need a sedative medication so that he or she will be motionless for the examination.

DOCUMENTATIONS IN NICU

- The unit should have printed problem oriented stationary for maintaining records, admission and discharge slips etc.
- Records of all admission should be maintained in a register or on a computer.
- The information should be analyzed and discussed at least once a month to improve the effectiveness of the NICU in providing the services.

EDUCATION PROGRAMME AT NICU

- There should be continuing medical education programmes for physicians and nurses in the form of lecturers, demonstrations and group discussions.
- This should cover important issues like resuscitation, sterilization to be maintained for critically ill babies, putting in arterial catheters, conducting exchange transfusion, maintenance of ventilators etc.
- Educational programmes covering the nurses and physician in the community should be developed.
- There should be regular meetings with the obstetrician to discuss the perinatal condition and care.
- Individual high risk cases.
- Education and follow up is necessary.

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