

NICU Required Elective

INTRODUCTION

The residents that rotate through the NICU will have exposure to and a breadth of experience to various disorders encountered in Neonatal-Perinatal Medicine. The intent of the NICU rotation is to train residents in the diagnosis and management of disorders in premature and full-term newborns and to provide up-to-date, comprehensive, compassionate care in the training of the next generation of pediatricians. This training program will provide the foundation necessary to become competent clinician within the field of Neonatal-Perinatal Medicine.

The overall goals for the residents in NICU are:

- 1 To develop and maintain a standard of excellence in the clinical practice of neonatal-perinatal medicine.
- 2 To develop a broad knowledge base in neonatal-perinatal medicine.
- 3 To base clinical decisions upon scientific evidence-based medicine.
- 4 To become proficient in techniques used routinely in the NICU.
- 5 To develop teaching skills.

The goals of the elective rotation include:

PATIENT CARE:

Residents are expected to provide patient care in the NICU that is compassionate, appropriate and effective for the promotion of health and prevention of illness. This includes the ability to gather appropriate information on the patient's condition, organize it in a rational manner, and develop a plan of diagnosis and treatment appropriate to the patient's needs. Thus, residents must:

- Gather essential, accurate and concise information (including a family history), perform a complete H&P, and order appropriate tests.
- Make informed diagnostic and treatment decisions, analyze and synthesize information, know one's limits of knowledge and expertise, and recognize when to obtain appropriate consultation.
- Develop and carry out patient care management plans, prescribe and perform procedures, and effectively counsel parents.
- Recognize and appropriately intervene in urgent and emergent situations.
- Be able to show understanding of the role of the family in the care and management of the patient.
- Learn to supervise the management of premature and full-term neonates with a variety of disorders in a multidisciplinary NICU.
- The residents should be able to perform the following techniques at the level appropriate for each year:

1st YEAR

The first year resident should be able to perform the following techniques under supervision.

2nd YEAR

The second year resident should be able to perform the following techniques with some supervision.

3rd YEAR

The third year resident should be able to perform the following techniques with minimal supervision.

Neonatal resuscitation
Venous and arterial access
Evacuation of air leaks
Endotracheal intubation
Ventilatory support
Continuous monitoring
Temperature control
Nutritional support, etc.

INTERPERSONAL & COMMUNICATION SKILLS:

Residents are expected to develop interpersonal and communication skills that result in effective information exchange. Residents are to maintain professional relationships with parents, families, and other members of the health-care team.

More specifically, residents must:

- Be proficient in communicating diagnoses, daily management of a neonate, potential outcomes, and discharge plans to his/her parents and family.
- Communicate effectively with primary care physicians and keep them involved with their patients in the NICU.
- Develop the ability to communicate both good and bad news regarding neonates in the NICU to parents.
- Develop the ability to communicate to parents and family information about a newborn that is dying.
- Show the ability to coordinate the management of all neonates on his/her team in the NICU including discharge planning, laboratory, occupational therapy, social services, family, and primary care physician.
- Develop effective communication with nursing staff, fellows, other residents and medical students.
- Show understanding of preparations needed for discharge.

1ST YEAR

The first year resident should maintain interpersonal and communication skills under close supervision of their attending.

2nd YEAR

The second year resident should be able to maintain interpersonal communication skills with some supervision from the attending.

3rd YEAR

The second year resident should be able to maintain interpersonal communication skills with minimal supervision from the attending

MEDICAL KNOWLEDGE:

1st YEAR

The first year resident in the NICU is expected to begin to develop a broad base of knowledge on the topics and areas outlined below:

2nd YEAR

The second year resident in the NICU should develop a broad base of knowledge on the topics and areas outline below and be able to begin teaching some of the material to 1st year residents and medical students:

3rd YEAR

The third year resident in the NICU should develop an even broader base of knowledge on the topics and areas outline below and show the ability to teach much of the material to 1st year residents and medical students:

All residents, starting with year one and continuing to year three, must obtain knowledge of the following topics by learning from and emulating the attendings in the NICU, discussion on rounds, and specific readings including online and reference literature. Specific areas are outlined below:

Gain experience with high-risk pregnancies and complicated labor and deliveries.

- A) Vital statistics and perinatal health care outcomes.
- B) Antenatal diagnosis and antenatal counseling.
- C) Fetal assessment and treatment during pregnancy.
- D) Tests commonly used to measure fetal developmental status and well-being.
- E) Fetal/neonatal effects of common obstetrical problems including:
 - Infections
 - Endocrine abnormalities
 - Intrauterine growth retardation
 - Maternal addiction
 - Immunologic abnormalities
 - Multiple gestations
 - Amniotic fluid production abnormalities
 - Placental/membrane abnormalities

- Pre-eclampsia
 - Prematurity
 - Complications of labor and delivery and effects of anesthesia
- F) Labor: normal and abnormal
- G) Delivery: normal and complicated

Develop expertise in newborn resuscitation and stabilization.

- A) Physiology of the transition from the fetal to neonatal state and acute and chronic asphyxial syndromes.
- B) Principles and mechanics of neonatal resuscitation
- Anticipation, environment, and equipment
 - Bag and mask techniques
 - Endotracheal intubations
 - Management of meconium aspiration
 - Chest compressions
 - Medications
- C) Identification and management of unsuspected anomalies in the delivery room (e.g. meningomyelocele, gastroschisis, cleft palate, etc.)

Develop expertise with procedures and techniques for neonatal diagnosis and management.

- A) Indications, necessary precautions, and support systems.
- B) Specific procedures
- Arterial puncture
 - Lumbar puncture
 - Bladder catheterization
 - Suprapubic aspiration
 - Gastric suction/lavage
 - Airway suction
 - Oro-gastric tube placement
 - Intravenous line placement
 - Umbilical Artery Catheterization
 - Umbilical Venous Catheterization
 - Thermal control
 - Conscious sedation
 - Cardioversion/defibrillation
 - Exchange transfusion
 - Inguinal hernia reduction
 - Enteral/parenteral medication administration
 - Nasal CPAP
 - Oxygen delivery
 - Surfactant administration
 - Mechanical ventilation initiation, maintenance and weaning
 - High frequency oscillatory ventilation/jet ventilation

Learn diagnostic and monitoring techniques, their clinical usefulness, limitations, and interpretation.

A) Indications, necessary precautions, and support systems with the following monitoring techniques:

- Gestational age assessment
- Apgar scoring
- Physiologic monitoring (cardiac, respiratory, blood pressures)
- Oxygen saturation
- X-rays
- Cranial ultrasound
- Abdominal ultrasound
- Echocardiography
- Doppler velocity
- Pulmonary function tests
- Hyperoxia test
- Electrocardiogram
- Abstinence scoring
- Newborn hearing assessment

Develop knowledge with laboratory procedures, specimen collection, handling, and interpretation of laboratory results.

- A) Blood culture
- B) Conjunctival specimen
- C) Nasopharyngeal secretions
- D) Rectal swab/stool
- E) Cerebral spinal fluid
- F) Skin lesions
- G) Abscess fluid
- H) Tracheal Aspirate
- I) Urine culture and analysis
- J) CBC
- K) Blood gases
- L) Metabolic screening
- M) TORCH titers
- N) RBC antigen/antibody testing
- O) Neonatal drug screening
- P) Pharmaco-kinetic assays

Develop the capacity to manage common neonatal problems associated with mild and moderate illness.

- A) Moderate perinatal asphyxia
- B) Prematurity greater than 34 weeks' gestation
- C) Prolonged rupture of membranes or other risk of sepsis
- D) Multiple gestations, greater than 34 weeks' gestation
- E) Non-hemolytic and mild hemolytic jaundice
- F) Polycythemia

- G) Respiratory distress requiring less than 40% FiO₂
 - H) Infant of Diabetic Mother
 - I) Uncomplicated Trisomy 21
 - J) Genetic Syndromes/Anomalies
 - K) Infant with non-acute isolated anomalies
 - L) Gastroesophageal reflux
 - M) Necrotizing enterocolitis
- Develop knowledge in nutritional management of newborns.

- A) Abnormal conditions
 - Prematurity
 - Intrauterine Growth Retardation
 - Bronchopulmonary dysplasia
 - Short bowel syndrome
 - Renal disease
 - Congestive heart failure
 - Unusual metabolic disorders
 - Post-surgical cases
- B) Feeding techniques
 - Breastfeeding
 - Gavage tube feeding
 - Parenteral nutrition
 - Adaptive feeding devices, including gastrostomy
 - Nutrition and growth of the preterm infant
 - Nutrition and growth of normal term infant
 - Minerals, vitamins and trace elements
 - Parenteral nutrition

Develop knowledge with common therapeutic agents in neonatal care.

- A) Anti-epileptics
- B) Anti-reflux medicines
- C) Antibiotics
- D) Antifungal agents
- E) Antiviral agents
- F) Diuretics
- G) Inotropes/Vasopressors
- H) Muscle relaxants
- I) Narcotic analgesia
- J) Neoprofen
- K) Prostaglandin E₂
- L) Sodium Bicarbonate
- M) Surfactant
- N) Vitamins
- O) Volume expanders
- P) Caffeine
- Q) Other, including nitric oxide, erythropoietin, etc.

Develop knowledge with the primary care components of neonatology.

- A) Immunizations for premature and high risk infants
- B) Surveillance of somatic growth
- C) Surveillance of nutritional status
- D) Surveillance of sensorineural residua of high risk birth
- E) Metabolic screening
- F) Surveillance of developmental status

Learn about the management of complex neonatal disorders in the NICU.

- A) Respiratory disorders
 - Morphologic abnormal development of the lung
 - Fetal Respiration
 - Control of breathing - normal and abnormal
 - Pulmonary surfactant - physiology, pathophysiology and treatment
 - Pulmonary function - normal and abnormal ventilation/perfusion
 - Respiratory mechanics - normal and abnormal
 - Oxygen transport and delivery
 - Pulmonary function testing in the neonate
 - Apnea of prematurity
 - Respiratory distress syndrome
 - Neonatal pneumonias
 - Meconium aspiration syndrome
 - Persistent pulmonary hypertension
 - Transient tachypnea of the neonate
 - Extrapulmonary causes of respiratory distress
 - Airway obstruction
 - Other causes of respiratory distress
 - Conventional/"unconventional" mechanical ventilation
 - Pulmonary barotrauma
 - Pleural disorders, e.g., effusion and chylothorax
 - Bronchopulmonary dysplasia
 - Indications for extracorporeal membrane oxygenation
 - Nitric oxide
- B) Cardiovascular system
 - Normal and abnormal cardiac embryology and development
 - Cardiovascular physiology
 - Congenital heart disease
 - Cardiopulmonary distress in the absence of congenital heart disease
 - Electrophysiology and dysrhythmias
 - Pharmacologic therapy of heart disease
- C) Genetic/chromosomal disorders
 - Complicated trisomy 21
 - Trisomy 13, 21, 18
 - Other trisomies
 - VACTERL association
 - Other syndromes

- Basic understanding of molecular genetics
 - Specific patterns of inherited congenital disorders
 - Patterns of noninherited congenital defects
 - Diagnostic approach to congenital defects
 - Prenatal and neonatal genetic counseling
- D) Gastrointestinal disorders
- Necrotizing Enterocolitis
 - Meconium Ileus or plug
 - Peritonitis
 - Esophageal atresia
 - Intestinal obstruction
 - Gastroesophageal reflux
 - Congenital hyperbilirubinemia
 - Surgical abnormalities such as malrotation, volvulus, omphalocele, gastroschisis, Hirschsprung's disease
- E) Metabolic/endocrine disorders
- Fluid and electrolyte imbalance/balance
 - Hypocalcemia
 - Hypoglycemia
 - Hypo/hyernatremia
 - Hyperkalemia
 - Hyperglycemia
 - Metabolic acidosis
 - Metabolic bone disease of prematurity
 - Other (e.g., congenital hyperthyroidism, congenital adrenal hypoplasia)
 - Hyperbilirubinemia
- F) Renal physiology/salt and water metabolism
- Renal functions in the fetus and neonate
 - Water and electrolyte metabolism during development
 - Water and electrolyte metabolism in the neonate
 - Renal diseases in the fetus and neonate
 - Peritoneal dialysis
- G) Hematologic
- Anemia
 - Hemolytic anemia
 - Anemia of prematurity
 - Anemia in general
 - Twin-to-twin transfusion and/or fetomaternal hemorrhage
 - Thrombocytopenia
 - Neutropenia
 - Disseminated Intravascular Coagulation
 - Oncology: tumors in newborn
- H) Neurologic/sensory
- Hypoxic ischemic encephalopathy
 - Intraventricular hemorrhage
 - Periventricular leukomalacia

- Neural tube defects
 - Hydrocephalus
 - Neonatal seizures
 - Neonatal narcotic withdrawal
 - Retinopathy of prematurity
 - Hearing deficit
 - Subarachnoid hemorrhage
 - Other, e.g. encephalocele, myelomeningocele
 - Neurologic examination: physical examination, neurodiagnostic tests
 - Brain vascular abnormalities
 - Cranial and neurologic trauma
 - Neuromuscular disorders
 - Neurocutaneous disorders
- I) Infectious diseases
- Infections of organ systems
 - Etiologic agents
 - Treatment of specific infections
 - Prevention of infections
 - Infection control in the Neonatal Intensive Care Unit
 - Congenital viral infections
 - Hepatitis
 - Bacterial and fungal sepsis
 - Bacterial meningitis
 - Pyelonephritis
- J) Bilirubin
- Biochemistry and metabolism
 - Bilirubin toxicity
 - Measurement
 - Physiologic jaundice
 - Breastfeeding and jaundice
 - Pathologic hyperbilirubinemia and physiologic or breastfeeding
- K) Immunology
- Developmental biology of the immune system
 - Specific components of the immune system
 - Abnormal function of the immune system
 - Immunization
- L) Miscellaneous
- Hydrops fetalis of: immune and non-immune origins

PRACTICE-BASED LEARNING AND IMPROVEMENT:

Residents are expected to investigate and evaluate patient care practices and to appraise and assimilate clinic information to make appropriate patient management decisions. They should learn to improve their care of any given condition as they learn more about the condition they are treating throughout their rotations in the NICU.

- Respond to feedback; demonstrate a willingness to learn from errors.
- Provide constructive feedback to learners.

- Become an active educator of patients, families, students, and other health professionals.
- Demonstrate knowledge of investigation and evaluation of best practices in the NICU.
- Utilize resources such as web-based information, published peer-reviewed journal articles, and textbooks to improve patient care practices.
- Consistently utilize evidence-based medicine versus anecdotal therapy.
- Recognize and initiate alternative care plans when appropriate.
- Respond and adapt to systems and individual errors.
- Respond to criticism and advice when warranted.
- Acquire the skills needed to identify areas of deficiency and analyze and improve the quality of neonatal intensive care practices.
- Participate in and become aware of the newest studies in neonatal intensive care targeted to improve outcome.

1st YEAR

The first year resident is expected to identify deficiencies in patient-care practices and to appraise and assimilate scientific evidence to improve patient management as outlined above with the direct supervision of the attending in neonatal-perinatal medicine.

2nd YEAR

The second year resident is expected to identify deficiencies in patient-care practices and to appraise and assimilate scientific evidence to improve patient management as outlined above with some supervision from the attending in neonatal-perinatal medicine.

3rd YEAR

The third year resident is expected to identify deficiencies in patient-care practices and to appraise and assimilate scientific evidence to improve patient management as outlined above with minimal supervision from the attending in neonatal-perinatal medicine.

PROFESSIONALISM:

Residents are expected to understand and demonstrate a commitment to carry out professional responsibilities, adhere to ethical principles, and be sensitive to diversity. Residents will have a responsible attitude toward their patients, their profession, society and themselves. The residents must:

- Demonstrate caring and respectful behaviors when interacting with patients, families, staff, and colleagues.
- Maintain patient/family confidentiality.
- Follow hospital procedures for reporting errors.
- Be punctual, reliable, and accountable for actions and responsibilities.
- Acquire and apply knowledge of basic principles of bioethics in clinical management of neonates in the NICU.
- Place interests of patients and families ahead of self-interest.
- Form therapeutic and ethically sound relationships with patients and families.
- Demonstrate awareness of and sensitivity to differences in culture, religion, age,

gender, disability, and sexual preference, and their relevance to clinical care of neonates in the NICU.

- Understand the areas of expertise of the various interdisciplinary team members in the NICU and maximize the expertise of each team member.

st **1 YEAR**

The first year resident is expected to demonstrate a commitment to carry out professional responsibilities, adhere to ethical principles, and be sensitive to diversity as outlined below under the supervision of an attending in neonatal-perinatal medicine.

nd **2 YEAR**

The second year resident is expected to demonstrate a commitment to carry out professional responsibilities, adhere to ethical principles, and be sensitive to diversity as outlined above with some supervision from the attending in neonatal-perinatal medicine.

rd **3 YEAR**

The third year resident is expected to demonstrate a commitment to carry out professional responsibilities, adhere to ethical principles, and be sensitive to diversity as outlined above with minimal supervision from the attending in neonatal-perinatal medicine.

SYSTEMS-BASED PRACTICE:

Residents are expected to practice quality health care that is cost-effective and to advocate for patients within the health care system by helping them successfully navigate through it for the best outcomes possible. They should be able to work effectively in a multi-disciplinary team of providers to aid in the best outcomes possible for NICU patients. The residents must:

- Develop the ability to simultaneously manage a large number of neonates requiring intensive care and coordinate patient related services including nursing staff, laboratory, diagnostic radiology, respiratory therapy, neonatal nutrition, occupational therapy, social services, discharge planning, and consultative services related services to ultimately benefit the patients and families in the NICU.
- Advocate for neonates and help parents and families as they navigate system complexities
- Coordinate with all pediatric subspecialty consultants to ensure that appropriate questions are being asked and ensure that there is effective flow of communications amongst specialists, parents, and the health care team.
- Develop knowledge of the cost of care of high-risk neonates, available funding mechanisms for needy families, and understand the role of the neonatologist in limiting the cost of care.
- Follow hospital procedures for preventing and reporting errors/adverse events.
- Develop knowledge of community health resources..
- Understand the role of private pediatricians in the long-term management of infants after discharge from the NICU.

- Coordinate with discharge planning, Neonatal Follow-up Clinic, Early Intervention, occupational therapy, and insurance agencies to ensure that appropriate questions are being asked, and to ensure that there is effective flow of communication
- Develop the expertise in documentation of neonatal clinical course
 - A) Appropriate medical record documentation.
 - B) Appropriate documentation for consults, diagnostic imaging, and clinical charts.

st **1 YEAR**

The first year resident is expected to show proficiency in using context and systems in which health care is provided and apply this knowledge to improve and optimize care as outlined above under the supervision of the attending in neonatal-perinatal medicine.

nd **2 YEAR**

The second year resident is expected to show proficiency in using context and systems in which health care is provided and apply this knowledge to improve and optimize care as outlined above with some supervision from the attending in neonatal-perinatal medicine.

rd **3 YEAR**

The third year resident is expected to show proficiency in using context and systems in which health care is provided and apply this knowledge to improve and optimize care as outlined above with minimal supervision from the attending in neonatal-perinatal medicine.

References:

Assisted Ventilation of the Neonate. Goldsmith and Karotkin.
 Drugs for Pregnant and Lactating Women. Weiner and Buhimschi.
 Fanaroff and Martin's Neonatal-Perinatal Medicine: Diseases of the Fetus and Infant.
 Martin, Fanaroff, and Walsh.
 Fetal and Neonatal Physiology. Polin and Fox
 Intensive Care of the Fetus and Neonate. Spitzer
 Neonatology: Management, Procedures, On-Call Problems, Diseases, and Drugs.
 Gomella
 Neurology of the Newborn. Volpe
 Red Book. AAP
 Smith's Recognizable Patterns of Human Malformation. Jones
 Textbook of Neonatal Dermatology. Eichenfield, Frieden and Esterly.