The chart shows the percentage distribution of questions on the Neonatal Neuro-Intensive Care exam across the major content categories covered on the examination.
### Exam Outline

Areas of knowledge to be tested on the Neonatal Neuro-Intensive Care examination are listed in the following outline. This list is not intended as an all-inclusive review. It is provided only to help candidates evaluate their own practice.

Percentages identified for the topic areas represent the number of test questions assigned to each content area. These percentages do not necessarily reflect the content of future examinations.

<table>
<thead>
<tr>
<th>Topic Area</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.00 Neurologic Development and Evaluation of the Fetus and Newborn (21%)</td>
<td></td>
</tr>
<tr>
<td>Normal CNS development in the fetus, risk factors and outcomes</td>
<td></td>
</tr>
<tr>
<td>Antepartum and intrapartum indicators of neurological risks to the fetus and neonate</td>
<td></td>
</tr>
<tr>
<td>Comprehensive neurological exam identifying normal and abnormal findings</td>
<td></td>
</tr>
<tr>
<td>11.00 Neuro-monitoring, Imaging and Diagnostic Tools (17%)</td>
<td></td>
</tr>
<tr>
<td>Neurological monitoring, Recognition of and General knowledge of EEG/aEEG</td>
<td></td>
</tr>
<tr>
<td>Use of Neurologic Imaging to assess and modify treatment and evaluate prognosis</td>
<td></td>
</tr>
<tr>
<td>12.00 Assess and Manage Pathophysiologic States specific to the neurologically compromised or at-risk neonates and provide neuro protection (34%)</td>
<td></td>
</tr>
<tr>
<td>Pathophysiology of neurologic injuries</td>
<td></td>
</tr>
<tr>
<td>Prevention, management and maintenance of health for at risk neonates or those with neurologic injury</td>
<td></td>
</tr>
<tr>
<td>13.00 Assess and Manage Neuro-development, Psychosocial Behavioral States, Follow-up and Discharge (23%)</td>
<td></td>
</tr>
<tr>
<td>Apply knowledge of Neurosensory environmental experiences</td>
<td></td>
</tr>
<tr>
<td>Describe and manage stress and pain pathways and the impact on behavioral and physiological parameters</td>
<td></td>
</tr>
<tr>
<td>Collaborate with health care providers to assess and manage psychosocial behavior states and evaluate social determinants of health, modify the plan of care and prepare for discharge</td>
<td></td>
</tr>
<tr>
<td>14.00 Professional Issues (EBP, Professional, Legal, Ethical, Safety) (5%)</td>
<td></td>
</tr>
</tbody>
</table>
EXAMINATION CONTENT

ASSOCIATED COMPETENCIES

- Identify antepartum and intrapartum indicators of neurological risk and their implications to the fetus and neonate.
- Systematically assess neonatal neurological status utilizing clinical neurological assessment skills and neuroimaging to differentiate abnormal from normal.
- Utilize and interpret bedside neuro-monitoring tools to identify alterations in cerebral function and perfusion and implement appropriate interventions.
- Apply knowledge of the pathophysiology of neurologic injuries in the neonate including risk factors, presentation, and outcomes to implement diagnostic, therapeutic interventions and plan of care.
- Develop an individualized plan of care for the prevention, maintenance and promotion of health for neonates at risk or those with neurological injuries or dysfunction to improve overall outcomes.
- Utilize knowledge of neurosensory development, pain and stress pathways and implement evidence based strategies to minimize adverse outcomes in the at risk neonate.
- Through on going communication with the family, evaluate discharge needs, psychosocial behavioral states and the social determinants of health and modify the plan of care in collaboration with other health care providers.
- Identify professional, legal and ethical issues that present when caring for neonates at risk for neurological injury or dysfunction.
NEUROLOGIC DEVELOPMENT AND EVALUATION OF THE FETUS AND NEWBORN

I. Physical, Gestational Age, Behavioral and Neurologic Assessment
• Critical periods of fetal CNS and sensory development
  Synaptogenesis
  Organization
  Migration
  Myelination
  Pruning
  -Apoptosis
  Overproduction

II. Antenatal and intrapartum indicators of neurological risk to the fetus and neonate
• Maternal risk factors to fetal CNS development
  Genetic predisposition
  Maternal health
  Placental health
  Toxin exposure
  Infection

• Neurological risks to the fetus and neonate during labor and delivery, stabilization and resuscitation and transition
  Perinatal emergencies
  Ineffective resuscitations
  Equipment issues
  Preterm labor and delivery

III. Comprehensive neurological exam identifying normal and abnormal findings
• Comprehensive neurological exam at all gestational ages
  Head
  -Size
  -Shape
  -Sutures
  Cranial Nerves
  Neonatal reflexes
  -Deep tendon reflex
  Tone
  Posture
  Movement
  Level of consciousness

• Impact of pharmacological agents on the neonatal neurological exam
  Benzo
  Opioids
  Maternal drugs
  -SSRI
  -Magnesium sulfate

• Abnormal findings
  Dysmorphic features
  Hair tufts
  Dimples
  Birth marks
  Head
  -Cephalohematoma
  -Subgaleal hematoma
  -Caput
STUDY GUIDE

NEUROMONITORING, IMAGING AND DIAGNOSTIC TOOLS

I. Neuromonitoring, Recognition of and General knowledge of EEG/aEEG
- Cerebral monitoring
  EEG/aEEG/NIRS
  - clinical use
  - limitations
  - artifact
- Clinical Indications and significance of normal and abnormal findings of EEG/aEEG
  Background patterns
  Seizures
- Patient care needs during neurological monitoring
  Skin assessment and protection
  Event marking

II. Use of Neurologic Imaging to assess and modify treatment and evaluate prognosis
- Clinical indications of neuro imaging
- Identification of anatomical structures and recognition of significant neuro-imaging findings
  Intraventricular hemorrhage (IVH)
  Periventricular leukomalacia (PVL)
  Posthemorrhagic Hydrocephalus (PHH)
  Hypoxic Ischemic Encephalopathy (HIE)
  Stroke
  Intracerebral hemorrhage (ICH)
  subdural hemorrhage
  Subgaleal hemorrhage
  Congenital brain malformations
- Patient care needs during neurological imaging
  Skin protection
  Off unit transport
ASSESS AND MANAGE PATHOPHYSIOLOGIC STATES SPECIFIC TO NEUROLOGICALLY COMPROMISED OR AT RISK NEONATES AND PROVIDE NEUROPROTECTION

I. Pathophysiology of neurologic Injuries
   For all injuries: incidence, etiology, clinical presentation, diagnostics, lab studies, treatments
   - Hypoxic Ischemic Encephalopathy (HIE)
     Mechanism of injury
     Multisystem organ failure
   - Neonatal stroke
     Arterial
     Cerebral Sino-venous thrombus (CSVT)
   - CNS Malformation
     Anatomical
     Vascular
     Congenital hydrocephalus
     Neural tube defects
   - Cranial deformities
     Plagiocephaly
     Craniosynostosis
   - CNS infection
     Viral
     -HSV
     -CMV
     -Zika
     Bacterial
   - Encephalopathy
     Metabolic/endocrine
     -Hypoglycemia
     -Inborn errors of metabolism
     -bilirubin
     Hepatic
     -Neonatal hemochromatosis
     -Hemophagocytic lymphohistiocytosis (HLH)
     Genetic
     - Neonatal drug exposure
     Neonatal abstinence syndrome (NAS)
     Iatrogenic
   - Neuromuscular disease
     Spinal muscular atrophy (SMA)
     Congenital myopathies
   - Premature neonate
     Intraventricular hemorrhage (IVH)
     Periventricular leukomalacia (PVL)
     Posthemorrhagic Hydrocephalus (PHH)
   - Birth injuries
     Subgaleal hemorrhage
     Brachial plexus

II. Prevention, Management and Maintenance of health for at risk neonates or those with neurologic injury
   - Eligibility, contraindications and interventions to initiate therapeutic hypothermia (passive or active), maintaining treatment and rewarming
   - Perinatal risk factors
     Encephalopathy staging
     Interpretation of cord gas
     Fluid and electrolyte and nutrition
     Complications
   - Recognition and management of seizures
     Types
     Subclinical/clinical
     Phenobarbital
   - Recognition and management of apnea
     Prematurity
     Central
   - Interventions to prevent or minimize brain injury
     Positioning
     Delayed cord clamping
     Maternal and neonatal pharmacological agents
     Stabilize and maintain appropriate physiologic parameters
     Optimize ventilatory strategies
     Protected sleep
   - Prevention of infection and systemic inflammation
     Central line-associated bloodstream infection (CLABSI)
     Necrotizing enterocolitis (NEC)
I. Apply knowledge of neurosensory environmental experiences
   • Neurosensory environmental experiences
     Auditory
     Visual
     Vestibular
     Olfactory
     Tactile
   • Therapeutic positioning
     Neutral body alignment
     Appropriate containment
     Swaddle
     Skin-to-skin
   • Protected sleep
     Environment of care
     Maturation of sleep cycles
     Negative effects of sleep deprivation
   • Thermoregulation
     Temperature instability
     Consequences of hypo/hyperthermia
   • Nutrition
     Special considerations

II. Describe and manage stress and pain pathways and the impact on behavioral and physiological parameters
   • Neurobehavioral development
     Habituation
     Motor organization
     State organization
   • Pain assessment
     Special considerations for the neurologically compromised
     Pain reassessment
   • Neonatal pain management
     Pharmacologic
     Non-pharmacologic
   • Stress response
     Hormones and neurotransmitters
     HPA axis
     Stress cues
     Toxic stress

III. Collaborate with health care providers to assess and manage psychosocial behavior states and evaluate social determinants of health, modify the plan of care and prepare for discharge
   • Family centered care and integrations
     Partnered care
     Parental-neonatal attachment
     Stress and separation
     Participation in decision making and daily caregiving
     Culturally and spiritually sensitive care
   • Discharge/preparation/process
     Developmental follow up
     Specially follow up
     Hearing screening
     Family support
     Teaching
     -SIDS prevention
     -Motor, cognitive and language delays
   • End of life care/ palliative care/ grieving process
     Non-initiation
     Comfort care
     Hospice
I. Identify professional and ethical issues in the care of neonates at risk or with neurological injury or dysfunction

- Evidence based research
- Risks and outcomes
- Benchmarking
- QI/process improvement
- Best practice guidelines and bundles
- Translocation science

- Professional practice
  - Communication
  - Teamwork
  - Continuity of care
  - Patient safety
  - Education and training
  - Compassion fatigue
  - Self-care

- Ethical and legal issues that impact the neurologically impaired neonate
- Life limiting conditions
STUDY RESOURCES

- Blackburn, Maternal, Fetal, & Neonatal Physiology, Elsevier, 2018
- Snell, et al., Care of the Well Newborn, Jones & Batrlett, 2017