Objectives

1. Assess common congenital disorders of the newborn and recommend an appropriate intervention/plan of care after diagnosis.
2. Summarize updates in newborn screening recommendations, including the diagnosis of congenital anomalies through genomics.
3. Integrate new guidelines and advanced assessment skills into future practice changes.

Where do you work?

A. Newborn Nursery, Hospital Setting
B. Pediatric Primary Care, Outpatient Setting
C. Neonatal ICU
D. Other

Genetic Considerations of the Newborn

- Incidence of chromosomal abnormalities: 6 in 1000
- Causative genetic diagnosis in developmental delays: 14%
- Number one cause of death in infants < 1 year of age, accounting for 20% of all infant deaths

Newborn Screenings

- Since 1963 in MA for PKU (HRSA)
- Saves 12,500 babies annually
- Guthrie vs. Point of Care
- Components vary by state
- HHS Advisory Panel (2000)

https://www.healthy.arkansas.gov/programs-services/topics/newborn-screening
Criteria for Population-Based Screening: Core, Secondary, and N/A

- Substantial Public Health Benefit
- Feasibility of Screening
- Satisfactory Laboratory Methods
- Appropriate Laboratory Facilities and Quality Control
- Appropriate Counseling, Treatment and Follow-Up
- Acceptable Costs
- Effective Education & Evaluation of Program Outcomes

Ethical Considerations

- Consent
  - Opt-Out policies
  - Privacy and Confidentiality
- Residual Dried Blood Spots
  - 20 states address retention, 13 address information, 17 have no laws
  - NESTRAN developed VRDBS
    - Repository of >2 million bloodspots for researchers
    - Lessons learned from Minnesota and Texas
    - Incidental Findings

Advances in NBS Technology

- MS/MS vs. DNA extraction
- Digital Microfluidics (“lab-on-a-chip”)
- DNA genome sequencing on-demand
  - Rapid Diagnosis
  - Family Planning
  - Expediting Research
  - Disease Prevention
- Genomic Sequencing and Newborn Screening Disorders Program
  - $5 million grant
  - 4 group comparison
  - Studying effectiveness of genome sequencing for population screening

Genomic Aspects of Perinatal History

- Maternal Health & Habits
- Parental Health & Age at conception
- Ethnicity
- Consanguinity
- Teratogen Exposure
- Amniotic Fluid Volumes
- Fetal Activity
- Pre-conception counseling
- Amniocentesis
- Ultrasound
- Chorionic Villus Sampling
- Abnormal Fetal U/S

Perinatal History

- Maternal age, gravida, para
- Maternal Blood group & Rh factor
- Historic duration of pregnancy (> weeks)
- Prenatal conditions/complications
- Intrapartal Complications
- Medications used during labor
- Family History
- Delivery anesthesia
- Delivery date & time
- Type of delivery & rationale
- Hours of ROM before delivery
- Length of Labor (>24hr & <6 hrs-fetal stress)
- GBS status
- Birth weight
- APGAR score

Assessment by Observation

- Overall size, shape, & symmetry
  - Activity State
    - Quiet sleep
    - Active sleep
    - Dreamy
    - Alert
    - Fussy
    - Crying
  - Posture, tone
  - Skin color, signs of trauma
- Respiratory effort
  - Grunting
  - Nasal flaring
  - Retractions
  - Respiratory Rate
- Jitteriness
  - No abnormal gaze or eye movements
  - Stimulus sensitive
  - Predominant motion is tremor-not classic jerking
Dysmorphic Features
Genetic Considerations in Childhood

Considerations
- Number of Systems Involved
- Major or Minor
- Family Characteristics
- RAPI D Approach
  - Pedigree
  - Physical Assessment
  - Developmental Assessment

Growth
- Accurate Measurements
- Standardized Growth Charts
- Decreased weight gain - GI or nutritional
- Decreased height velocity - endocrine
- Both - familial vs. multi-system
- When to Worry

Examples of Dysmorphic Features
- Head
  - Dysmorphic Skull
  - Craniosynostosis
  - Micro/Macro-cephaly
  - Frontal bossing
  - Facial Asymmetry
  - High Forehead
  - Low Set posterior hairline
  - Vertical furrowing of central forehead
  - Round/Long/Flat Facies
  - Finely arched/Heavy eyebrows

- Eyes
  - Long eyelashes
  - Ptosis
  - Epicanthal folds of the eyes
  - Upward or downward slanting palpebral fissures
  - Wide-Sets Eyes
  - Almond Shaped Eyes
  - Coloboma
  - Iris Abnormality
  - Strabismus
  - Nystagmus
  - Glaucoma
  - Congenital Cataracts

Examples of Dysmorphic Features
- Choanal Atresia
- Oppose thumb to volar forearm
- Skeletal disproportion
- Cubitus Varus
- Arachnodactyly
- Ectrodactyly
- Pes planus
- Toe walking

- Mallor hypoplasia
- Bifid uvea
- Hypodontia
- Conical anterior teeth
- Micrognathia
- Widened neck
- Redundant Skin
- Café-au-lait spots
- Micropenis
- Pectus excavatum/carinatum

Case Studies
Application Exercises
Case Study

Hypotonic Posture
Umbilical Hernia
Coarse Facial Features
Large Anterior Fontanelle

Macroglossia

What is the most likely diagnosis?

A. Congenital Adrenal Hyperplasia
B. Congenital Hypothyroidism
C. VACTERL Syndrome
D. Cri du Chat

After treatment initiated.....

Tone improved
Umbilical hernia reducing in size
More alert
Macroglossia resolved

What is the most appropriate question to ask in this mother's prenatal history?

A. Did you travel during your pregnancy?
B. Do you have a history of any sexually transmitted infections?
C. Do you have a family history of microcephaly?
D. Did you experience a traumatic injury during pregnancy?
What is the most likely diagnosis?

A. Turner’s Syndrome
B. Marfan’s Syndrome
C. Down’s Syndrome
D. Fetal Alcohol Syndrome

Case Study

- Preauricular Skin Tag
  - Otherwise normal physical exam
  - Unremarkable prenatal history

What is the most appropriate test to order at this time?

A. Urine and Meconium Drug Screen
B. Hearing Screen
C. Renal Ultrasound
D. Xray: Plain Skull Films

Case Study

- Male infant at 18 hours of life
- Initial exam at 4 hours of life unremarkable
- Weak cry
- O2 sat 83% RA, 84% on blow-by
- Glucose 16
- Tachypnea, RR=108, Grunting, Intercostal Retractions
What is the most likely diagnosis for this infant?

A. Transient Tachypnea of the Newborn
B. Coarctation of the Aorta
C. Spontaneous Pneumothorax
D. Total Anomalous Pulmonary Venous Return

Central Cyanosis

<table>
<thead>
<tr>
<th>Cardiac</th>
<th>Pulmonary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyanotic</td>
<td>Cyanotic</td>
</tr>
<tr>
<td>No response to O2</td>
<td>Response to O2</td>
</tr>
<tr>
<td>Abnormal EKG</td>
<td>Normal EKG</td>
</tr>
</tbody>
</table>

Pulse Oximetry

- AAP/AHA consensus statement
- Figure:
  - A: Cyanotic CHD
  - B: Differential Cyanosis: CoA
  - C: Reverse Differential Cyanosis: TGA

Case Study

Noted on physical exam
**What is the most likely diagnosis?**

A. VACTERL Syndrome  
B. TORCH Syndrome  
C. Holt-Oram Syndrome  
D. Spina Bifida/Myelomeningocele

**Case Study**

Reports increased spit-up  
Poor Feeder  
Na 121, Potassium 6.5, Glucose 25

**What is important to rule out?**

A. Congenital Hypothyroidism  
B. Angelman Syndrome  
C. Bladder Exstrophy  
D. Congenital Adrenal Hyperplasia

**Case Study**

Otherwise normal exam

**What is the most appropriate provider order to enter?**

A. Implement seizure precautions  
B. Order an echocardiogram  
C. Obtain a renal ultrasound  
D. Draw labs: CBC, CMP, LFT

**Case Study**

Healthy Male Newborn  
No other physical exam anomalies
What is the most likely diagnosis?
A. Mongolian Spots  
B. Neurofibromatosis Type I  
C. Tuberous Sclerosis  
D. Congenital Nevi

What is the most likely diagnosis?
A. Trisomy 13  
B. Velocardiofacial Syndrome  
C. Cri du chat Syndrome  
D. Rhett Syndrome

Craniostenosis/Craniosynostosenosis
- Premature fusion of skull sutures  
- Look for absent fontanels  
- Normal brain growth inhibited  
- Usually develops in utero  
- 20% associated with genetic syndrome  
- Surgery usually performed at 4-7 months

Case Study
Systolic murmur noted on exam.

Case Study
Webbed Neck
Edema of the dorsum (hands and feet)
Short fingers

Nose
- Observe for symmetry  
- Ensure nare patency (infants are obligate nasal breathers)  
- Positional deformities may result from birth process  
  - If able to manipulate, will probably correct itself  
  - If non-pliable, may be associated with congenital deformity  
- Choanal Atresia
What is the most likely diagnosis?
A. Acyanotic Heart Defect
B. Cyanotic Heart Defect
C. Congenital Adrenal Hyperplasia
D. Turner Syndrome

What is the most likely diagnosis?
A. Treacher-Collins Syndrome
B. Potter’s Syndrome
C. Cri du Chat Syndrome
D. Prader Willi Syndrome

Marfan Syndrome
- Autosomal-dominant
- Connective tissue disorder
- Cystic medial necrosis of aorta
- Joint laxity
- Subluxation of ocular lens
- Arm span exceeds height

Myelomeningocele
- Neural tube defect
- 75% cases occur in lumbosacral region
- 1:1,200 live births
- Flaccid paralysis of lower extremities
- Absence of DTR
- Lack of response to touch & pain
- Constant urinary dribbling
- Mortality 10–15%
- 70% normal intelligence

Summary
- Examine patients through a genetic lens
- Genetic Counseling
- GINA
**TABLE 8.1. Features of Genetic Syndromes.**

<table>
<thead>
<tr>
<th>Head</th>
<th>Musculoskeletal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dyssomorphic skull</td>
<td>Connective tissue abnormalities</td>
</tr>
<tr>
<td>Craniosynostosis</td>
<td>Hypermobility joints or joint laxity</td>
</tr>
<tr>
<td>Microcephaly</td>
<td>Ability to oppose thumb to volar forearm</td>
</tr>
<tr>
<td>Macrocephaly</td>
<td>Abnormal upper-to-lower segment ratio</td>
</tr>
<tr>
<td>Frontal bossing</td>
<td>Skeletal disproportion</td>
</tr>
<tr>
<td>Facial asymmetry</td>
<td>Arm span that exceeds height</td>
</tr>
<tr>
<td>Meningomyelocele</td>
<td>Limb deformities</td>
</tr>
<tr>
<td>High forehead</td>
<td>Long bone fractures</td>
</tr>
<tr>
<td>Low set posterior hairline</td>
<td>Scoliosis</td>
</tr>
<tr>
<td>Vertical furrowing of central forehead</td>
<td>Kyphosis</td>
</tr>
<tr>
<td>Round face</td>
<td>Vertebral anomalies</td>
</tr>
<tr>
<td>Long face</td>
<td>Joint contractures</td>
</tr>
<tr>
<td>Flat facies</td>
<td>Frequent or sprains, dislocations, and subluxations</td>
</tr>
<tr>
<td>Mide line defects</td>
<td>Early onset chronic musculoskeletal pain</td>
</tr>
<tr>
<td>Finely arched, heavy eyebrows</td>
<td>Long thin extremities</td>
</tr>
<tr>
<td></td>
<td>Cubitus valgus or turned-in elbows</td>
</tr>
<tr>
<td></td>
<td>Small hands and feet</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Eyes</th>
<th>Hands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long eyelashes</td>
<td>Arachnodactyly</td>
</tr>
<tr>
<td>Ptosis</td>
<td>Polydactyly, extra digits$^a$</td>
</tr>
<tr>
<td>Epicanthal folds of the eyes</td>
<td>Absent thumbs$^a$</td>
</tr>
<tr>
<td>Upward or downward slanting palpebral fissures of the eyes</td>
<td>Ectrodactyly, missing or deficient central digits of the hand</td>
</tr>
<tr>
<td>Hypertelorism or wide set eyes</td>
<td>Clinodactyly, bent or curved fifth fingers</td>
</tr>
<tr>
<td>“Almond shaped” eyes</td>
<td>Syndactyly (webbing)</td>
</tr>
<tr>
<td>Prominent eyes</td>
<td>Short fifth finger</td>
</tr>
<tr>
<td>Colobomas or other iris anomalies</td>
<td>Single transverse (simian) palmar creases</td>
</tr>
<tr>
<td>Strabismus</td>
<td>Bridged palmar crease, two transverse palmar creases that are connected</td>
</tr>
<tr>
<td>Nystagmus</td>
<td></td>
</tr>
<tr>
<td>Keratoconus</td>
<td></td>
</tr>
<tr>
<td>Vision defects or blindness</td>
<td></td>
</tr>
<tr>
<td>Glaucoma</td>
<td></td>
</tr>
<tr>
<td>Cataracts</td>
<td></td>
</tr>
<tr>
<td>Retinal detachment</td>
<td></td>
</tr>
<tr>
<td>Ocular lens subluxation, ectopia lentis</td>
<td></td>
</tr>
<tr>
<td>Brushfield spots or spots on the periphery of the iris</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ears</th>
<th>Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preauricular pits or tags</td>
<td>Wide space between first and second toe</td>
</tr>
<tr>
<td>Deafness</td>
<td>Ectrodactyly, missing or deficient central digits of the foot</td>
</tr>
<tr>
<td>Long, wide or protruding ears</td>
<td>Bilateral clubfoot, congenital talipes equinovarus$^a$</td>
</tr>
<tr>
<td>Folded or dysplastic ears</td>
<td>Rocker-bottom feet</td>
</tr>
<tr>
<td>Creases in the earlobes</td>
<td>Pes planus</td>
</tr>
<tr>
<td>Microtia$^a$</td>
<td>Toe walking</td>
</tr>
<tr>
<td>Low set ears</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nose</th>
<th>Stature, weight and growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat or broad nasal bridge</td>
<td>Short stature</td>
</tr>
<tr>
<td>High nasal bridge</td>
<td>Tall stature</td>
</tr>
<tr>
<td>Small nose</td>
<td>Obesity</td>
</tr>
<tr>
<td>Choanal atresia$^a$</td>
<td>Failure to thrive</td>
</tr>
<tr>
<td></td>
<td>Alterations in growth velocity</td>
</tr>
</tbody>
</table>

(continued)