I. **Announcements** Quiz 4 1st 15-20 min. Q? Presentations Group I today! Today’s lecture prep for Dr. St. Germain’s & Dr. Bradshaw's guest lectures, Mar 2nd+7th. **Reminders:** Sign-in, attendance, guest feedback, .pptx vs Prezi vs…Q?

II. **Neonatal & Pediatric Physiology** Prep for Dr. Bradshaw

A. What’s a *neonate*? Age range for pediatric patients?

B. Some differences?

1. Markers to predict problems (**NB**: rare ~95%x OK!)
2. *cf*: Neonate vs. adult human values (selected)
4. Heart differences?
5. More frequent, yet still uncommon problems: congenital genetic defects, Tetralogy of Fallot, Down syndrome, Edward's syndrome, Cystic fibrosis

C. Development & Pediatrics tour, Tanner scale. Ref: Moore, Persaud, Shiota (MPS); Johnson (RVJ) +...
Providing intervention and advocacy for children who are victims of or witnesses to crime.

Dr. Deanna St. Germain, DO
Medical Director
Kids’ FIRST

Change Their World and it Will Change Yours!

PROVIDING INTERVENTION AND ADVOCACY FOR CHILDREN WHO ARE VICTIMS OF OR WITNESSES TO CRIME.
Pediatrics = Gr. παιδιά/paidiá/children
Γιατρός/Giatrós/physician

medical branch that treats child: development, care, disease treatment

Life-long education...

Safety, prevention...
In the USA:
13.4 million readers
57,695 pediatricians
2,100 nominated
7 chosen
1 is our Dr. B

You’re one of our favorite pediatricians and *Parents* magazine’s, too!

Pilar Bradshaw, M.D., F.A.A.P.
<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>NEONATE</th>
<th>ADULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>WT (lb)</td>
<td>7</td>
<td>♀ 110 ♂ 150</td>
</tr>
<tr>
<td>WT (lb, range)</td>
<td>4.5–11</td>
<td>wide variation</td>
</tr>
<tr>
<td>HR (b/min)</td>
<td>130</td>
<td>~2 x 70</td>
</tr>
<tr>
<td>RR (breaths/min)</td>
<td>40</td>
<td>3 x 12-15</td>
</tr>
<tr>
<td>BV (mL)</td>
<td>!16.7 x 300</td>
<td>$\frac{1}{17}$ x 5000</td>
</tr>
<tr>
<td>CO/$\dot{Q}$ (mL/min)</td>
<td>100 x 50</td>
<td>$\frac{1}{100}$ x 5000</td>
</tr>
<tr>
<td>BP (mm Hg)</td>
<td>70/50</td>
<td>?? x120/80</td>
</tr>
<tr>
<td>BMR (relative)</td>
<td>2x Adult</td>
<td>1</td>
</tr>
<tr>
<td>FLUID $\Delta$(relative)</td>
<td>7x Adult</td>
<td>1</td>
</tr>
</tbody>
</table>

H$_2$O Homeostasis!
Fetal Circulation: Aqua Animal!

1. Ductus Arteriosus
2. Foramen Ovale
3. Ductus Venosus

G&H 2016 fig 84-4
G&H 2011 fig 83-4
5 wk

RV Johnson (RVJ)
1994 Mayo Clinic p A2
6 wk
t = 0

$3 \text{ wk}$ Embryo $8 \text{ wk} \geq 9^{\text{th}} \text{ wk}$

Organogenesis

Fetus = distinct human appearance

$28 \text{ wk later}$

$56 \text{ d}$

How so fast? Cell divisions in as little as $4 \text{ hr}$!

How so fast? Cell divisions in as little as $4 \text{ hr}$!

24 hr/d

<table>
<thead>
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<th>8</th>
<th>12</th>
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<td>2</td>
<td>4</td>
<td>8</td>
<td>16</td>
<td>32</td>
<td>64</td>
</tr>
</tbody>
</table>

$2^0$ $2^1$ $2^2$ $2^3$ $2^4$ $2^5$ $2^6$

...100 trillion!
Embryo?
Fetus?
Baby?
Fetus @ 28 wk or 7 mo
1100 g (1.1 kg)
≈ 2.5 lb

J Langman 1981 Medical Embryology p 80
### Where you’ll gain the weight

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight Range</th>
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<tbody>
<tr>
<td>Your baby</td>
<td>6 1/2 to 9 pounds</td>
</tr>
<tr>
<td>Placenta</td>
<td>1 1/2 pounds</td>
</tr>
<tr>
<td>Amniotic fluid</td>
<td>2 pounds</td>
</tr>
<tr>
<td>Breast enlargement</td>
<td>1 to 3 pounds</td>
</tr>
<tr>
<td>Uterus enlargement</td>
<td>2 pounds</td>
</tr>
<tr>
<td>Fat stores and muscle development</td>
<td>4 to 8 pounds</td>
</tr>
<tr>
<td>Increased blood volume</td>
<td>3 to 4 pounds</td>
</tr>
<tr>
<td>Increased fluid volume</td>
<td>2 to 3 pounds</td>
</tr>
</tbody>
</table>

**Total** 22 to 32 1/2 pounds
Surprise!

Head

Head
Level 2 Ultrasound

Lungs

Fluid

Heart

Fluid
What are my chances of having a child with a birth defect? \( \leq 5\% \)

Of every 100 babies born in the United States, 95 to 97 are born healthy (no major medical or surgical intervention is necessary). According to the March of Dimes Birth Defects Foundation:

- One of every 175 is born with a congenital heart defect.
- One of every 400 is born with clubfoot.
- One of every 700 is born with cleft lip and palate.
- One of every 800 is born with Down syndrome.
- One of every 2,000 is born with spina bifida.

To put this list into perspective, consider the following:

- The odds of having twins are about one in 100.
- The odds of having triplets are about one in 8,000.
Tetralogy of Fallot

1. Aorta Displacement
2. Pulmonary Stenosis
3. Ventricular Septal Defect
4. R Ventricular Hypertrophy

f = 3.3 per 10,000 live births
15% TOF 22q11 deletion
7% TOF trisomy 21
≥ 4% TOF NKX2.5 mutation

G&H 2016 & 2011 fig 23-5
### Implications relative to Dr. Kaplan’s lecture & delaying pregnancy!

<table>
<thead>
<tr>
<th>Age</th>
<th>Risk for Down syndrome</th>
<th>Total risk for clinically significant chromosome abnormalities</th>
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<tbody>
<tr>
<td>20</td>
<td>1/1,667</td>
<td>1/526</td>
</tr>
<tr>
<td>21</td>
<td>1/1,667</td>
<td>1/526</td>
</tr>
<tr>
<td>22</td>
<td>1/1,429</td>
<td>1/500</td>
</tr>
<tr>
<td>23</td>
<td>1/1,429</td>
<td>1/500</td>
</tr>
<tr>
<td>24</td>
<td>1/1,250</td>
<td>1/476</td>
</tr>
<tr>
<td>25</td>
<td>1/1,250</td>
<td><strong>1/476</strong></td>
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<tr>
<td>26</td>
<td>1/1,176</td>
<td>1/476</td>
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<tr>
<td>27</td>
<td>1/1,111</td>
<td>1/455</td>
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<td>28</td>
<td>1/1,053</td>
<td>1/435</td>
</tr>
<tr>
<td>29</td>
<td>1/1,000</td>
<td>1/417</td>
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<tr>
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<td>1/952</td>
<td>1/385</td>
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<td>31</td>
<td>1/909</td>
<td>1/385</td>
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<td>1/769</td>
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<td>1/602</td>
<td>1/286</td>
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<td>34</td>
<td>1/485</td>
<td>1/238</td>
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<tr>
<td>35</td>
<td><strong>1/378</strong></td>
<td><strong>1/192</strong></td>
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<tr>
<td>36</td>
<td>1/289</td>
<td>1/156</td>
</tr>
<tr>
<td>37</td>
<td>1/224</td>
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<td>1/173</td>
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<td>39</td>
<td>1/136</td>
<td>1/83</td>
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<tr>
<td>40</td>
<td>1/106</td>
<td>1/66</td>
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<tr>
<td>41</td>
<td>1/82</td>
<td>1/53</td>
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<td>42</td>
<td>1/63</td>
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<tr>
<td>43</td>
<td>1/49</td>
<td>1/33</td>
</tr>
<tr>
<td>44</td>
<td>1/38</td>
<td>1/26</td>
</tr>
<tr>
<td>45</td>
<td>1/30</td>
<td>1/21</td>
</tr>
</tbody>
</table>
95% of Down Syndrome Trisomy 21
90% of Cases → Eggs Are Abnormal

Normal ♀

Down Syndrome ♂

Quad Screen? 4 Blood Chemistry Tests

2nd trimester, neural tube defects & chromosomal abnormalities, 81% sensitivity, 5% false +

**AFP:** alpha-fetoprotein, fetal liver

High, neural tube defects (spina bifida)

**hCG:** human chorionic gonadotropin, placenta

High, Down syndrome (Trisomy 21)
Low, Edward's syndrome (Trisomy 18)

**Estriol:** placenta + fetal liver

**Inhibin-A:** placenta + ovaries

http://www.mayoclinic.com/health/quad-screen/MY00127
http://www.americanpregnancy.org/prenataltesting/quadscreen.html
Amniocentesis or Chorionic Villus Sampling?
**Down Syndrome Fetus**

*NB:* 1:1400 incidence for maternal age 20-24; 75% spontaneously aborted. Flat frontal facies, anomalous auricles, simian crease, clinodactyly.

**SOURCE:** KL Moore, TVN Persaud & K Shiota (MPS)1994
DOWN SYNDROME NEONATE
10 KEY FEATURES (Hall)

1. Facial profile flat 90%
2. Hypotonia 80%
3. Poor Moro reflex 85%
4. Joint hyperflexibility 80%
5. Skin excess nape of neck 80%
6. Palpebral fissures slanted 80%
7. Pelvic dysplasia 70%
8. 5th finger mid-phalynx dysplasia 60%
9. Auricles anomalous 60%
10. Simian crease 45%
Dizygotic Twins Discordant for Down Syndrome
FIGURE 2. Down syndrome. *A*, Young infant. Flat facies, straight hair; protrusion of tongue; single crease on inturned fifth finger.
Recessive Disorders
e.g., Cystic Fibrosis

RVJ, Mayo Clinic p 61.

Chromosome 7

Dominant gene (normal)

Recessive gene (altered)

f = 4 in 10,000 live births
CFTR gene, 7q31.2
long arm chromosome 7

Most Common Position. Ideal!!

RVJ, Mayo Clinic p 317.

cf: G&H 2016 fig 83-9
G&H 2011 fig 82-9
Occiput Posterior/Sunnyside up! Oh No! …Yikes!

Largest presenting diameter!

RVJ, Mayo Clinic p 318.
Breech!

eg, Frank

RVJ, Mayo Clinic p 319.
Experienced Midwives & OB-GYN MD may be able to massage into position?

A baby who is positioned horizontally across the uterus, rather than vertically, is in a transverse lie position. Most babies in this position have a cesarean birth.
Low Transverse  Classic  Low Vertical
Baby @ birth
38 wk or 266 d
> conception!
3200 g (3.2 kg)
≈ 7 lb
## Apgar Scores: How Healthy Is Your Newborn?

<table>
<thead>
<tr>
<th>Sign</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Appearance (color)</td>
<td>Pale or blue</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulse (heartbeat)</td>
<td>Not detectable</td>
</tr>
<tr>
<td>Grimace (reflex irritability)</td>
<td>No response to</td>
</tr>
<tr>
<td></td>
<td>stimulation</td>
</tr>
<tr>
<td>Activity (muscle tone)</td>
<td>Flaccid (no or</td>
</tr>
<tr>
<td></td>
<td>weak activity)</td>
</tr>
<tr>
<td>Respiration</td>
<td>None</td>
</tr>
</tbody>
</table>

Scores determined for each sign are totaled. The highest possible score is 10. By 5 minutes of age, most healthy babies have scores of at least 7. A score less than that indicates that the baby warrants careful watching.

Virginia Apgar, MD, Anesthesiologist, 1953
Fall in body temperature of the neonate immediately after birth, and instability of body temperature during the first few days of life.
Behavioral development of the infant during the first year of life.
Cephalic to Caudal Development

2 mo. (fetal)  5 mo.  Newborn  2 yr.  6 yr.  12 yr.  25 yr.

Courtesy Dr. Allen Harlor, PeaceHealth Medical
The diagram illustrates the increments of DNA, Brain Weight, and Cholesterol percentages against adult values over time in weeks and months.

- **DNA**: Shows a sharp increase at birth, followed by a decrease, and then a steady decline over months.
- **Brain Weight**: Exhibits a steep rise early, peaking at birth, and then a gradual decline.
- **Cholesterol**: Displays a consistent and slow increase over weeks and months.

The y-axis represents increments as a percentage of adult values, while the x-axis indicates time in weeks and months post-conception or birth. The data is courtesy of Dr. Allen Harlor, PeaceHealth Medical.
Infant Eustachian tube smaller + more horizontal!

An infant’s ear is different from an adult’s ear because the eustachian tube is more horizontally positioned. Because of this, drainage from the middle ear occurs less easily, and your baby is at greater risk for an ear infection (otitis media). This condition occurs when the eustachian tube becomes blocked and fluid is trapped. It is marked by swelling and discoloration of the eardrum.

- Fluid-filled middle ear
- Bulging eardrum
- Swelling and inflammation
Tanner Stages of Development
Tanner Stages for Breast Development
Tanner Stages? What are the Ages?

All 14 $\frac{3}{4}$ yr!!

All 12 $\frac{3}{4}$ yr!!