Birth Defects in Texas and Beyond: Epidemiologic Findings

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Disclosure
Mark Canfield, PhD, has no relationships with commercial companies to disclose.

Learning Objectives
At the end of this presentation the participant will be able to:
1. Name 3 of the most common birth defects in Texas
2. Identify the most common critical congenital heart defect targeted for pulse oximetry screening
3. Identify a major birth defect that is increasing in prevalence over time

Public Health Impact:
Topics to be Covered
- Program History and Overview
- Prevalence of Selected Birth Defects in Texas
- Prevalence Differences
- Mortality/Survival
- Other Findings
- Program Resources

History
“Baby tragedy has no bounds/Woodlands, like the Valley, sees infants missing brains.”

Early Program Milestones
- 1993: Legislation enacted
- 1994: Registry established
- 1996: Center established
- 1999: Registry became statewide
Birth Defects Epidemiology & Surveillance Branch, Texas DSHS: 2 Components
Texas Birth Defects Registry (TBDR)
- One of largest birth defects surveillance systems globally
- Funded by State of Texas and Title V Office, DSHS
- Monitor and describe the occurrence of birth defects in TX
- Conduct cluster investigations
- Collaborative research and prevention
- Family outreach
Texas Center for Birth Defects Research and Prevention
- One of 10 in U.S. – funded by CDC
- Collaborate in the National Birth Defects Prevention Study: largest of its kind to date
- Establish collaborative epidemiologic-genetic research - TX

Features of the Texas Birth Defects Registry
- Computerized database of infants and pregnancies affected by birth defects
- Active surveillance--trained staff visit facilities to identify cases and collect info
- Structural/chromosomal malformations
- Emphasis on diagnostic accuracy
- Emphasis on hospitals/related clinics
- Includes all pregnancy outcomes

Prevalence of Selected Birth Defects

Prevalence of Critical Congenital Heart Defects Targeted for Pulse Oximetry Screening, Texas, 2005-2009

Variation in Birth Defect Prevalence, by:
- Time
- Maternal Age
- Infant Sex
- Maternal Race/Ethnicity
- Geographic area
Birth Prevalence of Children with Any Monitored Birth Defect by Year, Texas, 1999-2011

Prevalence of Three Selected Birth Defects Over Time, Texas, 1999-2011

Gastroschisis

Spina Bifida

Any Monitored Defect Texas, 1999-2011

Prevalence of Down Syndrome By Mother's Age
Prevalence of Gastrochisis By Mother’s Age

Summary Table of Adjusted Prevalence Ratios for 27 Birth Defects in 12 U.S. States

<table>
<thead>
<tr>
<th>Birth Defect</th>
<th>Male/All Other Groups</th>
<th>Selected Asian Subgroup</th>
<th>Incident All ( \times 10,000 )</th>
<th>Expected All ( \times 10,000 )</th>
<th>Adj Ratio</th>
<th>95% CI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anencephaly</td>
<td>-1.5</td>
<td>-1.5</td>
<td>7.6</td>
<td>7.6</td>
<td>1.00</td>
<td>-0.33</td>
<td>1.00</td>
</tr>
<tr>
<td>Cleft Palate/颚裂唇裂</td>
<td>1.0</td>
<td>1.0</td>
<td>7.6</td>
<td>7.6</td>
<td>1.00</td>
<td>-0.33</td>
<td>1.00</td>
</tr>
<tr>
<td>Congenital Aortic Fallot</td>
<td>1.0</td>
<td>1.0</td>
<td>7.6</td>
<td>7.6</td>
<td>1.00</td>
<td>-0.33</td>
<td>1.00</td>
</tr>
<tr>
<td>Gastroschisis</td>
<td>1.0</td>
<td>1.0</td>
<td>7.6</td>
<td>7.6</td>
<td>1.00</td>
<td>-0.33</td>
<td>1.00</td>
</tr>
<tr>
<td>Hypospadias</td>
<td>1.0</td>
<td>1.0</td>
<td>7.6</td>
<td>7.6</td>
<td>1.00</td>
<td>-0.33</td>
<td>1.00</td>
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<tr>
<td>Omphalocele</td>
<td>1.0</td>
<td>1.0</td>
<td>7.6</td>
<td>7.6</td>
<td>1.00</td>
<td>-0.33</td>
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<tr>
<td>Spina Bifida</td>
<td>1.0</td>
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</table>

Birth Defects Mortality and Survival

10 Most Common Causes of Death By Age Group, Texas 2008

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cause of Death</th>
<th>Deaths Under 1</th>
<th>Deaths 1-4</th>
<th>Deaths 5-14</th>
<th>Deaths 15-29</th>
<th>Deaths 30-64</th>
<th>Deaths 65+</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Birth Defects</td>
<td>102,245</td>
<td>78,791</td>
<td>32,536</td>
<td>1,769</td>
<td>107</td>
<td>48</td>
</tr>
<tr>
<td>2</td>
<td>Unintentional Injuries</td>
<td>11,972</td>
<td>11,554</td>
<td>2,410</td>
<td>108</td>
<td>20</td>
<td>16</td>
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</tbody>
</table>
Impact of Maternal Ethnicity, Gestational Age, and Size at Birth on Mortality from Birth Defects, Texas, 1996-2003

- **Maternal Ethnicity**
  - 50% increased risk of mortality for NH-Black infants vs. NH-White infants with birth defects
  - No increased risk of mortality for Hispanic infants vs. NH-White infants with birth defects

- **Gestational Age**
  - 2.7-fold increased mortality risk for infants with birth defects born preterm (vs. full-term)

- **Fetal Growth**
  - 2-fold increased risk of mortality for infants born SGA
  - 50% reduction in risk of mortality for infants born LGA.

Takeaway Points from 6 Survival Studies on Texas Children Born with Heart Defects, 1996-2007

- Non-Hispanic black children in Texas had a higher risk of death from several important heart defects, compared to non-Hispanic white children
- Texas children had a higher risk of death from specific heart defects if they:
  - were born in an earlier time period (1996-2000 vs. 2001-2003)
  - had co-occurring extracardiac defects
- Among the major heart defects, hypoplastic left heart syndrome had the lowest probability of survival in Texas children (roughly 1/3 survived 5 yrs.)
- Mortality from hypoplastic left heart syndrome in Texas:
  - pre-surgical mortality was highest for those with greatest driving distance from the birth hospital to a cardiac surgical center
  - post-surgical mortality was lower for cardiac specialty centers with higher patient volume

Infant Case-Fatality (%) for Critical Congenital Heart Defects Targeted for Pulse Oximetry Screening, Texas, 2005-2009

Other Findings

- Research Focus: First 20 years
- Obesity and Birth Defects
- Urban vs. Rural Residence
- Gastrochisis in Texas
- Childhood Cancer and Birth Defects
- Hospital Charges and Utilization
- Maltreatment of Children with Birth Defects
- Texas Neural Tube Defect Project
**Program/Center Research Focus: First 20 years**

- Environmental Hazards and Birth Defects
  - Hazardous Waste Sites
  - Air Pollution and Hazardous Air Pollutants
  - Pesticides
  - Occupational
- Racial/Ethnic Disparities in Occurrence of Birth Defects
- Mortality/Survival of Children Born with Heart Defects
- Obesity
- Urban/Rural and Border/non-Border Differences in Occurrence
- Genetic Factors
- Nitrates, Nitrites, and Nitrosatable Drugs
- Newborn Screening Analytes and Birth Defects
- Specific Birth Defects:
  - Neural Tube Defects, Particularly on the Border w/ Mexico
  - Amelia/Microtia
  - Choanal Atresia

*Highlighted in subsequent slides*

**Adjusted Odds Ratios for Pre-pregnancy Obesity and Selected Isolated Birth Defects, 1997–2002**

**Urban vs. Rural Prevalence of Selected Birth Defects in Texas**

**Prevalence of Gastoschisis, In Cases per 10,000 Live Births, Texas, 1999–2011**

**Prevalence of Gastoschisis Over Time, Texas, 1999–2011**
Gastroschisis: Summary of Findings from Texas

- After adjusting for important related factors, the occurrence in whites and Hispanics are similar, and occurrence in blacks are 60% lower than whites. (National data: Hispanics higher among mothers 20+ years of age.)
- There was no clear relationship between gastroschisis and maternal education or infant sex.
- Occurrence in teen mothers 15 times higher than the occurrence in mothers 30+ yrs.
- Higher in first births, compared to 2nd births.
- Lower among multiple births, compared to single infant births.
- Highest in the Abilene/Midland area and lowest in the Houston/Galveston area.
- Nueces County (Corpus Christi) is the urban county with the highest gastroschisis prevalence.
- 50% higher number of cases in 2011 vs. 1999, with a 5% increase in cases per year
- 70-80% lower in obese Texas mothers, compared to normal weight mothers.

Hospital Utilization and Charges for Children with Birth Defects

Highest Total Hospital Charges Due to Congenital Anomalies Primary Diagnosis, Texas, 2001-2010

Distribution of Charges by Payment Source for Congenital Anomalies - Primary Diagnosis Texas, 2004-2010

Highest Median Length of Hospital Stay Due to Congenital Anomalies - Primary Diagnosis, Texas, 2001-2010
### Maltreatment and Birth Defects: Methods

- **Study population:** > 3 million Texas children born 2002-2009, without any birth defect ("unexposed") or with target birth defects ("exposed")
  - Down syndrome (cognitive realm) n=3,743
  - Spina bifida (physical realm) n=871
- **Primary outcome:** confirmed maltreatment (reported at CPS/Texas DFPS):
  - Physical
  - Sexual
  - Emotional abuse
  - Neglectful supervision
  - Medical or physical neglect
  - Refusal to assume parental responsibility
  - Abandonment
- **Data linkage:**
  - Birth defect cases in Texas Registry linked to birth certificates (routine)
  - Child Protective Services (CPS) client list linked to Texas birth certificates
- **Analysis:** Cox regression to calculate hazard ratios, adjusted for SES, etc.

### Results: Maltreatment among Children with Specific Birth Defects (compared to kids w/o birth defects)

- **Risk of confirmed maltreatment varied by birth defect, age, and type of maltreatment.**
- **Adjusted relative risk of maltreatment (<2 yrs.)**
  - Spina bifida: 1.68 (95% CI=1.12-2.24)
  - CLP: 1.40 (95% CI=1.35-1.98)
  - Down syndrome: 1.08 (0.85-1.37) *(no difference)*
- **Among maltreated, risk of medical neglect 3-6 times higher in children in this age group with these birth defects**

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### Texas Neural Tube Defect (NTD) Project

**Summary of Important Findings**

**Maternal Environmental Exposures Associated w/ NTDs: TX-Mexico Border**

- Pesticides
  - In/around home or yard
  - Living near cultivated fields
- Solvents
  - Chemicals (hobbies, work)
- Other work exposures
  - Glycol ethers
  - Cleaning and health care professions
- Mercury (but only among highest-income subjects)
- *Burned treated wood*
- *Nitrosatable drugs (esp. w/ higher levels of nitrite/nitrate intake)*
- Cigarette smoke (active smoking and second-hand)
- *Fumonisins*

**Maternal Environmental Exposures NOT Associated w/ NTDs**

- PCBs
- Lead, Arsenic, Cadmium
- Aflatoxins
- *Novel findings*

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### Texas Neural Tube Defect (NTD) Project

**Summary of Important Findings**

**Other Factors Associated w/ NTDs:**

- Low serum B12 post partum
  - Independent of vitamin use, dietary B12/folate, RBC folate
  - Decreasing risk with increasing B12 levels
- *High blood insulin levels post partum*
  - Independent of hyperglycemia, obesity
- High serum homocysteine levels post partum
  - Independent of RBC folate, serum B12
- *Low serum ferritin post partum*
- *Stress in the periconceptional period*
- *Diabetes in the periconceptional period*
- Dieting in the periconceptional period
- Periconceptional fever/hyperthermia
- Genetic polymorphisms, including for enzymes in FA pathway
- *Novel findings*

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**Brazil warns against pregnancy due to spreading virus**

![Map of Brazil showing affected areas]

*Source: [WHO](http://www.who.int)*
**Pan-American Health Organization Epidemiological Alert: Dec. 1, 2015**

“Given the increase of congenital anomalies ... in areas where Zika virus is circulating and their possible relation to the virus, the PAHO/WHO recommends its Member States establish and maintain the capacity to detect and confirm Zika virus cases, prepare healthcare facilities for the possible increase in demand... and [to] strengthen antenatal care.”

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**Zika Virus: Vector and Transmission**

- Zika virus is transmitted by *Aedes aegypti* and *Aedes albopictus* mosquitos
  - *Aedes aegypti* mosquitos are also primary vectors of Dengue virus, Chikungunya virus, and yellow fever virus (CDC)
  - *Aedes* species are day-feeders that live in close proximity to humans (CDC)
  - Both *A. aegypti* and *A. albopictus* are present in the USA, primarily in the southeastern region including Texas (CDC)

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**Zika Virus and Microcephaly: Brazil**

- A twenty-fold increase in reported cases of microcephaly among newborns in Northeast Brazil relative to previous years coincides with the advent of autochthonous transmission of Zika virus in Brazil
  - 2000 prevalence: 5.5/100,000 live births
  - 2010 prevalence: 5.7/100,000 live births
  - 2015 prevalence: 99.7/100,000 live births
- Brazilian authorities in November detected Zika virus in blood and tissue samples from a newborn born with microcephaly in Pará

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**Program Resources**
THANK YOU

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