Navajo Birth Cohort Study (NNR# 11.323)

Supplement to Annual Progress Report and Continuation Request

August 16, 2016

Presenters: Debra MacKenzie¹, Ph.D., and Joseph Hoover¹, Ph.D.

Annual Report and Supplement prepared by Eszter Erdei¹, Ph.D., MPH, Chris Shuey², MPH, and Joseph Hoover¹, Ph.D.

Available to answer questions: David Begay³, PhD, Mae-Gilene Begay³, MSW, Malcolm Benally¹, Media Specialist, Johnna Rogers⁴, RN, Lead CCL and other members of the NBCS Field Team

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- Charlotte Swindal, NAIHS Chinle, CCL
- Marcia Tapaha, NAIHS Gallup, CCL
- Roxanne Thompson, NDOH-CHERS
Discussion Points

- NBCS Overview
- Enrollment Data, Follow-up
- Home Environmental Assessments
- Biomonitoring Results
- Micronutrients
- Preliminary Reproductive and Child Developmental Assessment Results
- Media outreach
- Future of the Navajo Birth Cohort Study
- Spatial Analysis of Gold King Mine Release
- Request for Continuation
- Signing NNHRRB Chair of new consents for 2016-2017

In January 2016, President Begaye and VP Nez attended an NBCS briefing and tour of uranium waste sites for NCEH director Patrick Breysse and staff, organized by the Tuba City Regional Health Care Corporation, TCRHCC Board of Directors and NBCS staffers Abigail Sanders and Maria Welch.
Congressional committee outraged over Navajo uranium legacy

By Kathy Helms, Dine Bureau, Gallup Independent, Oct. 24, 2007

WINDOW ROCK – A picture may be worth a thousand words, but the sound of an instrument used to detect radioactive contamination, clicking away over a soil sample from Tuba City, set a federal oversight committee on its ear Wednesday during a hearing in Washington.

Chairman Henry Waxman’s Committee on Oversight and Government Reform heard from a Navajo Nation delegation about the health and environmental impacts of uranium contamination during a four-hour hearing.

Several congressional leaders expressed outrage at the federal government for allowing such conditions to remain unchecked on Navajoland for so many years, saying they were “ashamed” and “embarrassed.” They offered apologies to the Navajo people.
Overview of the Navajo Birth Cohort Study

- Multi-agency, prospective study to assess pregnancy outcomes and child development in relation to uranium waste exposures among Navajo mother-infant pairs
- Cohort characterized with respect to mobility, exposures, co-exposures, demographic and cultural characteristics that may influence birth and developmental outcomes
- Extensive public outreach, communication of results
- NBCS is only cohort study involving Native American children in the U.S.
- Approved by Institutional Review Boards of the Navajo Nation, UNM, Yale Univ., and CDC/ATSDR, and by federal Office of Management and Budget
Navajo Birth Cohort Study
Cooperating Organizations

DiNEH Project Team
- UNM Community Environmental Health Program (CEHP)
- UNM Pediatrics Department, Center for Development and Disability
- Southwest Research and Information Center (SRIC)
- Consultants

Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry

Birth Cohort
Navajo mothers, fathers and babies; other community members; chapters

With Help From

Navajo Area Indian Health Service (NAIHS)
PL93-638 Facilities (Tséhootsooí, Tuba City)

Navajo Nation Department of Health

Growing in Beauty (developmental disabilities services provider)

Other Navajo Nation Agencies
Environmental Protection Agency, WIC, Health Education, Office of Uranium Workers

USEPA Region 9
NBCS Eligibility Criteria

- Any beneficiary of IHS health care services
- Have lived on the Navajo Nation for at least 5 years
- 14 to 45 years of age
- Confirmed pregnancy
- Plan to receive prenatal care and deliver at one of the participating facilities
- Willing to allow follow-up of the newborn baby for the first year
Enrollment increased in past year

Updated: July 18, 2016

Changes in NBCS Enrollments between 2015 and 2016

<table>
<thead>
<tr>
<th>Participant</th>
<th># Enrolled as of 7/13/15</th>
<th># Enrolled as of 7/18/16</th>
<th>Net Increase</th>
<th>% Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mothers</td>
<td>507</td>
<td>704</td>
<td>197</td>
<td>39.5</td>
</tr>
<tr>
<td>Fathers</td>
<td>161</td>
<td>211</td>
<td>50</td>
<td>31.1</td>
</tr>
<tr>
<td>Babies</td>
<td>367</td>
<td>574</td>
<td>207</td>
<td>56.4</td>
</tr>
<tr>
<td>TOTALS</td>
<td>1,035</td>
<td>1,489</td>
<td>454</td>
<td>43.9</td>
</tr>
</tbody>
</table>

Mother Enrollments by Service Unit Hospital, 2015 and 2016

<table>
<thead>
<tr>
<th>Service Unit</th>
<th># Enrolled as of 7/13/15</th>
<th># Enrolled as of 7/18/16</th>
<th>Net Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinle</td>
<td>220</td>
<td>310</td>
<td>90</td>
</tr>
<tr>
<td>Gallup</td>
<td>57</td>
<td>105</td>
<td>48</td>
</tr>
<tr>
<td>Kayenta</td>
<td>11</td>
<td>23</td>
<td>12</td>
</tr>
<tr>
<td>Shiprock*</td>
<td>48</td>
<td>49</td>
<td>1</td>
</tr>
<tr>
<td>Tséhootsooi*</td>
<td>50</td>
<td>52</td>
<td>2</td>
</tr>
<tr>
<td>Tuba City</td>
<td>121</td>
<td>165</td>
<td>44</td>
</tr>
<tr>
<td>TOTALS</td>
<td>507</td>
<td>704</td>
<td>197</td>
</tr>
</tbody>
</table>

*New enrollments ceased at Shiprock and Tséhootsooi in September 2015.

Enrollment data cited in these tables are derived from weekly reports prepared by UNM QA/QC Officer Carla Chavez, based on data abstracted from the NBCS REDCap database.
Enrollment Map (current thru 7/27/16)

Map by Joseph Hoover, PhD
NBCS field staff (CHERS, RFS, CCLs) conduct surveys, collect environmental and biological data for redundancies in exposure and health assessments

<table>
<thead>
<tr>
<th>Event</th>
<th>Staffing</th>
<th>Timing</th>
<th>Content</th>
<th>N (% of eligible)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enrollment Survey</td>
<td>CHERS (photos at L), RFS</td>
<td>Prenatal period</td>
<td>Participant and family lifetime uranium exposures, occupations, water &amp; land use, health histories, demographics</td>
<td>Mother: 484 (70%) Father: 154 (73%) (7/13/16)</td>
</tr>
<tr>
<td>Home Environmental Assessment (HEA)</td>
<td>RFS (photos below)</td>
<td>Prenatal period preferred</td>
<td>Outdoor &amp; indoor gamma radiation screenings; indoor radon; metals on dust wipe samples from 2 locations; drinking water use (Analyses of dust wipes, water samples @ USEPA-9 lab)</td>
<td>528 homes of 704 enrolled mothers: 75% (7/15/16)</td>
</tr>
<tr>
<td>Biomonitoring</td>
<td>CCLs</td>
<td>Pre- and post-natal</td>
<td>Blood, serum, urine for 36 metals, metalloids, micronutrients; meconium for alcohol metabolites (Biomonitoring analyses at CDC lab, Atlanta, GA)</td>
<td>Mother Enr: 492 (71%) Father Enr: 167 (84%) Baby Del:: 316 (58%) (7/13/16)</td>
</tr>
</tbody>
</table>

At left, Community Health and Environmental Research Specialists (CHERS)

Research Field Staff (RFS) – from left, Lynda Lasiloo, Teddy Nez, Sandy Ramone, Maria Welch.

All photos above by C. Shuey. L: Enrollment survey; middle: HEA; R: blood sample processing in hospital lab.
Home Environmental Assessments

Purpose: To ascertain participants’ exposures to contaminants in and around their homes. Major contaminant categories are gamma radiation, radon, metals in dust and contaminants in drinking water. All exposure pathways considered.

HEAs Conducted by Service Unit, 2013-2016 (thru 7/15/16)

<table>
<thead>
<tr>
<th>Location</th>
<th>HEAs Conducted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuba City</td>
<td>129</td>
</tr>
<tr>
<td>Ft. Defiance</td>
<td>40</td>
</tr>
<tr>
<td>Shiprock</td>
<td>47</td>
</tr>
<tr>
<td>Kayenta</td>
<td>21</td>
</tr>
<tr>
<td>Gallup</td>
<td>71</td>
</tr>
<tr>
<td>Chinle</td>
<td>220</td>
</tr>
</tbody>
</table>

Contaminants exceeding screening guidelines and percentage of homes having detectable levels of uranium in indoor dust (results through 7/15/16)

- Gamma Radiation (502): 2.2%
- Indoor Radon (470): 6.0%
- Drinking Water Standards Exceeded (502): 11.8%
- Metals in dust (487) (thru Batch 44, 5/31/16): 60.4%
- Detectable U in house dust (473) thru Batch 44: 85.0%

Most frequently occurring metals in indoor dusts:
- Lead
- Arsenic
- Iron
- Manganese
- Antimony
- Aluminum
Ingestion: Drinking water exposure concerns, unregulated water sources

- ~30% of Navajo population lack access to regulated drinking water (frequency among NBCS participants ~19%)
- Water quality data compiled from ~500 unregulated sources show 15% exceed arsenic MCL (map A), 13% exceed uranium MCL (map B), often co-located (Hoover et al., accepted)
- In contrast to previous studies, only 5% of NBCS participants report drinking from unregulated sources

Maps by J. Hoover, UNM-CEHP
Challenges determining drinking water exposures among participants whose homes are on Public Water Supplies (data through 6/26/16)

<table>
<thead>
<tr>
<th>System Name (Utility)</th>
<th>PWSID</th>
<th>Estimated Pop. Served (2015 except as noted)</th>
<th>Years</th>
<th>Contaminants Exceeding MCLs</th>
<th># NBCS Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aneth (NTUA)</td>
<td>NN4900220</td>
<td>1,521</td>
<td>2012</td>
<td>arsenic</td>
<td>1</td>
</tr>
<tr>
<td>Arizona Windsong Water Co. (AWWC)</td>
<td>AZ0401009</td>
<td>304 (2005)</td>
<td>2003-15</td>
<td>uranium</td>
<td>1</td>
</tr>
<tr>
<td>Cameron (NTUA)</td>
<td>AZ0403010</td>
<td>795</td>
<td>2012-14</td>
<td>Trihalomethanes</td>
<td>4</td>
</tr>
<tr>
<td>Cottonwood (NTUA)</td>
<td>NN0403021</td>
<td>1,329</td>
<td>2012-14</td>
<td>arsenic</td>
<td>8</td>
</tr>
<tr>
<td>Lukachukai (NTUA)</td>
<td>NN0403047</td>
<td>1,617</td>
<td>2012-14</td>
<td>arsenic, lead</td>
<td>8</td>
</tr>
<tr>
<td>Nav-Ft.Def-WRock (NTUA)</td>
<td>NN0403000</td>
<td>14,373</td>
<td>2012-14</td>
<td>uranium</td>
<td>8</td>
</tr>
<tr>
<td>Red Mesa (NTUA)</td>
<td>NN4903017</td>
<td>1,033</td>
<td>2013(c)</td>
<td>arsenic</td>
<td>4</td>
</tr>
<tr>
<td>Round Rock (NTUA)</td>
<td>NN0403023</td>
<td>868</td>
<td>2013</td>
<td>radium total</td>
<td>4</td>
</tr>
<tr>
<td>Shonto (NTUA)</td>
<td>NN0400322</td>
<td>449</td>
<td>2014</td>
<td>fluoride</td>
<td>5</td>
</tr>
<tr>
<td>Mariano Lake- Pinedale-Churchrock (NTUA)</td>
<td>NN3500211</td>
<td>4,692</td>
<td>2013</td>
<td>fluoride</td>
<td>14</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>26,981</td>
<td></td>
<td></td>
<td>57</td>
</tr>
</tbody>
</table>

- ~11% of NBCS participants drink from public water supplies (PWS) not in compliance with MCLs during their pregnancies
- Inexact measurement of drinking water exposure: use average annual contaminant concentrations in Consumer Confidence Reports
- Have not determined if U in drinking water is correlated with U in participants’ urine
Inhalation: Highest indoor radon concentrations scattered throughout Navajo Nation; levels greatest in winter months (based on indoor radon tests conducted through July 28, 2016)

- Only ~6% of NBCS homes had Rn levels > 2.7 pCi/l
- NBCS referral level
- Range 0.1 - 13.7 pCi/l
- Ave. Rn level = 1.0 pCi/l
Inhalation: Indoor dust increases exposures to metals among parents and babies

- 85% of homes tested have detectable levels of U in indoor dust
- Highest levels of uranium in indoor dust distributed more or less evenly throughout the Navajo Nation
- Map data based on dust wipe samples collected through May 31, 2016 with results reported by USEPA July 7, 2016

Map by J. Hoover, UNM-CEHP
Inhalation: Metals observed in indoor dust above Screening Guideline Values (SGVs) and distribution in homes across service units (results through Batch 44, 5/31/16)

<table>
<thead>
<tr>
<th>Metal</th>
<th>Symbol</th>
<th>SGV (in µg/m²)</th>
<th>Tests ≥ SGV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum (#6)</td>
<td>Al</td>
<td>653,720</td>
<td>74</td>
</tr>
<tr>
<td>Antimony (#5)</td>
<td>Sb</td>
<td>261</td>
<td>84</td>
</tr>
<tr>
<td>Arsenic (#2)</td>
<td>As</td>
<td>163</td>
<td>174</td>
</tr>
<tr>
<td>Barium</td>
<td>Ba</td>
<td>45,760</td>
<td>6</td>
</tr>
<tr>
<td>Beryllium</td>
<td>Be</td>
<td>1,307</td>
<td>0</td>
</tr>
<tr>
<td>Boron</td>
<td>B</td>
<td>313,578</td>
<td>1</td>
</tr>
<tr>
<td>Cadmium</td>
<td>Cd</td>
<td>649</td>
<td>6</td>
</tr>
<tr>
<td>Chromium</td>
<td>Cr</td>
<td>1,961</td>
<td>18</td>
</tr>
<tr>
<td>Cobalt</td>
<td>Co</td>
<td>13,074</td>
<td>0</td>
</tr>
<tr>
<td>Copper</td>
<td>Cu</td>
<td>26,148</td>
<td>11</td>
</tr>
<tr>
<td>Iron (#4)</td>
<td>Fe</td>
<td>392,232</td>
<td>125</td>
</tr>
<tr>
<td>Lead (#1)</td>
<td>Pb</td>
<td>270</td>
<td>330</td>
</tr>
<tr>
<td>Manganese (#3)</td>
<td>Mn</td>
<td>13,704</td>
<td>126</td>
</tr>
<tr>
<td>Mercury</td>
<td>Hg</td>
<td>65</td>
<td>3</td>
</tr>
<tr>
<td>Nickel</td>
<td>Ni</td>
<td>13,704</td>
<td>2</td>
</tr>
<tr>
<td>Selenium</td>
<td>Se</td>
<td>3,269</td>
<td>0</td>
</tr>
<tr>
<td>Silver</td>
<td>Ag</td>
<td>3,269</td>
<td>7</td>
</tr>
<tr>
<td>Thallium</td>
<td>Ti</td>
<td>46</td>
<td>1</td>
</tr>
<tr>
<td>Tin</td>
<td>Sn</td>
<td>470,366</td>
<td>0</td>
</tr>
<tr>
<td>Uranium</td>
<td>U</td>
<td>3,135.8</td>
<td>0</td>
</tr>
<tr>
<td>Vanadium</td>
<td>V</td>
<td>4,576</td>
<td>1</td>
</tr>
<tr>
<td>Zinc</td>
<td>Zn</td>
<td>196,116</td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Service Unit</th>
<th>Homes with No Metals in Dust</th>
<th>Homes with at least 1 Metal in Dust ≥SGV</th>
<th>% Homes with Metal Contamination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinle</td>
<td>58</td>
<td>125</td>
<td>68.3</td>
</tr>
<tr>
<td>Ft. Defiance</td>
<td>13</td>
<td>33</td>
<td>71.7</td>
</tr>
<tr>
<td>Gallup</td>
<td>32</td>
<td>30</td>
<td>48.4</td>
</tr>
<tr>
<td>Kayenta</td>
<td>7</td>
<td>11</td>
<td>61.1</td>
</tr>
<tr>
<td>Shiprock</td>
<td>23</td>
<td>21</td>
<td>47.7</td>
</tr>
<tr>
<td>Tuba City</td>
<td>60</td>
<td>74</td>
<td>55.2</td>
</tr>
<tr>
<td>All Service Units</td>
<td>193</td>
<td>294</td>
<td>60.4</td>
</tr>
</tbody>
</table>
Inhalation: Use of wood- and coal-burning stoves appear to contribute to elevated metals in indoor dust

Heat sources and metals-in-dust
(N=478 homes; dust-metal results through Batch 44, 5/31/16)

<table>
<thead>
<tr>
<th>Heat sources and metals-in-dust</th>
<th>No metals $\geq$SGVs</th>
<th>At least 1 metal $\geq$SGV in 1 room</th>
<th>At least 1 metal $\geq$SGV in 2 or more rooms</th>
<th>% Homes w/ Metal Contamination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood or wood pellet only or wood-coal, or coal only burning stoves</td>
<td>86</td>
<td>163</td>
<td>74</td>
<td><strong>73.4</strong> (237/323)</td>
</tr>
<tr>
<td>No wood-coal burning stove; other heat source(s), including natural gas and electricity</td>
<td>82</td>
<td>32</td>
<td>6</td>
<td><strong>31.7</strong> (38/120)</td>
</tr>
<tr>
<td>Unknown heat sources or no heat sources</td>
<td>21</td>
<td>9</td>
<td>5</td>
<td><strong>40.0</strong> (14/35)</td>
</tr>
</tbody>
</table>
Biomonitoring Results
**Biological sample collection in NBCS**

- **Purpose:** Obtain biological specimens for exposure assessment while maintaining routine standard of care
- **Specifics on samples from baby:**
  - Cord blood (4 tubes)
  - Meconium when possible: 2 quarter size amounts are enough!
  - Blood from baby at 2-6 months (well-baby visits) and 12 months
  - Urine collected at birth and well-baby clinic visit

<table>
<thead>
<tr>
<th></th>
<th>Blood</th>
<th>Urine</th>
<th>Meconium</th>
</tr>
</thead>
</table>
| **Mother** | ➢ Enrollment  
            ➢ Delivery                             | ➢ Enrollment  
            ➢ Delivery                             |          |
| **Father** | ➢ Enrollment                                | ➢ Enrollment                               |          |
| **Baby**   | ➢ Birth (cord blood)  
            ➢ 2-6 months of age  
            ➢ 12 months of age | ➢ Birth  
            ➢ 2-6 months of age  
            ➢ 12 months of age | ➢ Birth |
Biomonitoring for the NBCS samples

- To understand relationships between uranium exposures and birth outcomes and early developmental delays

- Why are we looking at so many metals?
  - To fully understand uranium exposures on health
    - U wastes are a combination of a wide range of metals
    - Metals often interact through similar toxicity pathways (arsenic and antimony, arsenic and uranium)
  - To identify other metals of potential health concern on the Navajo Nation
  - Metals from other than mining wastes sources
Biomonitoring results:

Urine-uranium among NBCS participants shifted to the right of the US NHANES average

- 21% of study participants have urine uranium concentrations greater than the US 95th percentile
  - NHANES national averages, 2011-12
  - 95th percentile is 0.031 micrograms per liter

- Father enrollment: 36%
- Mother enrollment: 24%
- Mother delivery: 17%
- Babies
  - Birth: 0.6%
  - 6 months: 17%
  - 12 months: 24%

Babies show continual increase over the first year of life.
Elevated urine-uranium levels, when compared with NHANES 50th and 95th percentile concentrations, occur in all service units without correlation with uranium mining areas.
Urine total arsenic distribution for NBCS mothers, fathers and infants has lower mean and 95th percentile levels than the US population (NHANES).

This finding is surprising because arsenic is
► component of mine wastes
► prevalent in home dust
► most frequent contaminant exceeding MCL in water sources

However, arsenic below the 95th percentile may be harmful over time

Similarly, blood lead (not depicted in graph here) for NBCS mothers, fathers and infants is lower than the mean and 95th percentile for the US population. Lead is the most frequently occurring metal exceeding its screening value in indoor dust.
Other metals for which NBCS distribution is greater than mean levels in US adults, based on NHANES data

<table>
<thead>
<tr>
<th>Metal</th>
<th>Attributes</th>
</tr>
</thead>
</table>
| Manganese            | • Higher than expected in babies (blood and urine)  
• Neurotoxicant  
• Among more frequently occurring metals exceeding screening values in indoor dust                                                                                                                                                                                   |
| Mercury (inorganic and total) | • Of concern due to coal burning in regional power plants and in homes  
• Known neurotoxicant  
• Elevated above US population for moms, dads, **babies at birth**                                                                                                                                                                                                 |
| Antimony             | • Replaced cadmium in solder; used in semiconductors, alloys, hardens lead in batteries, used as fire retardant  
• Toxicity to lungs, skins, liver, cardiovascular system reported, potential carcinogen  
• Similar mechanism of action to arsenic – increased DNA damage; hypothesized to inhibit repair enzymes  
• Among more frequently occurring metals exceeding screening values in indoor dust  
• Elevated in moms, dads, **babies**                                                                                                                                                                                                 |
| Tin                  | • Combustion byproduct of coal, waste; common in dusts  
• Toxicity relatively low – some reproductive and neurotoxic studies                                                                                                                                                                                                                                                                  |
| Tungsten             | • Used in bullets, fishing weights, darts, golf clubs, grinding wheels, cutting tools, light bulbs  
• Used to replace depleted uranium in armour penetrating weapons, lead in bullets  
• Often alloyed with nickel, copper – toxicity not well studied for metal or alloys  
• Only elevated in babies at birth!                                                                                                                                                                                                                                           |
Metal micronutrients
first assessment on Navajo since 1981
Micronutrient status:

NBCS Mothers are *iodine insufficient*

→ Iodine necessary for proper neurodevelopment

### Legend

- **Insufficient Iodine**
  - <100 µg/L adults and children
  - <150 µg/L pregnant women (WHO, 2007)

- **Adequate Iodine**
  - 100-200 µg/L adults and children
  - 150-250 µg/L pregnant women

- **Above Iodine Requirement**
  - >200 µg/L adults and children
  - >250 µg/L pregnant women

### NBCS Participants

- **Fathers**
  - n=151
  - Urinary Iodine GM = 140 µg/L

- **Infants**
  - n=120
  - Urinary Iodine GM = 100 µg/L

- **Pregnant Women**
  - n=307
  - Urinary Iodine GM = 96 µg/L

**Urinary Iodine Concentration (µg/L)**

0 50 100 150 200 250 300
Iodine insufficiency

- Iodine used as a population-level biomarker; daily variability exists
- Key for organogenesis and neurodevelopment
- ~ 40% below WHO sufficiency level
- Dietary sources of iodine – fish, dairy, wheat – low in Colorado Plateau soils

**NBCS Levels of UIO (Iodine - Urine), ug/L**

n=18 Outliers above 1200 ug/L are not shown on the plot:
Mothers: 11 at Enrol (ME), 3 at Del (MD), 2 Fathers, Babies: 1 at Birth, 1 at 12m
Zinc (Zn) insufficiency

- 364 of 595 NBCS Mothers (61.1%) below WHO Zn sufficiency level
- Important in DNA repair (As and U toxicity), coenzyme
- Tends to be lower in pregnant women, particularly mothers of several children
- Prenatal vitamins seem unrelated
- We have a new study to check function, not just level in serum
Nutrient Status During Pregnancy

Nutrient status generally improved over what was reported in 1981 (last published study on 22 pregnant Navajo women’s nutritional status)

Some key nutrients (e.g. folate, vitamin D) still lower than recommended for good fetal development

NOTE: Still missing many delivery weights, so normalization not yet complete

Supported by pilot funding from UNM-CTSC
Preliminary Reproductive and Child Developmental Outcomes
Selected Reproductive Outcomes – Preliminary Data

Current pregnancy information – based on enrollment data thru 8/1/16

- Miscarriages: 16 of 710 enrolled mothers; 2.25%
- Stillbirth: 1 of 710 enrolled mothers; 0.14%
- Neonatal death of child: 3 of 710 enrolled mothers; 0.42%

Information on mothers’ previous pregnancies (based on 310 Medical Record reviews by CCLs):

<table>
<thead>
<tr>
<th>Cases/Records</th>
<th>% NBCS</th>
<th>% US (NVSR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premature births</td>
<td>32/310</td>
<td>10.3</td>
</tr>
<tr>
<td>Stillbirth</td>
<td>8/310</td>
<td>2.6</td>
</tr>
<tr>
<td>Neonatal death of previous baby</td>
<td>10/310</td>
<td>3.2</td>
</tr>
</tbody>
</table>

- Will link these records to biomonitoring information – one of the goals of NBCS
- Comparison with National Vital Statistics Reports (NVSR); *work in progress
Child Developmental Assessments: Ages and Stages Questionnaire-Inventory (ASQ-I)

Preliminary results of ASQ-I and biomonitoring analyses

- CHERS and RFS completing ASQ-I’s at babies’ 2, 6, 9 and 12 months old
- CCLs help track participants for timely administration of ASQs
- Preliminary results:
  - 71 complete records with ASQ data and mothers’ delivery biomonitoring data
  - Child’s total blood mercury level was significant predictor of failure in any ASQs up to 12-month of age of the child
    - Estimate: 5.30, $p$-value: 0.045
  - Child’s urine uranium level was part of the statistical model, but was not a significant predictor variable
    - Estimate: 0.410, $p$-value: 0.51
  - Possible interaction between mercury and urine uranium levels was detected; may indicate metal mixtures are important in child development
  - Need larger sample sizes to confirm modeling results
2015-2016 NBCS Outreach and Training Activities

- 30 major outreach events, including NBCS Earth Day Awareness Presentations at Tuba City Chapter House, April 22, 2016 (poster at right)
- Two issues of Iiná Nizhóní newsletter insert to the Navajo Times published in August 2015 and February 2016
- Four quarterly Uranium Collaboration meetings and three reports to NNC Health Education & Human Services Committee
- 63 training sessions for NBCS staff
NBCS videos and media outreach materials on social media

- Women’s Health Minute Public Service Announcements on KTNN
- Blog site at: nbcs.healthyvoices.org
- Informational videos previewed by NNHRRB Chairperson Beverly Becenti-Pigman
Gold King Mine Release

NBCS participants in impacted chapters present opportunities for future assessment of long-term health effects

- Biomonitoring and home environmental data collected for ~20 participants who live near San Juan River
- Builds on existing partnerships and community presence through Navajo Birth Cohort Study

NIH Center of Excellence on Environmental Health Disparities Research (1P50ES026102-01)
Geospatial Data Visualization

- Visualized movement of metal plume down the Animas River into San Juan River
- Total Iron (Fe) concentrations shown in time-sequence maps at left
- Observed possible re-mobilization of metals around Mexican Hat

Data source: Total metal results by USEPA Regions 6, 8 and 9
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- 110 chapters
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