Some Changes in the Landscape

- Older Age
- Assisted Reproduction
- Obesity Epidemic
- Compromised Food Chain (metals, ‘poc’)
- Injury-Violence
- Mental Health
- Air Quality
- Disparity Gaps Widen

- “Epidemiology Toolkit” expands in impressive ways
  - Biochemical markers
  - SNPS to GWAS
  - Whole genome microarrays (mRNA, miRNA)

- National Children’s Study
Noting that 300 contaminants have been detected in umbilical cord blood of newborn babies, the study warns that: “to a disturbing extent, babies are born ‘pre-polluted.’”

“Accumulation of CVD risk begins early in life, and evidence on rising rates of childhood obesity and youth smoking in low and middle income countries as well as emerging evidence on the effects of early nutrition on later CVD health support the value of starting health promotion efforts during pregnancy and early childhood and continuing prevention efforts throughout the life course.”
Obesity and overweight have been increasing in US young women since the 1960s (CDC 2005).
Death from INJURY accounted for up to ½ of Maternal Deaths

- 48% of injury related deaths were intentional (homicide and suicide)
Center for Perinatal Studies (CPS) - established in 1992

Co-Directors: 
Michelle Williams & Tanya Sorensen

Multidisciplinary team -
Perinatology, neonatology, molecular biologists, biochemists, epidemiologists, statisticians, physiologists, obstetric ultrasound, obstetric pathology, neurology

Locally, nationally and internationally recognized for - clinical and research excellence and innovation
Center for Perinatal Studies

Collaborating Institutions and Partners include:

SMC - Based Clinicians

**University of Washington**, Tulane University, Harvard University

Fred Hutchinson Cancer Center

Tacoma General Hospital

Ministry of Health, **Peru**

Peking University Medical School, **China**

University of Zimbabwe, **Zimbabwe**

Thai Nguyen Medical College/Center, **Vietnam**

Addis Ababa University, **Ethiopia**

Chulalongkorn University, **Thailand**
MIRT Program 1994-Present

**Mandate-1:** to increase number of diversity students going into academic leadership positions in public health/global health

**Mandate-2:** strengthen academic institutions in developing countries
SHARED MISSION

…to increase knowledge about the causes and consequences of adverse pregnancy outcomes; and to use this knowledge to reduce the burden of morbidity and mortality in maternal and infant populations, locally, nationally and worldwide.

We work towards these ambitious goals by contributing to:

- Research
- Teaching
- Service
Program Focus

Clinical and Translational Research

• Improved screening methods to detect high risk pregnancies
• Evaluation of active management of labor

Epidemiological Research

• Identify modifiable (lifestyle, environmental factors) that predict outcomes of pregnancies

  Example: exercise, diet, mercury, air pollution, violence

Basic/Discovery Research

• Search for genomic and proteomic signatures predictive of adverse pregnancy outcomes
• Evaluate how these signatures may be used to identify new screening and treatment modalities
Pregnancy is characterized by profound metabolic and other physiological alterations involving virtually every maternal organ system.
Physiological Lipid Changes in Pregnancy

- Estrogen $\uparrow$ 16-fold; Progesterone $\uparrow$ 7-fold (by 30 weeks’ gestation)
- Every aspect of lipid metabolism is influenced by pregnancy:
  - Plasma CH $\uparrow$ 1.5-fold
  - Plasma TG $\uparrow$ 2-3 fold (mainly in 2nd and 3rd trimester)
  - HDL decreases (after 24 weeks)
  - HDL, LDL, VLDL and become MORE TG-enriched ($\uparrow$ 5-fold)
Other Changes in Pregnancy

**Insulin Sensitivity:**

- Insulin sensitivity in late pregnancy (> 28 weeks gestation) is ↓ by 45-70% reaching values commonly seen in type 2 diabetes (T2DM) in non-pregnant women and men

Pregnancy - stress test

Failure manifest as medical complications (e.g., gestational diabetes/hypertension)

Reproductive history - Informative of chronic disorders
Preeclampsia (PE)

- Common Complication of Pregnancy (3-7%)

- PE is characterized by:
  - New onset hypertension
  - Renal function decline
  - Inflammation, insulin resistance, tissue hypoxemia
  - Fetal growth restriction

- Risk Factors: Obesity, advanced maternal age, primiparity, multi-fetal pregnancies are common risk factors

- Across Life Course: Women with PE increased risks of CVD
Working Conceptual Model

Modifiable Factors
- Dietary
  - Antioxidants
  - Vitamin D
- Fiber
- Fat
- Carbohydrate

Other Life Style
- Physical activity
- Sleep

Metabolic State
- Obesity

Biochemical Markers
- Antioxidants
- Lipid profiles
- Inflammatory
- Adipocytokines
  ...

Genetic Determinants

Pregnancy OUTCOME
- GDM
- PE
  ...

Future Health Status:
- newborn
- mother
Pathophysiology/ Epidemiology Research Strategy –

Is EXPOSURE “A” Associated with OUTCOME “C”? …if so, HOW? Is it via Influence on “B”?

**A**

- Intrinsic/ Extrinsic Factors
- Genetics/Family Hx
- Parity/Obesity
- Diet/Exercise
- CHBP/DM
- Psychosocial Stress
- Solvents/Tobacco etc

**B**

- Placental Hypoxemia
- Pro-inflammatory State
- Oxidative Stress
- **Hyper-Leptin**
- Insulin/tHcy
- **Hyper-TG/Hypo-HDL**
- Altered PGI/TXA Ratio
- Endothelial Dysfunction

**C**

- Maternal Outcome
- **Preeclampsia**

Is PA associated with plasma **TG, HDL**, Leptin ox-LDL sVCAM-1, etc. in Early Pregnancy?
Prospective Cohort Study

- Seattle
- Enrolled: 5,000+ women
- Participation rate: 78%
- Follow-up: 94%
- Interview, Blood, Urine, Placenta, DNA, RNA

Case-Control Studies

- Seattle, 600+ Women
- Harare, Zimbabwe 500+ Women
- Lima, Peru 1000+ Women
- Thai Nguyen, Vietnam 600+ Women
- Bangkok, Thailand 700+ Women

- Interview, Blood, ±Placenta, ± DNA, ± RNA
Abnormal Lipid Profiles in the Pathophysiology of Preeclampsia
Is Dyslipidemia Associated with Preeclampsia Risk? –

**A**
- Intrinsic/Extrinsic Factors
  - Genetics/Family Hx
  - Parity/Obesity
  - Diet/Exercise
  - CHBP/DM
  - Psychosocial Stress
  - Solvents/Tobacco etc

**B**
- Placental Hypoxemia
- Pro-inflammatory State
- Oxidative Stress
- Hyper-Leptin
- Insulin/tHCY
- Hyper-TG/Hypo-HDL
- Altered PGI/TXA Ratio
- Endothelial Dysfunction

**C**
- Maternal Outcomes
- Preeclampsia

Is **Dyslipidemia** associated with Preeclampsia?
Plasma CH ➲ 1.5-fold

Plasma TG ➲ 2-3 fold (mainly in 2nd and 3rd trimester)
Women with the highest levels of TG had a 4.5 fold increased risk of PE as compares with those with the lowest levels. The test for linear trend in risk was significant (P for trend < 0.001) (Williams et al, Am J Hypertension, 2004.)

<table>
<thead>
<tr>
<th>Plasma TG (mg/dl)</th>
<th>PE Cases n</th>
<th>Controls n</th>
<th>Adjusted OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 91</td>
<td>19</td>
<td>50</td>
<td>1.0 (reference)</td>
</tr>
<tr>
<td>91 - 113</td>
<td>29</td>
<td>45</td>
<td>1.8 (0.8-4.0)</td>
</tr>
<tr>
<td>114 - 136</td>
<td>35</td>
<td>46</td>
<td>1.7 (0.8-3.8)</td>
</tr>
<tr>
<td>&gt; 136</td>
<td>90</td>
<td>45</td>
<td>4.5 (2.2-9.2)</td>
</tr>
</tbody>
</table>

Adjusted for age, GA, BMI, parity, Vitamin Use
## Lipids and Preeclampsia in Peru

Women with high levels of Triglycerides had a 5-fold ↑ risk of preeclampsia (PE).

(Ware-Jauregui et al, Int J Gynecol Obstet, 1999)

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<th>Plasma TG (mg/dl)</th>
<th>PE Cases n</th>
<th>Controls n</th>
<th>Adjusted OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 189</td>
<td>14</td>
<td>48</td>
<td>1.0 (reference)</td>
</tr>
<tr>
<td>189 - 233</td>
<td>20</td>
<td>45</td>
<td>1.6 (0.7-3.9)</td>
</tr>
<tr>
<td>234 - 284</td>
<td>29</td>
<td>45</td>
<td>3.1 (1.0-5.1)</td>
</tr>
<tr>
<td>&gt; 284</td>
<td>62</td>
<td>44</td>
<td>5.0 (2.3-11.1)</td>
</tr>
</tbody>
</table>
Summary Data

- Relatively large body of literature suggest that dyslipidemia of pregnancy is exaggerated in PE cases versus normotensive controls.

- Elevated TG is far more consistently observed than elevated Total CH.

- Reasonable consistency seen with regards to reduced HDL-cholesterol concentrations in PE versus controls.

- Patterns (elevated TG, reduced HDL) seen in virtually all populations studies (North American, Asian, Southern African, South American)

- Inferences limited by cross-sectional design: **Cause vs. Consequence?**
Prospective Study - Seattle

- Prospectively Collected pre-diagnostic blood samples (13 weeks gestation N = 851); Nested case-control analysis:
  - Excluded 45 women with pre-existing chronic hypertension
  - Selected all 57 PE cases (ACOG 2000)
  - Randomly selected 510 normotensive controls

- Standard Enzymatic procedures
### Table. Plasma Lipoproteins (mg/dl) Concentrations among PE Cases and Controls **Seattle**, WA, USA, 1996-2000

<table>
<thead>
<tr>
<th>Lipid</th>
<th>PE Cases (N=57)</th>
<th>Control Subjects (N=510)</th>
<th>P-value**</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SE</td>
<td>Mean ± SE</td>
<td></td>
</tr>
<tr>
<td><strong>Total CH</strong></td>
<td>198.1 ± 3.7</td>
<td>190.7 ± 1.6</td>
<td>0.069 3.9%↑</td>
</tr>
<tr>
<td>LDL-CH</td>
<td>107.5 ± 3.0</td>
<td>97.4 ± 1.2</td>
<td>0.002 10.4%↑</td>
</tr>
<tr>
<td>HDL-CH</td>
<td>64.1 ± 1.4</td>
<td>69.0 ± 0.7</td>
<td>0.028 7.0%↓</td>
</tr>
<tr>
<td>LDL/HDL-Ratio</td>
<td>1.7 ± 0.5</td>
<td>1.5 ± 0.3</td>
<td>&lt;0.001 15.5%↑</td>
</tr>
<tr>
<td>TG</td>
<td>137.8 ± 6.7</td>
<td>121.3 ± 2.5</td>
<td>0.024 13.6%↑</td>
</tr>
</tbody>
</table>

Women who subsequently developed PE had 10.4%, 13.6% and 15.5% higher concentrations of LDL-CH, TG and LDL/HDL ratios, respectively, than controls (all p values were <0.05).

Notably, HDL-CH concentrations were 7.0% lower in cases as compared with controls.
Elevated Total TG in early pregnancy is predictive of PE risk later in pregnancy, even after controlling for confounders.


<table>
<thead>
<tr>
<th>Plasma Total TG (mg/dl)</th>
<th>PE Cases</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 93</td>
<td>9</td>
<td>166</td>
</tr>
<tr>
<td>93 - 133</td>
<td>19</td>
<td>170</td>
</tr>
<tr>
<td>&gt; 133</td>
<td>29</td>
<td>174</td>
</tr>
</tbody>
</table>

OR (95% CI)

1.0 (reference)

2.3 (0.8-6.3)

4.2 (1.4-11.4)

Adjusted for maternal age, parity, race, BMI at blood collection, gestational age at blood collection, physical activity during pregnancy, and hours since last meal at blood collection.

Dyslipidemia Precedes Diagnosis of PE
SO……Is Dyslipidemia Associated with Preeclampsia Risk? – YES

A

Intrinsic/Extrinsic Factors
- Genetics/Family Hx
- Parity/Obesity
- Diet/Exercise
- CHBP/DM
- Psychosocial Stress
- Solvents/Tobacco etc

B

- Placental Hypoxemia
- Pro-inflammatory State
- Oxidative Stress
- Hyper-Leptin
- Insulin/tHcy
- Hyper-TG/Hypo-HDL
- Altered PGI/TXA Ratio
- Endothelial Dysfunction

C

Maternal Outcomes
- Preeclampsia

Is Dyslipidemia associated with Preeclampsia YES
Relationship of Maternal Plasma Lipids, Physical Activity and Risk of Preeclampsia
# Pathophysiology/Epidemiology Research Strategy – Does PA ↓ PE Risk?

## A) Intrinsic/Extrinsic Factors
- Genetics/Family Hx
- Parity/Obesity
- Diet/Exercise
- CHBP/DM
- Psychosocial Stress
- Solvents/Tobacco etc

## B) Placental Hypoxemia
- Pro-inflammatory State
- Oxidative Stress
- Hyper-Leptin
- Insulin/tHcy
- Hyper-TG/Hypo-HDL
- Altered PGI/TXA Ratio
- Endothelial Dysfunction

## C) Maternal Outcomes
- Preeclampsia
Epidemiological/Clinical and Experimental literature point to favorable physiological changes and overall health benefits of regular leisure time PA in men and non-pregnant women.

**Benefits include:**
- Favorable lipid/lipoprotein profile
- Favorable systolic and diastolic blood pressures
- Favorable endothelial function, glycemic control
- Reduced risk of hypertension, coronary heart disease
- Reduced risk of type 2 diabetes and certain cancers
Three published studies of recreational physical activity and preeclampsia risk: Marcoux (1989); Sorensen (2003); and Saftlas (2004)
Does PA Reduce the Risk of Preeclampsia?

- Physical activity and preeclampsia
- Regular activity in early pregnancy associated with reduced risk in 2 case-control and 1 cohort studies
  - Marcoux 1989: OR=0.67 (95% CI 0.46-0.96)
  - Sorensen 2003: OR=0.65 (95% CI 0.43-0.99)
  - Saftlas 2004: OR=0.66 (95% CI 0.35-1.22)
- Inverse relations with time, intensity, and energy expenditure in two studies

Likely, YES
Pathophysiology/ Epidemiology Research Strategy – How Does PA ↓ PE Risk? …if so, HOW?

Intrinsic/ Extrinsic Factors
Genetics/Family Hx
Parity/Obesity
Diet/Exercise
CHBP/DM
Psychosocial Stress
Solvents/Tobacco

Biologically plausible associations are reinforced by mechanistic studies (increasing evidence documenting known effects of PA on metabolic profile)

Is PA associated with plasma lipids etc. in early pregnancy?

Maternal Outcomes
Preeclampsia

Placental Hypoxemia
Pro-inflammatory State
Oxidative Stress
Hyper-Leptin
Insulin/tHCY
Hyper-TG/Hypo-HDL
Altered PGI/TXA Ratio
Endothelial Dysfunction
Mechanistic Considerations

Lipids & Physical Activity

Figure 4. Mean maternal plasma triglyceride and total cholesterol concentrations according to recreational physical activity energy expenditure (metabolic equivalent [MET] h·wk$^{-1}$) (2).

(Butler, et al, AJE 2004)
PA in early pregnancy is generally associated with lower non-fasting plasma TG (regardless of BMI) 

*(Butler, et al, AJE 2004)*
Can Physical Activity Influence Plasma Lipid Concentrations in Early Pregnancy? – Apparently YES

Biological plausibility of PA-PE association is enhanced
Discussion

- PA, a modifiable protective factor of PE, may represent one non-pharmacological means whereby lipid profiles \textit{--and perhaps, PE risk--} may be favorably modified in pregnant women.

- ACOG now provides more precise recommendations regarding health benefits of PA in pregnancy.

- Stronger recommendation for using PA as an: (1) adjunct to treating GDM; (2) and maintaining physically active lifestyle during pregnancy to reduced risk of PE and GDM.
The Global Challenge of Gender-Based Violence: Physical and Mental Health Consequences of Violence against Women
Why Gender Based Violence?

- “Violence kills and disables as many women (15-44 yrs) as cancer” …

- ”Toll on women’s health surpasses that of MVA and Malaria combined” ---UN 2006

- Consequences - Mother, Child, Family, Society
Five most common causes of maternal death in reporting areas in USA (1980-1985) were:

- Embolism
- Non-obstetric injury
  - Hypertensive disorders of pregnancy
  - Ectopic pregnancy
  - Obstetric hemorrhage

Rochat et al
Intimate Partner Violence - Global

- Australia
- Canada
- Israel
- South Africa
- USA

40-70% of female murder victims are killed by their male partners

Krug 2002
## Lifetime Prevalence of IPV

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Country</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coker</td>
<td>2002</td>
<td>USA</td>
<td>29%</td>
</tr>
<tr>
<td>Jewkes</td>
<td>2002</td>
<td>South Africa</td>
<td>25%</td>
</tr>
<tr>
<td>Change</td>
<td>1999</td>
<td>Egypt</td>
<td>34%</td>
</tr>
<tr>
<td>Koenig</td>
<td>2003</td>
<td>Uganda</td>
<td>30%</td>
</tr>
<tr>
<td>Ahmed</td>
<td>2005</td>
<td>Nigeria</td>
<td>31%</td>
</tr>
<tr>
<td>Ahmed</td>
<td>2005</td>
<td>Sudan</td>
<td>42%</td>
</tr>
</tbody>
</table>
Violence Survey – Lima, Peru

2005–2006

- Any IPV
- Physical IPV
- Sexual IPV
- Emotional IPV

Lifetime:
- Any IPV: 45.1%
- Physical IPV: 34.1%
- Sexual IPV: 28.4%
- Emotional IPV: 8.7%

Current Pregnancy:
- Any IPV: 21.4%
- Physical IPV: 11.9%
- Sexual IPV: 3.9%
- Emotional IPV: 15.6%

Cripe, Sanchez, et al 2009
Young Women Attending College are not Spared Exposure to IPV....

Project Title:
Prevalence and risk factors of gender-based violence female college students in Awassa, Ethiopia.

Partner Institutions:
Addis Ababa University
University of Washington

Results

Any GBV | Physical Violence | Sexual Violence
---|---|---
Lifetime | 59.9% | 46.2% | 54.9%
Since Enrolling in College | 46.1% | 46.2% | 26.3%
Current Academic Year | 40.3% | 22.5% | 35.3%

Arnold, 2009
Consequences of GBV are:
- Devastating
- Diverse
- Multi-Generational

- Lifelong Emotional Distress
- Re-Victimization
- Mood Disorders
- Poor Reproductive Health
- Increased HIV Risk
- Increased Health Care Expenditure
- Poor School performance, high drop-out rates
- Economic Costs
Social Issues in Reproductive Health

Association of intimate partner physical and sexual violence with unintended pregnancy among pregnant women in Peru

Swee May Cripe a,*, Sixto E. Sanchez b, Maria Teresa Perales c, Nally Lam d, Pedro Garcia d, Michelle A. Williams a

<table>
<thead>
<tr>
<th>Severity of physical abuse</th>
<th>Unintended pregnancy</th>
<th>Planned pregnancy</th>
<th>Unadjusted odds ratio (95% CI)</th>
<th>Adjusted odds ratio a (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No abuse</td>
<td>785 (57.1)</td>
<td>516 (69.4)</td>
<td>1.00 (Reference)</td>
<td>1.00 (Reference)</td>
</tr>
<tr>
<td>Moderately severe</td>
<td>383 (27.9)</td>
<td>168 (22.6)</td>
<td>1.50 b (1.21–1.85)</td>
<td>1.43 c (1.15–1.77)</td>
</tr>
<tr>
<td>Severe</td>
<td>206 (15.0)</td>
<td>59 (7.9)</td>
<td>2.30 b (1.68–3.13)</td>
<td>2.17 b (1.57–2.97)</td>
</tr>
</tbody>
</table>

Values are given as number (percentage), or odds ratio (confidence interval).

a Adjusted for maternal age (continuous variable) and parity.
b P<0.0005.
c P=0.001.
Mood Disorders

Depressive Symptoms Among Female College Students Experiencing Gender-Based Violence in Awassa, Ethiopia

Bizu Gelaye
Dodie Arnold
Michelle A. Williams
*University of Washington School of Public Health and Community Medicine*
Miruts Goshu
Yemane Berhane
*Addis Ababa University*

PHQ-9 – used to assess depressive symptoms and score

Gelaye 2008
Ethiopia Study results are consistent with observations reported by -

**Bonomi et al, 2006**
- Predominately non-Hispanic white women in Seattle, WA members of Group Health Cooperative:
- IPV associated with an increased risk of severe depressive symptoms (PR = 2.6; 95% CI 1.9-3.6)
- Physical and/or sexual abuse associated with severe depressive symptoms (PR=4.1; 95% CI 2.45-6.7) to report

**Houry et al, 2006**
- Prospective cohort-study of African American female emergency room patients, reported that physical, sexual and emotional intimate partner abuse was associated with a 5.9-fold increased risk of depressive symptoms (RR=5.9; 95% CI 4.1-8.5).
Violence IS.....

- Ubiquitous

- Diverse (type, severity, perpetrators, etc)

- Has Devastating direct/in-direct impacts on MCH, families, communities, and national economies

- Epidemiological research adds voice and increase urgency to implement effective screening and intervention.....We’re launching a series of large NIH-funded studies to address this important area of women’s health
Gene Expression Profiling
Moving from Theory to Practice
Overarching objective - to demonstrate the feasibility of comparing maternal whole blood gene expression (in early pregnancy) as a way to identify those at high risk of preterm delivery.

Identify differences in patterns of gene expression in peripheral blood cells (PBLs) among 14 women distained to deliver preterm (spontaneous preterm delivery 20 to 34 weeks gestation; sPTD) versus 16 women who subsequently delivered at term (≥37 weeks gestation).

If we can identify high risk patients, perhaps we can avoid some “emergencies”….also we can try to identify new therapeutic targets.
How do the expression profiles of the two groups (preterm vs. full term control) differ?

- We identified **611 candidate genes** that were significantly differentially expressed in maternal early pregnancy PBL.

- **87 candidate genes** differed by more than 2-fold between term and preterm.
Is there a maternal early pregnancy PBL gene expression profile or list of candidate genes that can identify patients with a higher relative risk for sPTD?

These data document the feasibility of using maternal early pregnancy PBL gene expression profiles to predict sPTD risk.

We have an ARRA grant that seeks to develop new bioinformatics tools for this line of research.
Next Steps

- Expand our “Epi toolkit” in preparation for emerging challenges and opportunities over the next 20 years!

- Moving to Translational Research
  - Lifestyle intervention programs
  - Violence prevention programs
  - Empowerment programs for mothers and children exposed to violence
  - Implement & Test risk prediction protocols
Summary

…highly multidisciplinary research group; that is creative, nimble and productive

cutting-edge (integrates new technology) and is relevant to concerns and issues of modern perinatology, disease prevention and health promotion among reproductive age and pregnant women

cross-cuts basic science, environmental, international and public health, and clinical research

Lots of People to Thank.....
## Collaborators

<table>
<thead>
<tr>
<th>Collaborators</th>
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<th>Collaborators</th>
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<tbody>
<tr>
<td>Bizu Gelaye</td>
<td>Dr. Sixto Sanchez</td>
<td>Dr. Tanya Sorensen</td>
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<td>Dr. Naya Frederick</td>
<td>Dr. Nelly Lam</td>
<td>Dr. David Yanez</td>
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<tr>
<td>Dr. Irv Emanuel</td>
<td>Dr. Maria T. Parales</td>
<td>Dr. Mary Lou Thompson</td>
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<tr>
<td>Dr. Irena King</td>
<td>Dr. Pedro Garcia</td>
<td>Dr. Swee May Cripe</td>
</tr>
<tr>
<td>Dr. Wendy Leisenring</td>
<td>Dr. Berhane Yemane</td>
<td>Dr. Annette Fitzpatrick</td>
</tr>
<tr>
<td>Dr. Chunfang Qiu</td>
<td>Dr. Carole Rudra</td>
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</tr>
<tr>
<td>Dr. Daniel Enquobahrie</td>
<td>Dr. Jane Koenig</td>
<td>Dr. David Siscovick</td>
</tr>
</tbody>
</table>

![Image of children in a classroom](image-url)
Research Staff - Then
Research Staff - Now
Special Thanks to:

Todd & Alex
Thank You....