Infant Mortality Research Partnership

Dr. Steve Gabbe, MD
The Ohio State University Wexner Medical Center
Task 4 Project Team

• Dr. Steven Gabbe, M.D. (PI)
• Dr. Courtney Hebert, M.D., M.S., Project Manager
• Dr. Peter Embi, M.D., M.S.
• Dr. Pat Gabbe, M.D., MPH, M.S.
• Dr. Stan Lemeshow, PhD, MSPH
• Dr. Becky Reno, PhD, M.S.W., M.A.
### Subject Matter Experts Assignments

<table>
<thead>
<tr>
<th>Name</th>
<th>University</th>
<th>Task Assigned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kristin Baughman, PhD</td>
<td>Northeast Ohio Medical University</td>
<td>1 &amp; 4</td>
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<tr>
<td>Eric Hall, PhD</td>
<td>University of Cincinnati</td>
<td>1 &amp; 4</td>
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<tr>
<td>Rose Maxwell, PhD</td>
<td>Wright State University</td>
<td>3 &amp; 4</td>
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<tr>
<td>Sarah Rubin, PhD</td>
<td>Ohio University</td>
<td>2 &amp; 4</td>
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Purpose

• General coordination and facilitation for the IM Research Partnership
• Provide guidance to the leadership of Tasks 1, 2 and 3 to advance the IM Partnership goals
• Validate and synthesize the data from Tasks 1 through 3 to develop a final comprehensive data display system for the project sponsors
Data Display System

- Data Display System of the IMRP research findings
  - Incorporating models contributed by Tasks 1, 2 and 3;
  - Allow users to manipulate parameters in the user interface in order to create and compare alternate scenarios;
  - Allow users to use interfaces to view results and manipulate parameters at multiple levels of analysis;
  - Generate outputs in a variety of formats, including but not limited to graphical, tabular and geographical;
  - Allow incorporation of new data as it becomes available;
  - Be accessible via an application programming interface
Implications of Data Display System

• Readily accessible IM data
• Easily consumable for all agencies
• Display of differences, types of issues, and disparities in specific areas at different levels
• Display of current risk factors
• A system that compliments and incorporates the state sponsors’ current tools
Implications Continued

- Information on which populations should be prioritized:
  - Which mix of interventions are best for a community
  - Expected ROI for implementing interventions at different geographic levels
  - Expected time for intervention to be effective in reducing IM
  - Expected impact on IM rate for each intervention
Task 1: Systems Modeling of Infant Morality in Ohio

Alireza Ebrahimvandi, Rob Fischer, Joshua Hawley, Niyousha Hosseinichimeh, Ayez Hyder, Peter Koh, Julie Maurer, Randall Olsen, Lauren Porter, Becky Reno
(alphabetical order, Co-PI’s in bold)
Main Problem

• Infant mortality is a complex and interconnected problem, involving the child, mother – and many other factors (e.g., the environment, employment, education, housing, medical system, health policies).

• Traditional causal modeling can be supplemented by systems modeling, which is distinguished by efforts to map factors that contribute to infant mortality, and describe the emergence of feedback mechanisms in the system.
Systems Approach

Group Model Building/System Dynamics Modeling

Agent Based Modeling (micro-simulation modeling)

Causal Modeling
Task Activities

• Build a System Dynamics Model
  – Causal loop diagram (done)
  – Group Model building (done)
  – Calibrated Model (in process)

• Causal Modeling (in process)
  – Provide statistical model of mothers and children from individual level data

• Agent Based Model (in process)
  – Design state chart of individual agents
  – Build and calibrate ABM of infant mortality
The initial systems model provides a simulation of outcomes for women at high and low social risk and their children.

**At High Social Risk**
- Women at high social risk in early pregnancy
- Women at high social risk with uncomplicated pregnancy
- Women at high social risk with complicated pregnancy
- Women at high social risk at high medical risk
- Babies at high social risk dying in first year
- Babies at high social risk becoming one year old
- Babies preterm birth
- Babies leaving NICU
- Babies at risk babies dying in first year
- Hospital based LARC prog
- Investment in hos prog
- Babies moving from low to high social risk
- Babies moving from high to low social risk
- Babies moving from high to low social risk giving complicated birth
- Babies giving complicated birth
- Babies giving uncomplicated birth

**At Low Social Risk**
- Women at low social risk in early pregnancy
- Women at low social risk with uncomplicated pregnancy
- Women at low social risk with complicated pregnancy
- Women at low social risk at high medical risk
- Babies preterm birth
- Babies leaving NICU
- Babies at risk babies becoming one year old
- Babies moving from low to high social risk
- Babies moving from high to low social risk
- Babies giving complicated birth
- Babies giving uncomplicated birth
- Babies at risk babies dying in first year

**System Model**
- Women with low medical risk in LARC
- Women with low medical risk giving uncomplicated birth
- Women with low medical risk giving complicated birth
- Women at low social risk receiving non-hospital LARC
- Non-hospital based LARC prog
- Investment

Agent Based Model

- Age
- Race
- Smoking
  - Drug/alcohol use
- Residential location
- Prenatal care
  - High-risk pregnancy
  - Health care costs
- Food security
  - Breastfeeding
- Postnatal education
  - Home visits
  - Home environment
- Birthweight
  - Gestational age
  - Small-for-gestational age

Survival to 1st birthday
Outcomes

• Web-based models to allow policy modeling and show how factors can impact individual level outcomes.

• Causal models of the impact of individual and institutional factors on infant mortality
Our team

From Left to Right: Julie Maurer, Lauren Porter, Ayez Hyder, David Anderson, Niyousha Hosseinichimeh, Josh Hawley, Becky Reno, Rod McDonald, Alireza Ebrahimvandi, Peter Koh
Task 3
Spatial Analysis of Infant Mortality in Ohio: Tools to Support Evaluation and Program Development

Elisabeth Dowling Root, PhD
Associate Professor
Department of Geography & Division of Epidemiology

The Ohio State University
1. Examine spatial patterns and clusters of infant mortality in Ohio
2. Understand how individual and area-level risk factors contribute to spatial patterns
3. Demonstrate how spatial analytic techniques can be used for program planning and evaluation
4. Develop a web-based mapping solution for program planning, evaluation and dissemination
Methods

• Mapping!
• Cluster analysis
  – Maps of clusters of IM
• Multilevel Modeling
  – Maps of predicted IM rates
• Spatio-temporal Modeling
  – For each community, trajectory of IM rates over time and change in the relationship between IM and each predictor
Example: LISA Cluster Map
Proportion Reporting Poor/Fair Health

2008 OFHS

2015 OMAS

LISA Cluster
Not Significant, High-High, Low-Low, Low-High, High-Low
Example: Area Specific Plots

- Shows the effect of a hypothetical predictor ($\beta$) of the log-odds of IM over time
  - Increasing trend over time

- Example: For census tract 8701 (located in Cleveland), Hispanic ethnicity ($\beta$) has a greater effect on IM in month 90 vs. month 0
Example: Mapping Application
Implications of Geospatial Analysis

Geographic Information Systems (GIS) and spatial analysis provide public health officials with the capability to perform unique types of analysis:

1) Finding areas of high or low incidence that are and worthy of further investigation and/or intervention

2) Examining the spatial relationship between health outcomes and population/contextual factors that vary across space

3) Monitoring the impact of interventions/programs over time
COIL: Task 2

Lawrence C. Kleinman, MD, MPH
Center for Child Health and Policy
Principal Investigator
Team Members

The Case Western Reserve – Ohio State Universities Collaboration for Infant Life (COIL)

**CWRU**
- Mandel School of Applied Social Sciences
  - Center on Urban Poverty and Community Development
  - Departments of Pediatrics, OB-GYN and Division of Neonatology
  - Center for Child Health and Policy at Rainbow
  - Center for Health Care Research & Policy at Metro

**OSU**
- School of Medicine
  - The Research Institute at Nationwide
  - Center for Innovation in Pediatric Practice

**Kelleher**
- Deena Chisolm
- Jennifer Cooper

**School of Public Health**
- Lawrence Kleinman
  - Sandra Hassink
  - Siran Koroukian
  - Ann Nevar
  - Suzanne Lo
  - Marie Masotya

**School of Public Health**
- Randy Cebul
  - Thomas Love
  - Brian Mercer
  - Jennifer Baillit
Purpose and Path

• Develop models that can be used to target interventions to children or individuals based upon risks identifiable across the course pregnancy. In this sense our models are dynamic.

• Data Plan:
  – Build a panel of women and child(ren) enrolled in Medicaid including baseline and time-varying characteristics.
  – Panel data will allow us to estimate sequential predictive models of IM or its precedents (eg LBW, VLBW, prematurity) at various stages of the pre and postnatal period.
Methods: Develop Models

• High quality model building
  – Guided by theory and empirical findings
  – Examine univariate and bivariate distributions
  – Explore extent and nature of missing data
  – Examine bivariate relationships of transformed variables (eg square, ln, inverse)
  – Explore covariance among selected variables
  – Review published papers
  – Iteratively assess models guided by above
  – Distinct development and testing data sets whenever possible
Explore Potential Sources of ‘Risk’

- **Biological risk** based on their personal health history,
- **Environmental /exposure risk** based on where they live and have lived
- **Clinical risk** based upon the availability and quality of the medical care that they do (or do not) receive, including the capacity of the institutions that serve them to escalate levels of care as needed
- **Emotional risk** based upon biological and environmental factors
- **Social risk**, i.e. stress, deprivation, social inclusion or isolation, etc
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<th>Factor (data element)</th>
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Influence Diagram across the Course of Pregnancy
Develop Models Sequentially

• Life Course: What happens now may matter later
• With info available
  – Pre pregnancy
  – In first trimester, then second, then third trimester
  – When entering hospital of birth
  – After birth
  – After first discharge, and during first year (e.g. delayed vaccination)
• Consider stratified models
  – Among full term infants, what are predictors of post neonatal mortality
  – Among LBW infants, what are the predictors of post neonatal mortality? Among VLBW?
• Model relevant outcomes (e.g. premie, small, large, IM)
Metrics over the Course of Pregnancy

- Pre pregnancy: Mother’s demographics; previous pregnancy outcomes; prior sibling data; mother’s health; environment, community economic status, among others.
- During pregnancy: onset of prenatal care, medication use, evidence of chronic illness, domestic violence, use of specialty care, hospital first admitted, hospital of birth, etc.
- Variables may change because of substantive change (e.g., new exposures) or because we have better information over time (newly insured with chronic illness not treated in Medicaid until second trimester). For the purposes of a predictive model, we treat these the same.
Some Key Policy Relevant Questions

- Can we identify pregnancies at greatest risk for neonatal mortality and infants at greatest risk of dying in Year 1?
- To what extent do neighborhood or community measures of risk (e.g., poverty, extremes of racial segregation composition, degree of single head of household, child maltreatment rate, housing violation rate) contribute to observed variations in infant mortality?
- To what extent are patterns of health care behavior in mothers or their prior children associated with observed variations in infant mortality?
- Can we identify subpopulations for which prior bad outcomes are less predictive of future bad outcomes (suggesting that they better managed or more resilient than others)?
- Does hospital of birth contribute to risk?
Questions?