# Group Model Building Techniques for Rapid Elicitation of Parameter Values and Effect-Size-Driven Formulations

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**2nd Asia-Pacific Region System Dynamics Conference of the System Dynamics Society**

**February 19-22, 2017**
**National University of Singapore**

UNIVERSITY AT ALBANY
State University of New York

Virginia Tech

OHIO STATE

# Our Author Team

Please feel free to contact Niyousha Hosseini, our lead author, at Niyousha@vt.edu if you have any comments or questions.

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# Three-Parts to This Presentation

I. Group Model Building and the Ohio Infant Mortality Project

II. More Details on Rapid Elicitation of Parameters and Size Effects

III. Advance Look at the Resultant Model as of February, 2017

# Part I: Group Model Building and the Ohio Infant Mortality Project

Fast Flight Over a Two-Day GMB Session

August 10 and 11, 2016

# System Dynamics Group Model Building for Infant Mortality in Ohio

*Columbus, Ohio*

August 10 & 11, 2016

# Purpose of the Meeting

To collaboratively develop a system dynamics model of infant mortality for the State of Ohio. We will talk about your hopes and fears, policy levers, and key stakeholders. We will sketch the key structure influencing infant mortality and elicit the model parameters from the participants. The scope of the model will be discussed on both days and finalized at the end.

# Agenda for Wednesday, August 10, 2016

| Time | Description |
|---|---|
| 8:00 AM | Coffee and Participant Introductions (All) |
| 8:30 | Welcome and Meeting Purpose (All) |
| 8:40 | Participant introductions:  Hopes and Fears (All) |
| 9:10 | Identify Key Stakeholders Driving System Behavior (All) |
| 9:45 | Preliminary policy levers of interest (All) |
| 10:15 | Break |
| 10:30 | Using a Concept Model to Introduce Simulation Approach to be used (All) |
| 11:00 | Eliciting Graphs of Key Variables over Time (All) |
| 12:30 | Lunch |
| 1:30 | Eliciting Graphs of Key Variables over Time--Continued (Core Participants) |
| 1:45 | Mapping of Key Stocks and Flows in the System (Core Participants) |
| 2:30 | Break |
| 2:45 | Mapping Feedback in the System (Core Participants) |
| 4:00 | Modeler provides feedback (Core Participants) |
| 4:20 | Closing remarks and Review of Work for Tomorrow (Core Participants) |
| 4:30 | Adjourn |

# Agenda for Thursday, August 11, 2016

| Time | Description |
|---|---|
| 8:00 AM | Coffee and Breakfast |
| 8:30 | Welcome and Plan for the Day + Discussion of Model Scope (Core Participants) |
| 8:40 | Presentation and Review of Work from Yesterday + board Clearing Exercise.<br>(Core Participants) |
| 9:00 | Continue and Refine Mapping of Feedback in the Model (Core Participants) |
| 10:00 | Break (Core Team) |
| 10:15 | Mapping and Refining LARC & Housing Policies (Core Participants) |
| 11:15 | Estimating Parameters for the Model—Further Data Sources and Experts (Core Participants) |
| 12:15 | Lunch (Core Participants) |
| 1:00 | Final Issues; Discuss Housing, Update on Agent Based Modeling, Definition of High Medical Risk, Definition of High Social Risk,. |
| 1:30 | Presentation of Results from Two Day Workshop with Full Group Reflections and Comments (All) |
| 2:30 | Break (All) |
| 2:45 | Project Next Steps and Follow Up (All) |
| 3:00 | Adjourn |

# Core Participants

- Assistant Professor Epidemiology, OSU Wexner Medical Center
- Vice President, Hospital Council of Northwest Ohio, Executive Director, Toledo-Lucas County CareNet
- Consultant, IPAC; Associate Professor at OSU
- OB/GYN and Emeritus Professor, OSU Wexner Medical Center, Ohio Perinatal Quality Collaborative
- Chief, Division of Family and Community Health Services, Ohio Department of Health
- Director, Office of Epidemiology, Columbus Public Health
- Director of Celebrate One
- Health Services Policy Specialist, Ohio Department of Medicaid
- Clinical Professor of Pediatrics at Nationwide Children's Hospital; Senior Medical Director Advisor, Ohio State University Health Plans
- Assistant Director of Health Equity, Ohio Department of Health
- OB/GYN and Professor, Former CEO OSU Wexner Medical Center
- Policy Analyst, Ohio Department of Jobs and Family Services
- Health Planning Administrator, Child and Family Health Services Program, Ohio Department of Health

# Participants

- Ohio Department of Medicaid
- ODH, Bureau Maternal Child Health
- Director, Government Resource Center (GRC)
- OERC Project Manager
- 1st GRC Participant
- 2nd GRC Participant
- 3rd GRC Participant

# Modeling and Facilitation Team

Josh Hawley – Task 1, OSU

Lauren Porter – Task 1, OSU

Ayaz Hyder – Task 1, OSU

Becky Reno – Task 1, OSU

Julie Maurer– Task 1, OSU

Peter Koh –Post-Doc, OSU

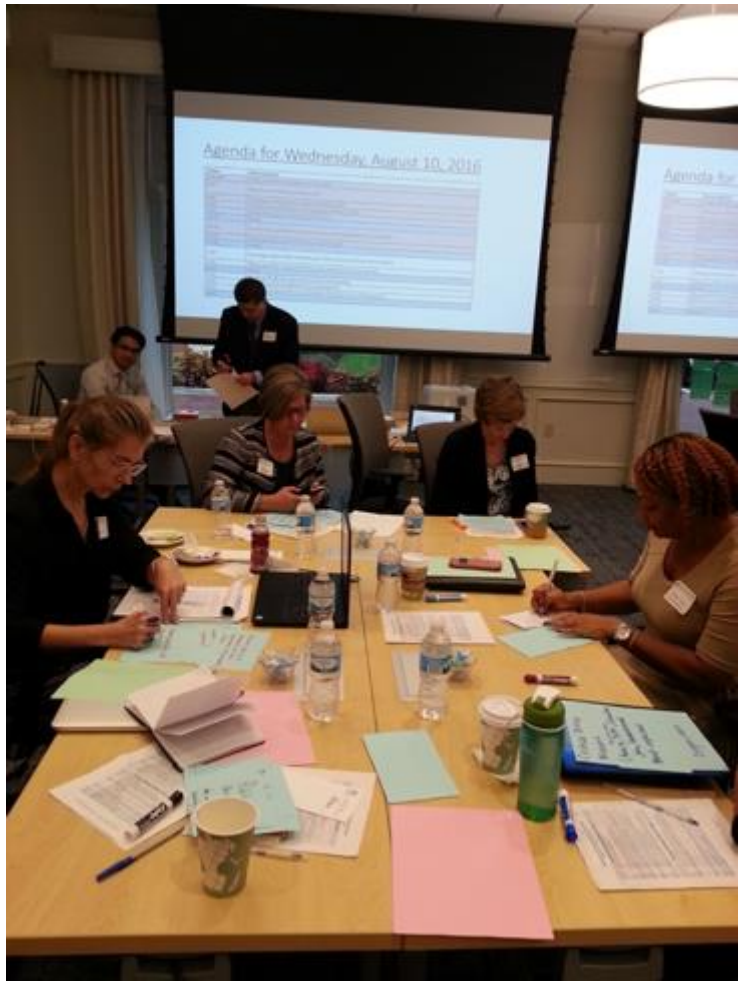
Niyousha Hosseinichimeh – Task 1, Virginia Tech

Alireza Ebrahimvandi – Task 1, Virginia Tech

David Andersen – Task 1, University at Albany

Rod MacDonald – Task 1, University at Albany

# Writing Hopes and Fears




# Hopes and Fears

# Identifying Stakeholders


Columbus, Ohio

8/10/2016

# Stakeholders (pictures)

# Stakeholders

High Power

Low Power

Media

K. Faber

Business community

M. DeWine

State workforce policy board

Farmers/ farm bill a.k.a.

Companies where pregnant women at risk (and their partners) work; fast food, etc.

Community physicians

Professional associations & boards (nursing, med, hospital associations)

Ohio Dept. of Education→ get moms/WRA graduating high school

Justice system

Substance Abuse Centers

Federal/national leaderships

mayors

Medical Schools

Public housing (local decision makes wins housing to give)

Private insurance plans (but mainly public)

Local+state health + social services providers + leaderships

Hospital System Leadership

Conservative newer GA members

Ohio PTA/PTO association

Grocery stores; food access

Governor and M. Kasich

C. Moody

Governor's Policy Team

Pharmaceutical Companies

Charitable Organizations

legislators

Critical policy makers (housing, transportation, politicians, education, jobs, health-related)

COTA & transportation services

Churches

Medical records clerks at birth hospitals

Public health leadership

Teachers + childcare

Schools

Ohio Medicaid + plans

Champions

Some key stakeholder

Children's health consumer advocates

Women of childbearing age

Church leaders, ministers and their spouses

Ohio MAS

Ohio commission of minority health

Small business (people wins jobs); they care about their workers

African American community leaders

Parents/women who have lost an infant

Community health workers

Women who are unaware of the importance of prenatal care

Between 5 - 9 votes

Between 3 - 4 votes

Between 1 - 2 votes

No votes

Low interest in public health

High interest in public health

# Summary of Key Stakeholders

## Stakeholders (Number of Votes)

1. Champions (8)*
2. Legislators (7) and Mayors (4)
3. Women of Childbearing Age (6)
4. Teachers/ Schools/ Childcare (6)
5. Ohio Medicaid's Plans (5)
6. African American Women Families (4)

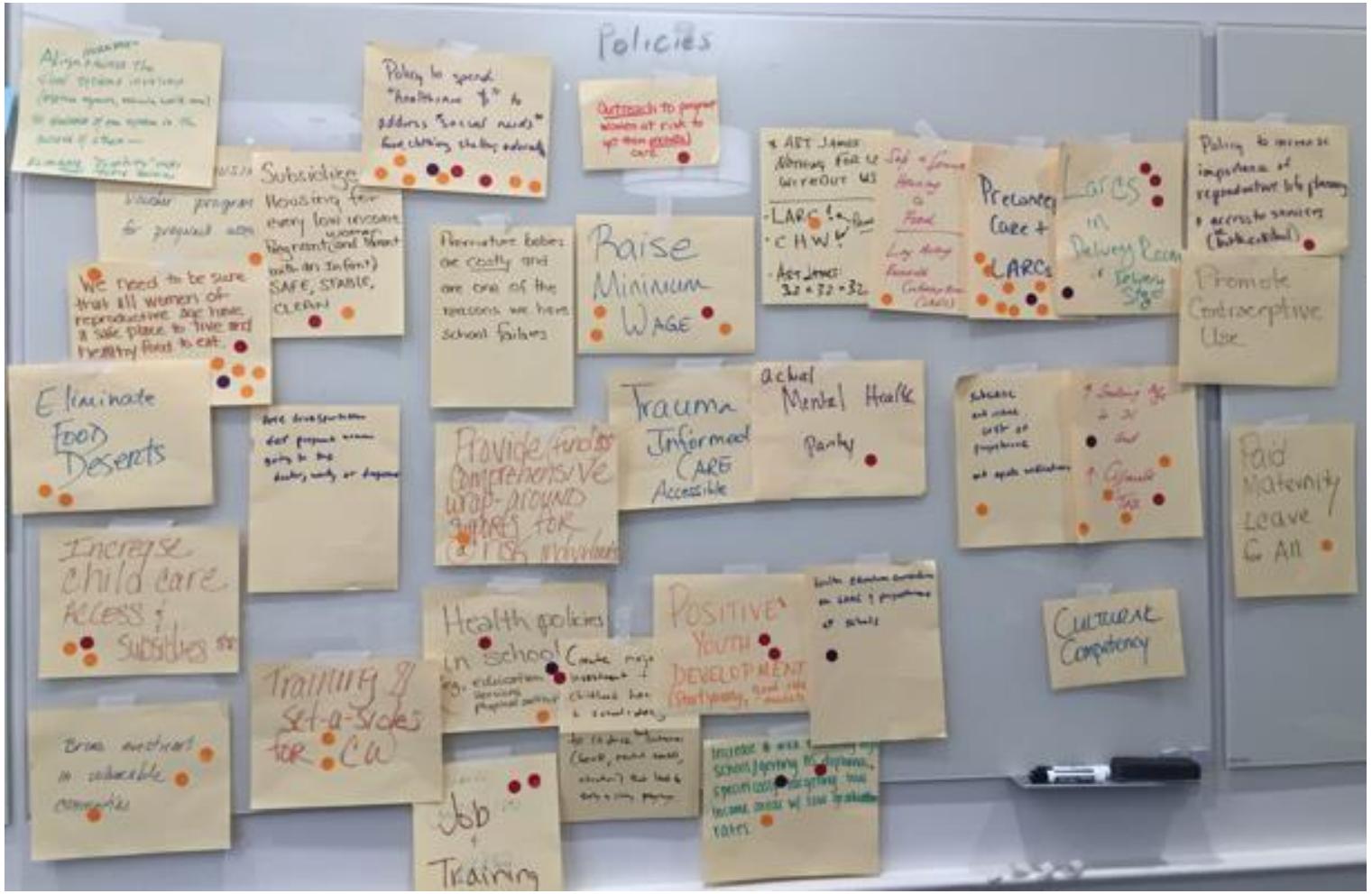
* Numbers inside the parentheses indicate number of votes

# Identifying Policy Levers


Columbus, Ohio

8/10/2016

# Policy Levers of Interest




Columbus, Ohio

8/10/2016

# Visualizing Policy Levers

Robust housing voucher program for pregnant women

Subsidized housing for every low income pregnant women (and parent with an infant) safe, stable, clean

We need to be sure that all women of reproductive age have a safe place to live and healthy food to eat.

Increase childcare access & subsidies $$

Free transportation for pregnant women going to the doctor, work, or daycare

Eliminate food desert

Broad investment in vulnerable communities

Policy to spend "healthcare $" to address "social needs" food, clothing, shelter, education

Safe & secure housing and food -Long Acting Reversible Contraception (LARC)

Art James: Nothing for us, without us 1-LARC! 2-C.H.W! 3-Art James!

Raise Minimum Wage

Outreach to pregnant women at risk to get them prenatal care

Preconception Care + LARCs

LARC in delivery room or delivery stages

Increase smoking age to 21 and cigarette tax

Provide fund ($$) comprehensive wrap-around supports for at risk individuals

Paid ma leave f

Trauma Informed Care Accessible

Health policies in schools (e.g. education, services, physical activity) Job training

Actual Mental Health Parity

Promote Contraceptive Use

Subsidize and reduce cost of progesterone and opiates medication

Provide (fund$$) comprehensive wrap-around supports for @ risk individuals Outreach to pregnant women at risk to get them prenatal care

Health education curriculum on LARC and progesterone at schools

Positive youth development (start young, good role models)

Training $ set-a-sides for CW

Policy to increase importance of reproductive life planning + access to services (i.e. birth control)

Increase # WRA finishing high school/getting HS diploma, specifically targeting low income areas w/ low graduation rates

Job Training

Create major Investment in childhood health & schools designed to reduce bad outcomes (health, mental health, education) that lead to early risky pregnancy

Align incentives across the systems involved (social service agencies, schools, healthcare) so success of our system is the success of others—; Eliminate "eligibility" rules that create barrios

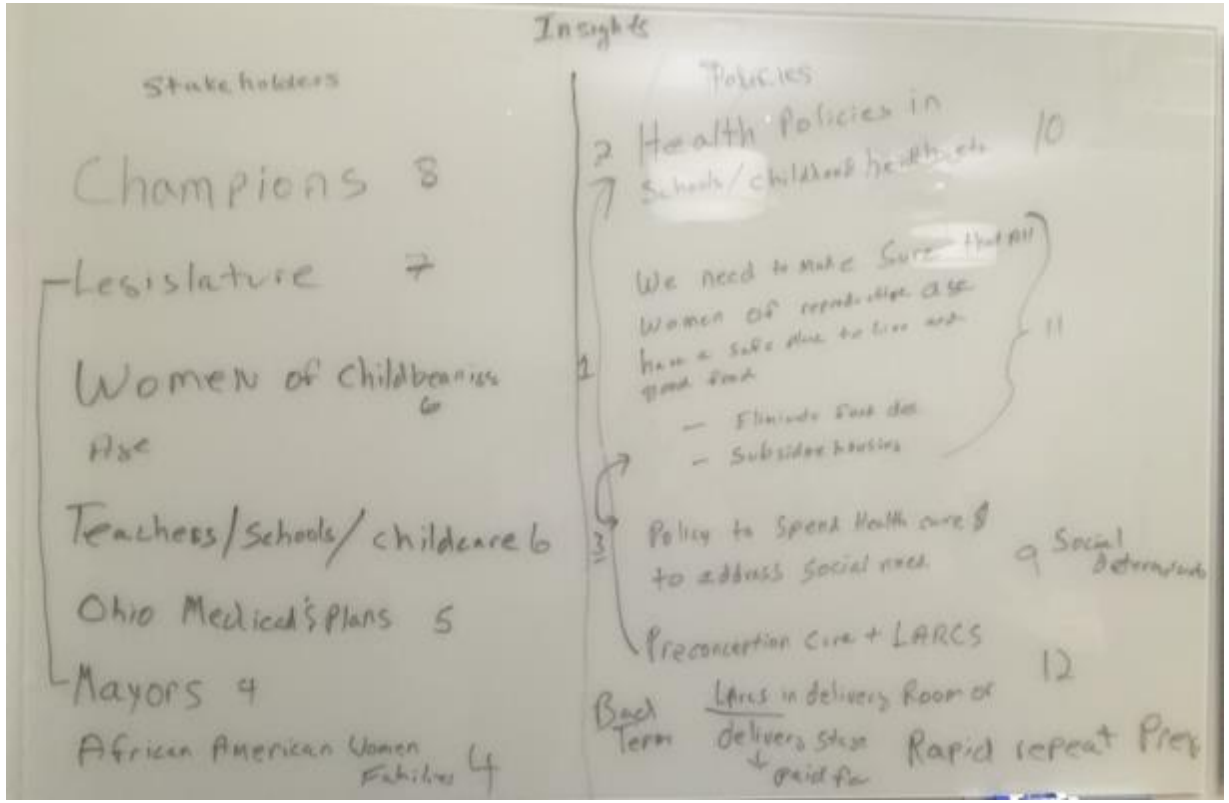
Progesterone + LARC

Mixed Policies

Education Policies

Housing and Food Policies

# Summary of Key Policy Levers




Columbus, Ohio

8/10/2016

# Summary of Key Policy Levers

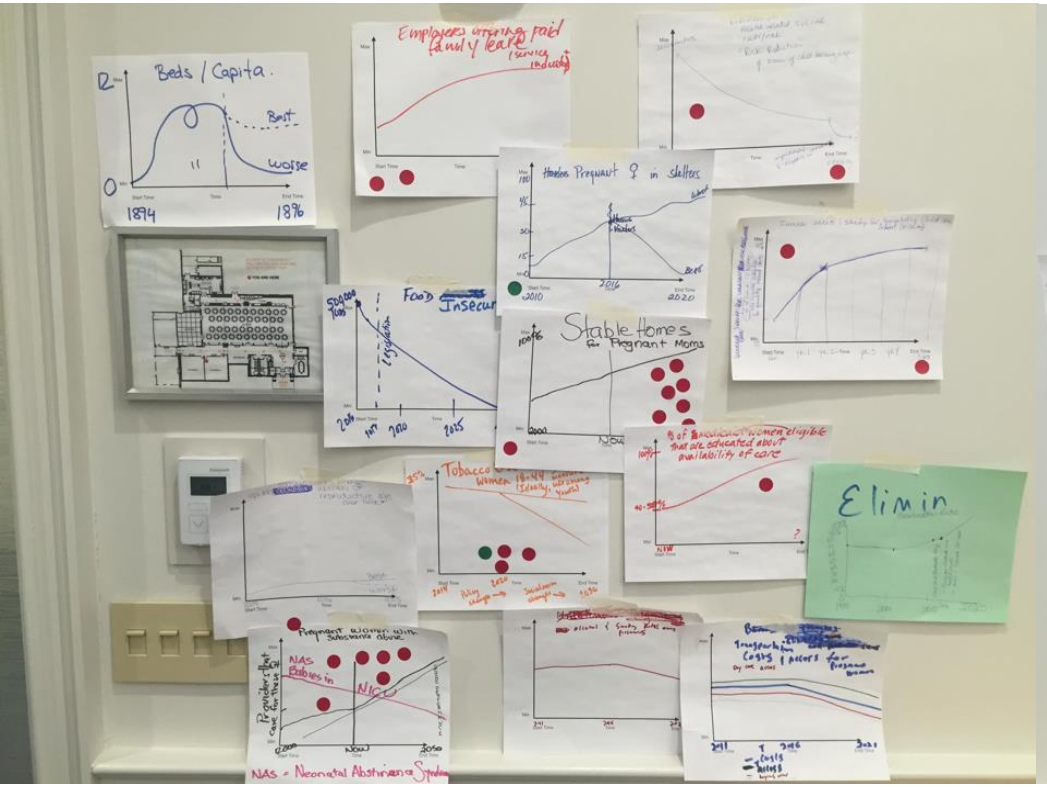
## Policies (Number of Votes)

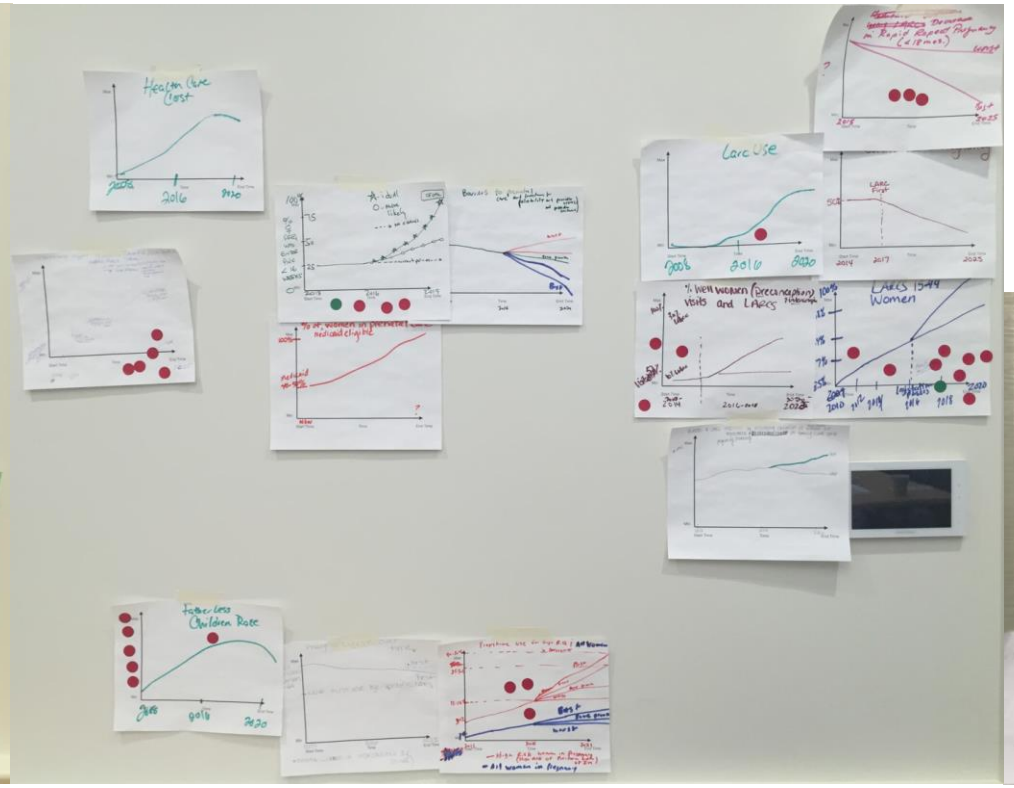
1. Make sure that all *women of reproductive age* have access to *safe place*, *good food, preconception care, and contraceptives*.
   a) Eliminate Food Deserts (11)*
   b) Subsidize housing (11)
   c) Preconception Care (12)
   d) LARC (12)
2. Health Policies in school/childhood health etc. (10).
3. Policy to spend health care dollars to address social need (9).

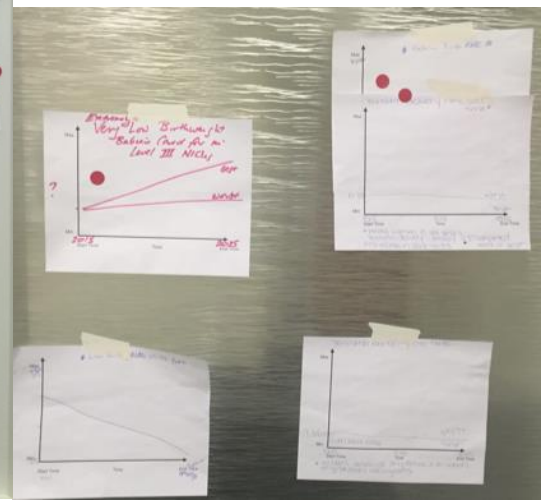
* Numbers inside the parentheses indicate number of votes

# Building Graph Over Time for Key Variables

# Eliciting Graphs of Key Variables over Time



Columbus, Ohio

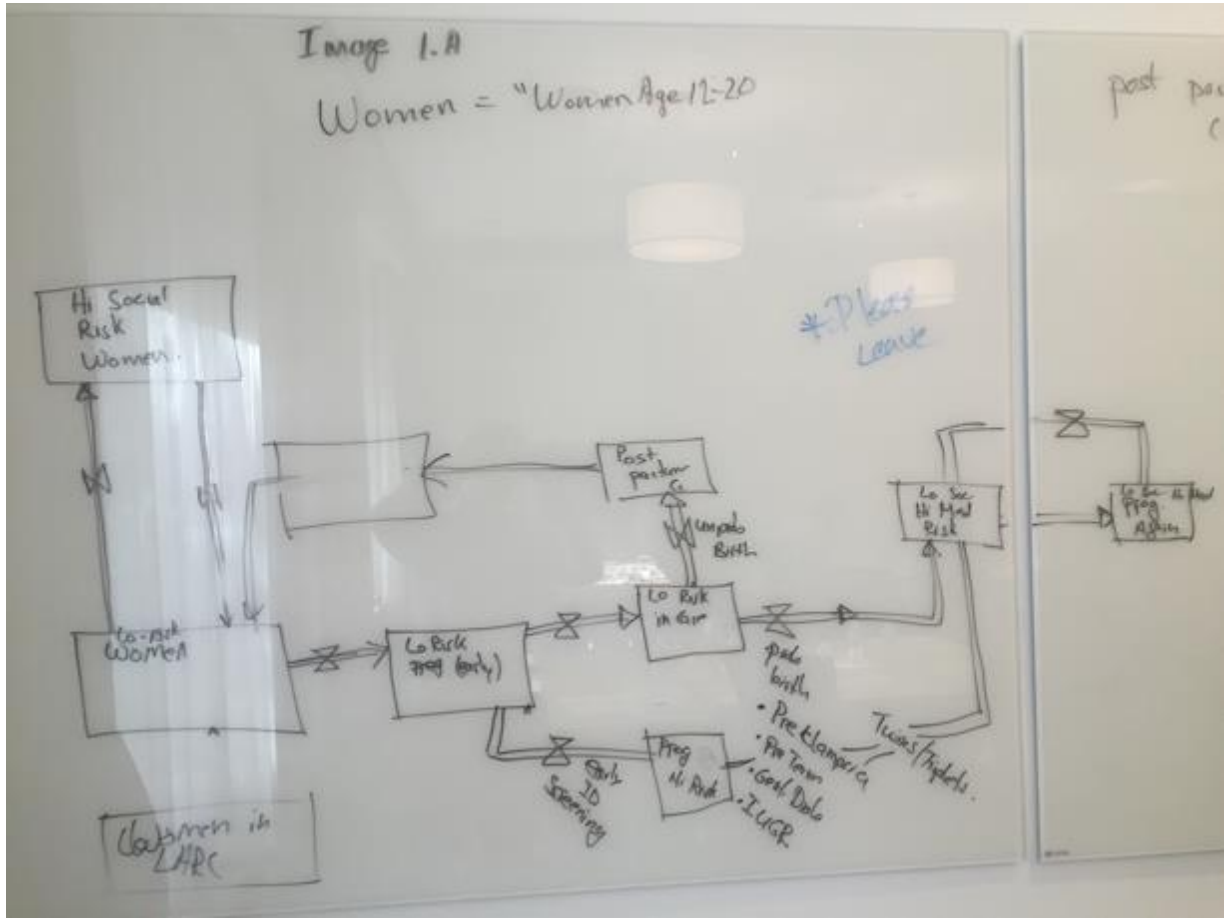
8/10/2016

# Summary of Key Variables Over Time

1. LARCS 15-44 (9)*
2. Stable homes for pregnant women (8)
3. Pregnant women with substance abuse (6+)
4. Fatherless children care (6)
5. Pregnancy support/ Family navigator/Community health workers (5)
6. Tobacco use women 18-44 (4)
7. Pregnant who enter early prenatal care (4)

* Numbers inside the parentheses indicate number of votes

# Image 1.A. First Conceptualization for Low Risk Women (1:30 PM Day One)



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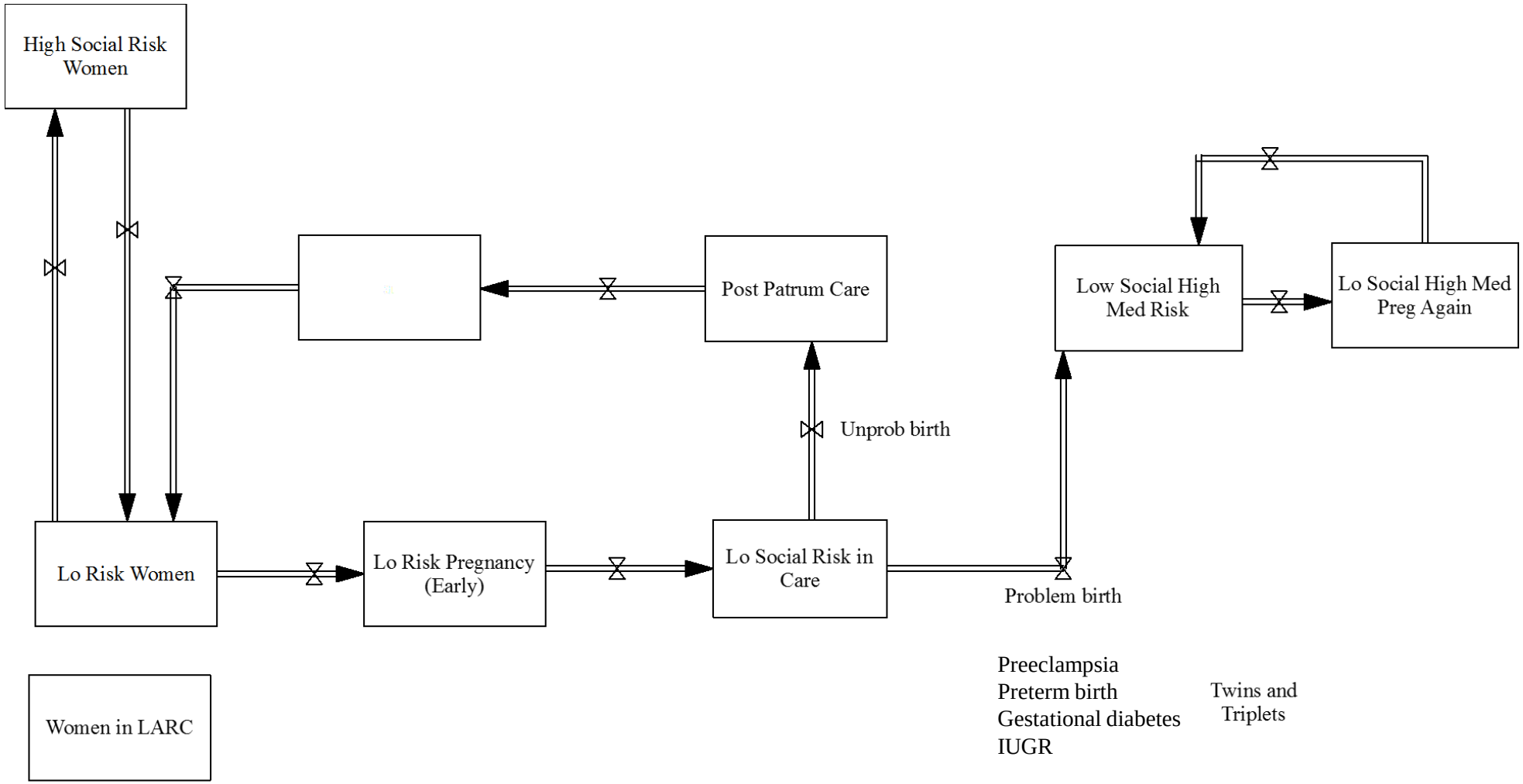
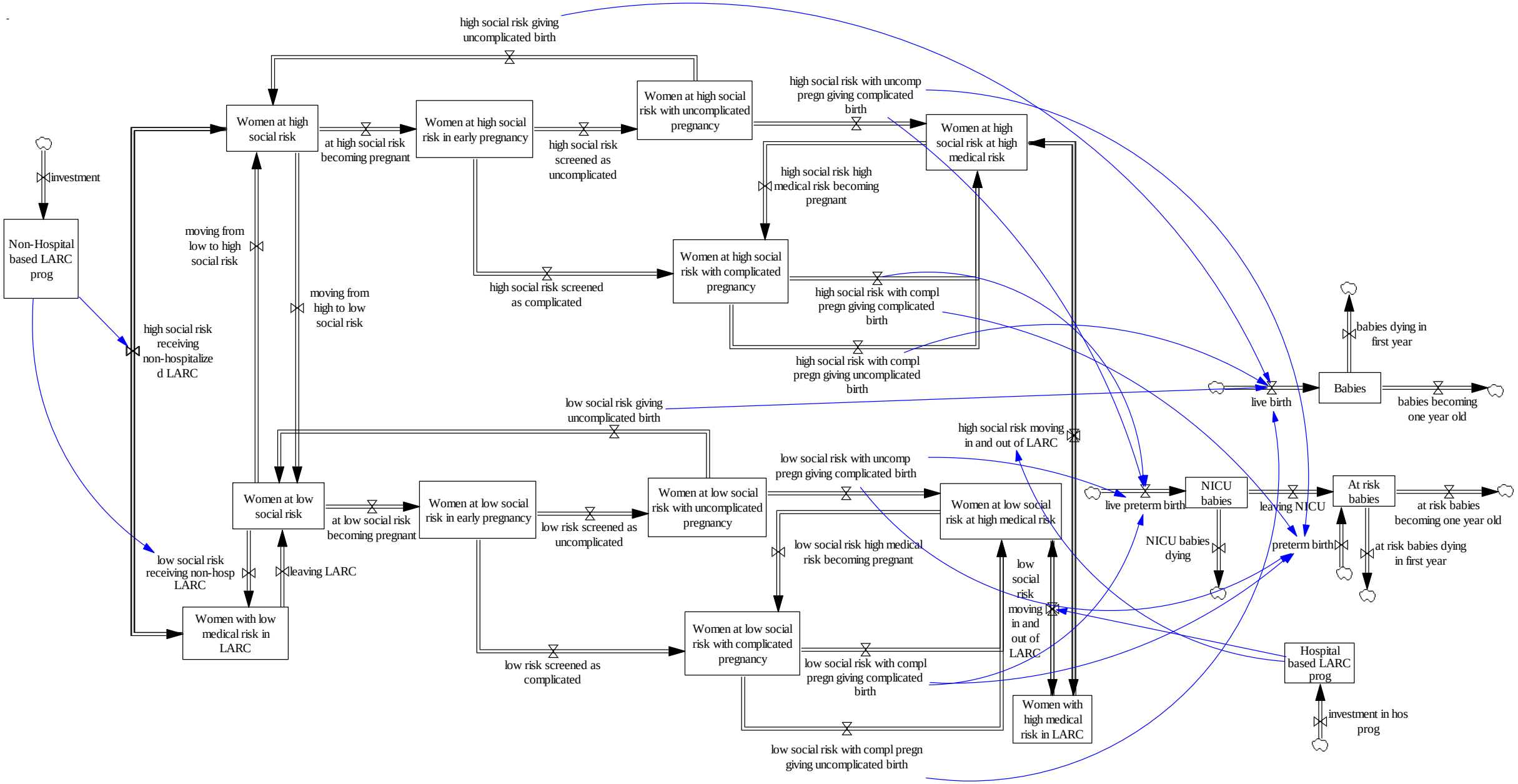





# Vensim Sketch of Model as of 4 PM on the First Day

# Part II: More Details on Rapid Elicitation of Parameters and Size Effects

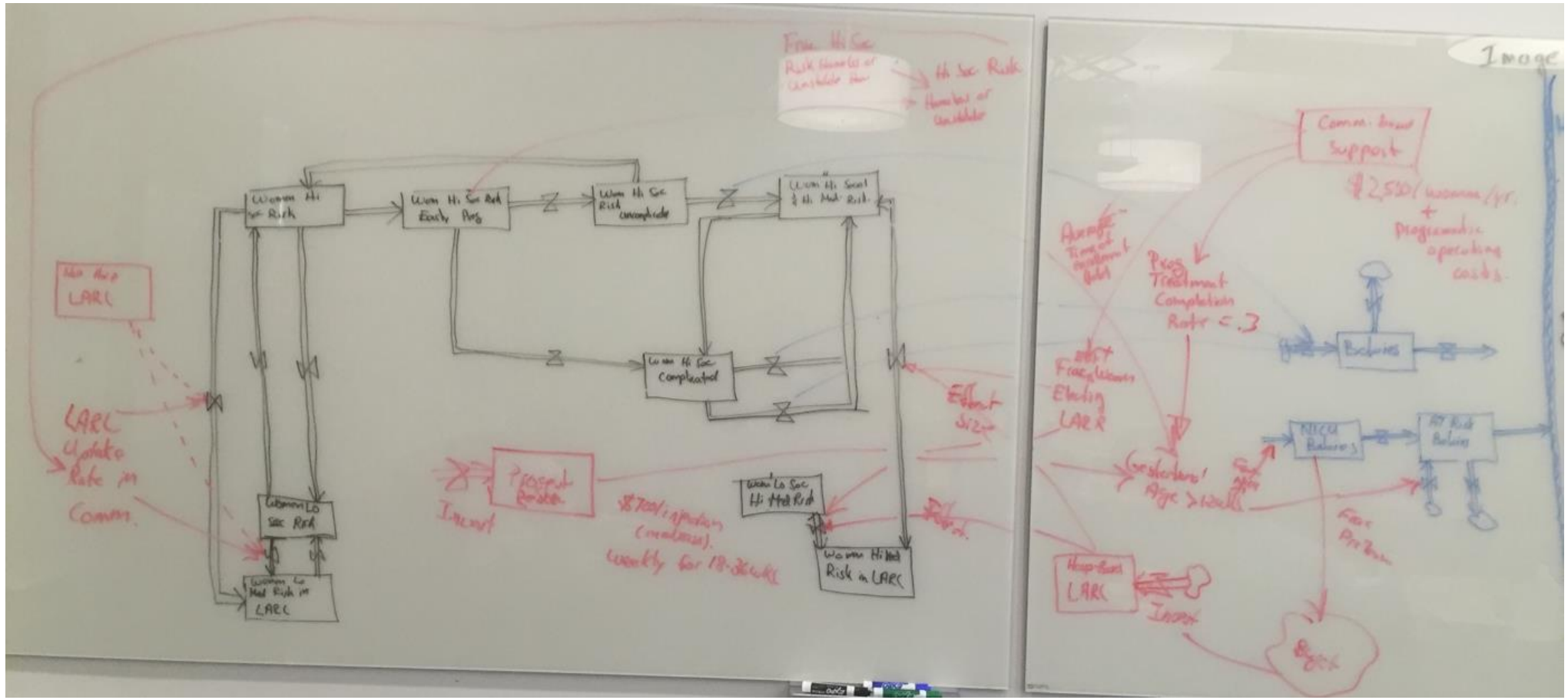
This is the Core of Our New Work:

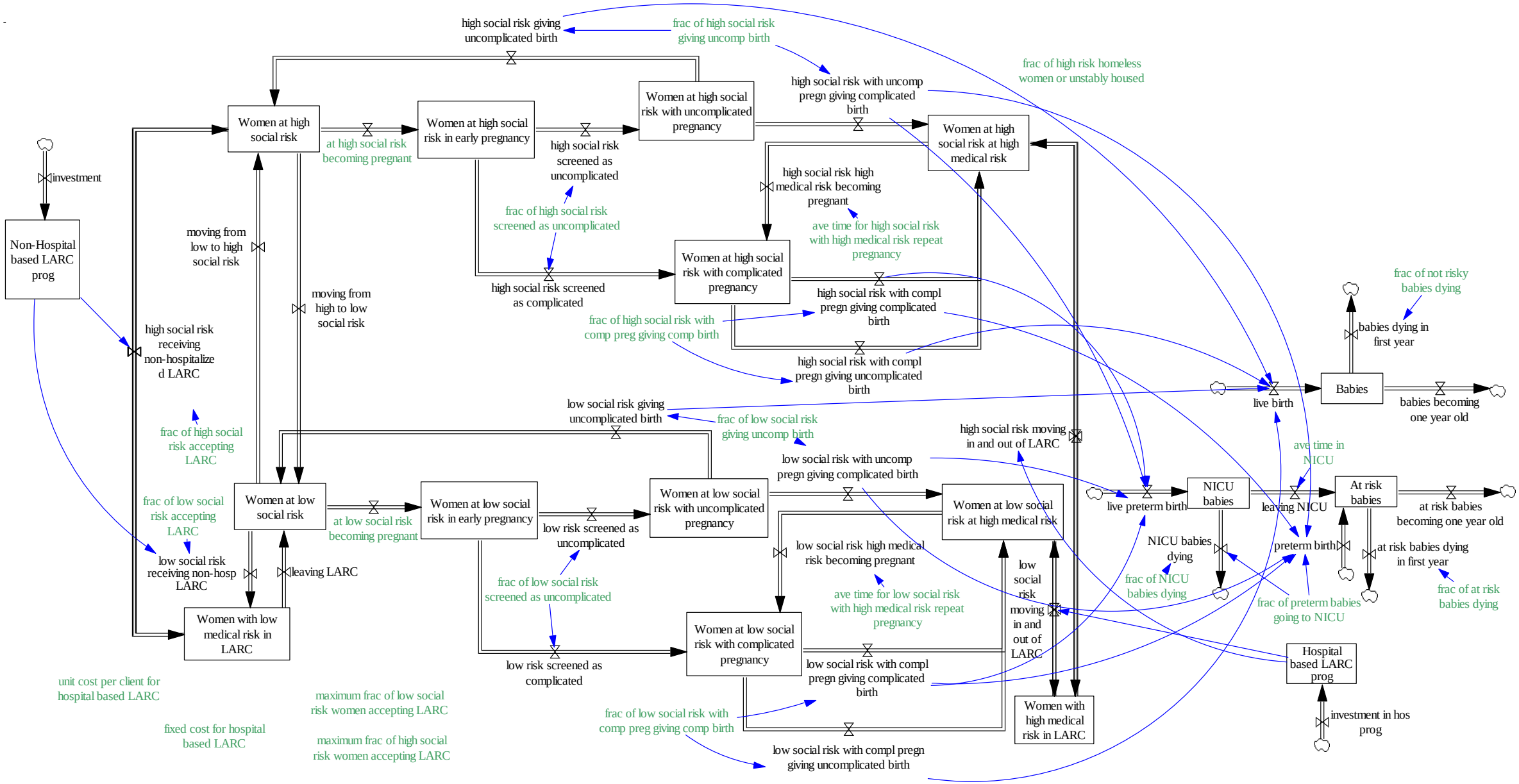
Three Scripts that We Used To Parameterize the Model

# Parameter Booklet Script

- This script usually requires that a fairly advanced conceptual sketch exists
- Key parameters (including initial values and annual rates) marked on public version of model sketch
- All parameters inserted into a blank spreadsheet
- As a group activity, individuals fill in the parameter booklet
- Booklets are collected and become expert data for model development

# Mapping of Resources into Stock (10 AM Day Two)





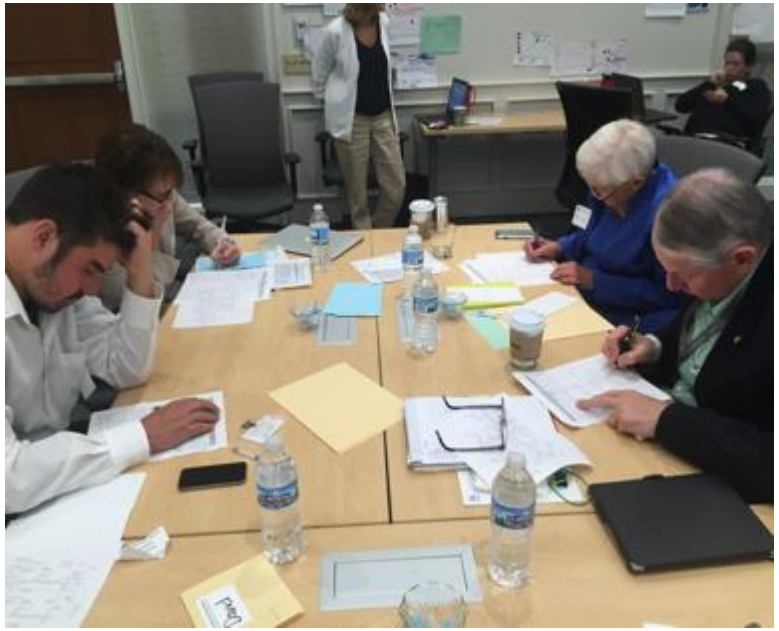

# Stock and Flow Diagram as of Beginning of Day 2

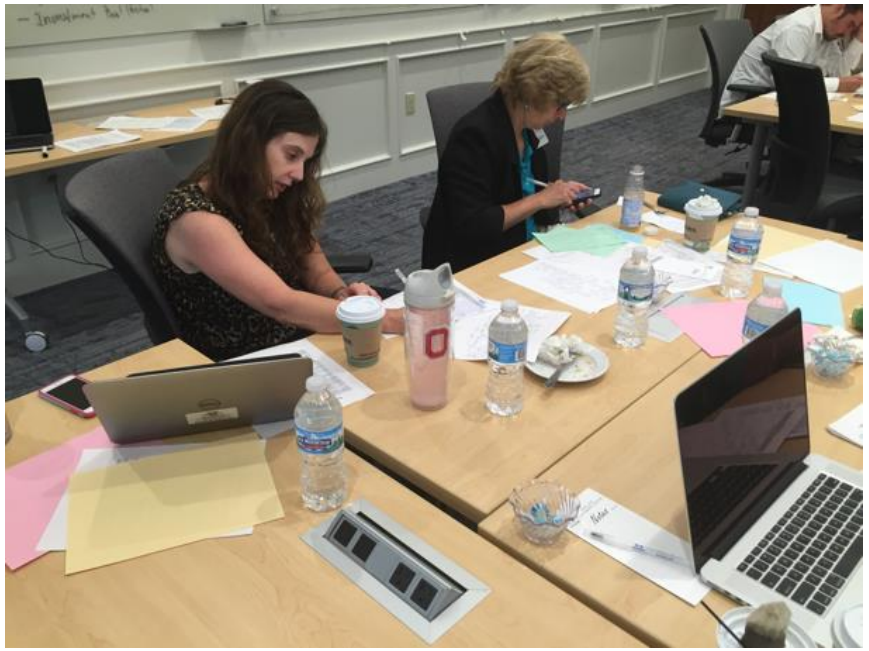
# Sample of Format for Parameter Booklet

**Expert Judgement Decisions**

| | Variable Names from Model | Units | My Estimate | Data Type and Availablitly , and Sources |
|---|---|---|---|---|
| | **Low Social Risk Parameters** | | | |
| 1 | At low social risk becoming pregnant | Women per Month | 4% | National survey of fam |
| 2 | Fraction of low social risk screened as uncomplicated | Fraction | 80% | us birth records |
| 3 | Fraction of low social risk giving uncomplicated birth | fraction | 70 % | us birth records |
| 4 | Fraction of low scoical risk with complicated pregnancy giving complicated birth | Fraction | 30 % | us birth records |
| 5 | Average time for low social risk with high medical risk for repeat pregnancy | Month | 24 | Linked birth cert |
| | **High Social Risk Parameters** | | | |
| 6 | At high social risk becoming pregnant | Women per Month | 8% | Nat survey |
| 7 | Fraction of high risk screened as uncomplicated | Fraction | 30% | |
| 8 | Fraction of high social risk giving uncomplicated birth | Fraction | 20 % | us birth records |
| 9 | Fraction of high scoical risk with complicated pregnancy giving complicated birth | Fraction | 20% | |
| 10 | Average time for high social risk with high medical risk for repeat pregnancy | Month | 9 | Inter preg interval studies |
| | **Low Social Risk Baby Parameters** | | | |
| 11 | Fraction of per-term babies going to NICU for low social risk | Fraction | 95% | us birth cert |
| 12 | Average time in NICU for low social risk | ~~Month~~ days | 13.2 days | march of dimes |
| 13 | Fraction of NICU babies dying for Low Social Risk | Fraction | .008 | neonatal mortality rate, march of dimes |
| 14 | Fraction of at risk babies dying from low social risk | Fraction | .004 | MOD |
| | **High Social Risk Baby Parameters** | | | |
| 15 | Fraction of per-term babies going to NICU for High Social Risk | Fraction | 100% | us birth cert |
| 16 | Average time in NICU for High Social Risk | ~~Month~~ | 35 days | march of dimes |
| 17 | Fraction of NICU babies dying for High Social Risk | Fraction | .016 | march of dimes |
| 18 | Fraction of at risk babies dying from high social risk | Fraction | .008 | |
| | **LARC Parameters** | | | |
| 19 | Unit cost per client for hospital based LARC | Dollars per Women | see back | cost as a barrier to LARC → Eisenberg |

# Parameter Estimation Practice





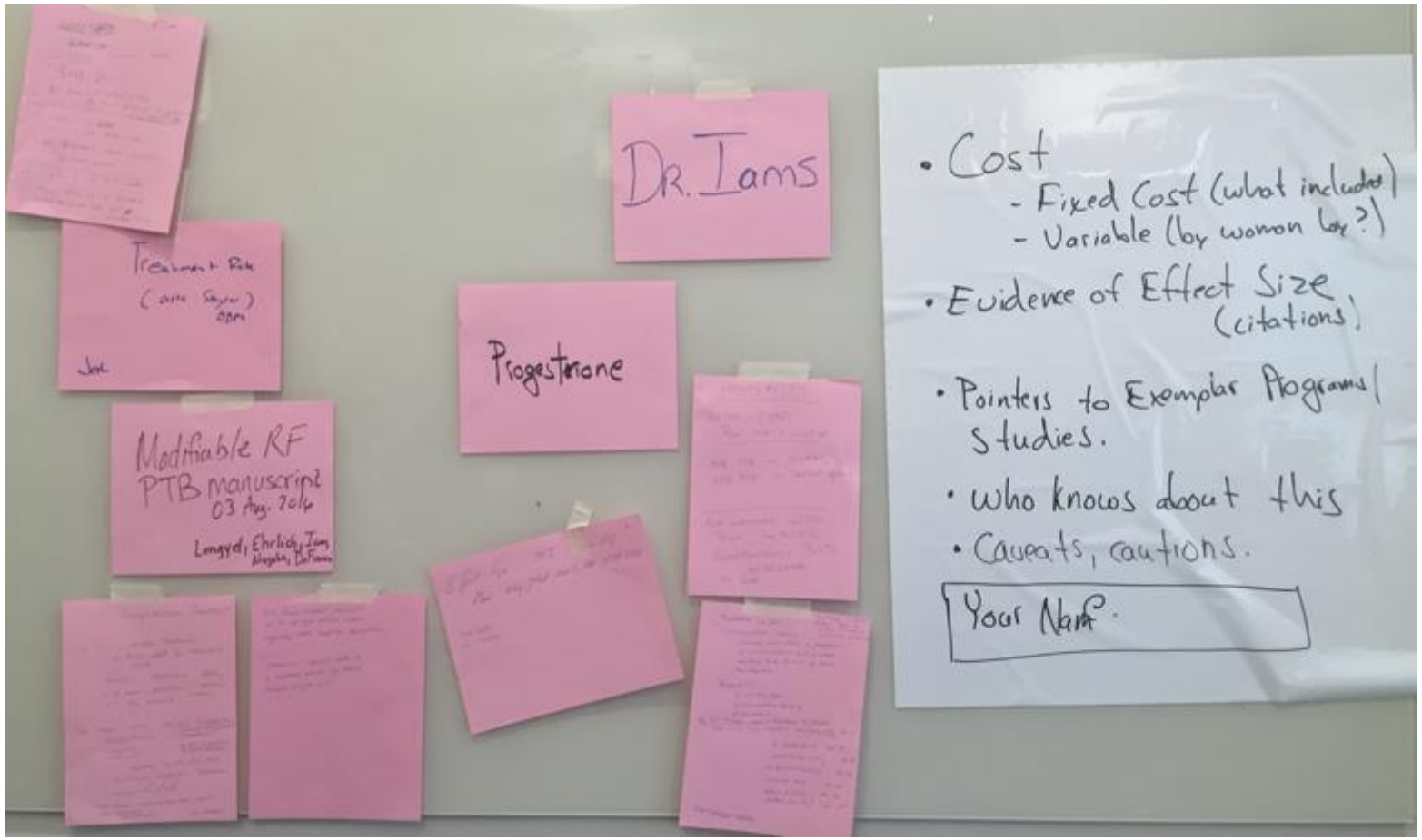
# Results from 3 (of 39) Parameters Elicited from Parameter Booklet

| Variable Name from Model | Units | Min | Max | Median | N | Mean |
|---|---|---|---|---|---|---|
| **Women at low social risk** | | | | | | |
| At low social risk becoming pregnant | Women per month | 600 | 6000 | 3500 | 7 | 3695 (2022,5368) |
| Fraction of low social risk screened as uncomplicated | Fraction | 0.5 | 0.9 | 0.8 | 5 | 0.78 (0.63,0.92) |
| Fraction of low social risk giving uncomplicated birth | Fraction | 0.7 | 0.9 | 0.8 | 7 | 0.83 (0.77,0.88) |

# Wall of Evidence Script

- Script Useful When Experts in the Room and Previous Good Research Exists
- Simply Post the Effect Postulated in the Model (It is important to be able to point to where the effect is and what it does)
- Ask Participants to detail evidence pertaining to this effect
- Very simple, but very powerful script!!

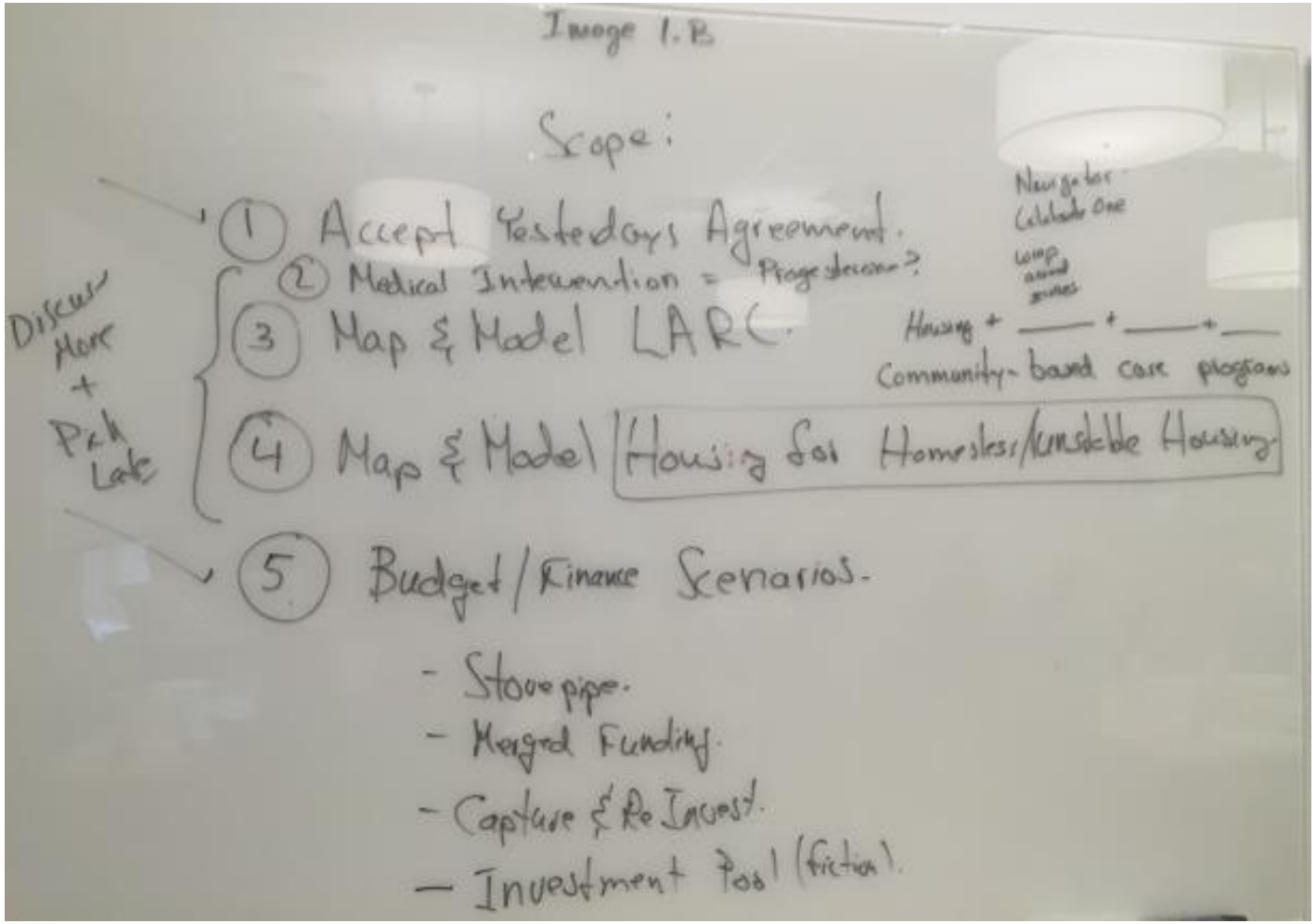
# Evidence for Progesterone (11 AM Day Two)



# Scope Agreement as Key Take Away Script

- The “Key Take Away” script posits that members of the client group need to be given an important product at least every two hours to maintain a legitimate and motivated process
- Agreements about a model’s scope can be one such Key Take Away
- At the end of Day #1, the client group agree to limit boundary to effects that are primarily measured within the Medicaid system
- A Second facilitated discussion on Day #2 elaborated on these earlier agreements

# Scope of Model (Discussion)



# Scope (agreement among the group, what the model would accomplish)

- Accept yesterday's agreement (the preliminary structure of the model in the previous page)
- Map and model progesterone
- Map and model LARC – hospital and community based services
- Map and model community based services
- Map and model housing for homeless/unstable housing (if empirically tractable)
- Add budget/finance scenarios
    - Stove pipe
    - Merged funding
    - Capture and reinvest
    - Investment pool

# Utility, Validity, and Confidence in GMB Parameterization Exercises

- Within days, the modeling team had a set of parameters that allowed creation of prototype running simulations
- Data Collection and verification continue
- Our research program is tracking just how accurate and complete GMB parameterization exercises are
- Preliminary results suggest that 64% of parameters collected from “hard” data sources are not significantly different from expert elicitation
- Sensitivity analysis continues as we get the model up and running

**Table 3. Parameter values collected in the Ohio GMB and corresponding empirical values obtained from Medicaid and peer-reviewed articles.**

| Variable Name from Model | Units | Min | Max | Median | Mean (ConfInterval) | Empirical Data |
|---|---|---|---|---|---|---|
| Fraction of low social risk screened as uncomplicated | Fraction | 0.5 | 0.9 | 0.8 | 0.78 (0.63,0.92) | 0.51 |
| Fraction of low social risk giving uncomplicated birth | Fraction | 0.7 | 0.9 | 0.8 | 0.83 (0.77,0.88) | 0.62 |
| Fraction of low social risk with complicated pregnancy giving complicated birth | Fraction | 0.1 | 0.8 | 0.2 | 0.35 (0.13,0.57) | 0.63 |
| Fraction of high risk screened as uncomplicated | Fraction | 0.075 | 0.8 | 0.3 | 0.35 (0.18,0.51) | 0.44 |
| Fraction of high social risk giving uncomplicated birth | Fraction | 0.2 | 0.9 | 0.45 | 0.49 (0.30,0.68) | 0.55 |
| Fraction of high social risk with complicated pregnancy giving complicated birth | Fraction | 0.15 | 0.9 | 0.55 | 0.53 (0.31,0.75) | 0.68 |

Data is Not "In Range"

Empirical Data is "In Range"

# Part III: Advance Look at Model Results as of February, 2017

Model Development is Still in Process

# The Following Preliminary Runs are based on the structure elicited in August, using data available very soon after the conference

# Thank You and Questions

UNIVERSITY AT ALBANY
State University of New York

Virginia Tech

OHIO STATE

# Part I: High Level Overview of Group Model Building Techniques

Some Basic Principles to Get This Talk Started

# What is Group Model Building?

- A form of group decision support, involving a group of stakeholders with a complex problem

  - Group facilitation
  - Model building and refinement in public
  - Simulation of scenarios and strategic options
  - Extensive facilitated discussion and analysis
  - Facilitated policy design and decisions

# What is Group Model Building?
# Components of the Process

- Problem definition meeting
- **Group modeling meeting**
- Formal model formulation
- Reviewing model with model building team
- **Rolling out model with the community**
- Working with flight simulator
- **Making change happen**

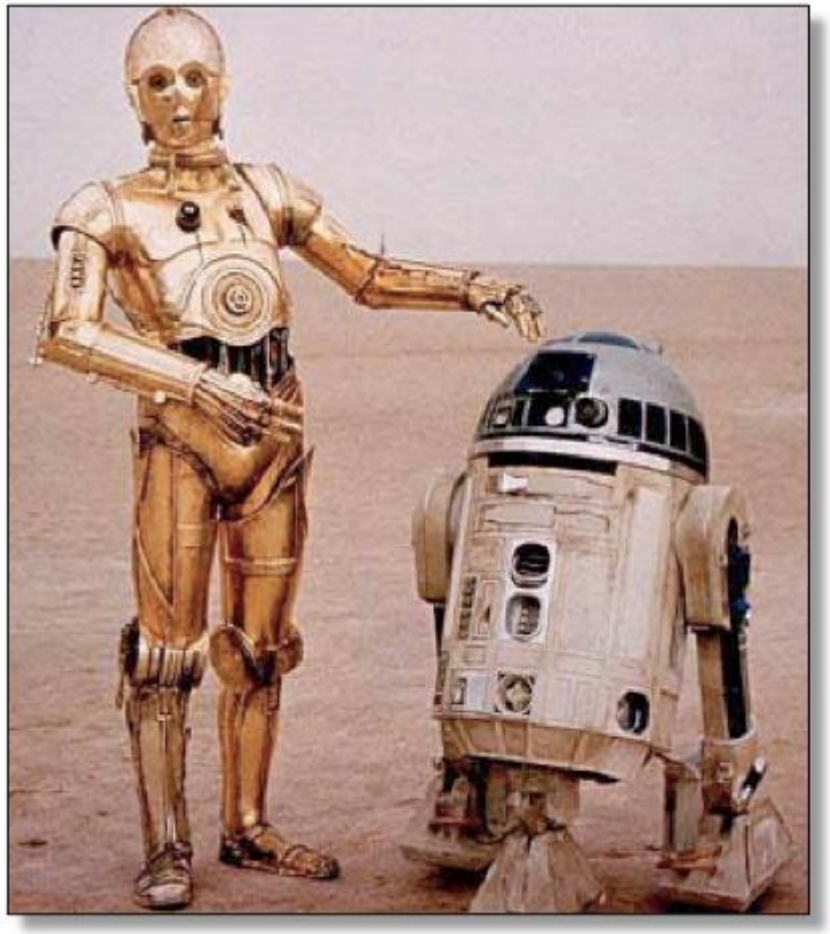
# What is Group Model Building?

- Principles as a “Three-Legged Stool”

  - Roles
  - Scripts
  - Improvisation

# The Albany Teamwork Approach
# The “First Leg” on our GMB Stool

- Facilitator / Elicitor
- Modeler / Reflector
- Process coach
- Recorder
- Gatekeeper



# Scripts—Our “Second Leg” for GMB
# Typical First Group Model Building Scripts

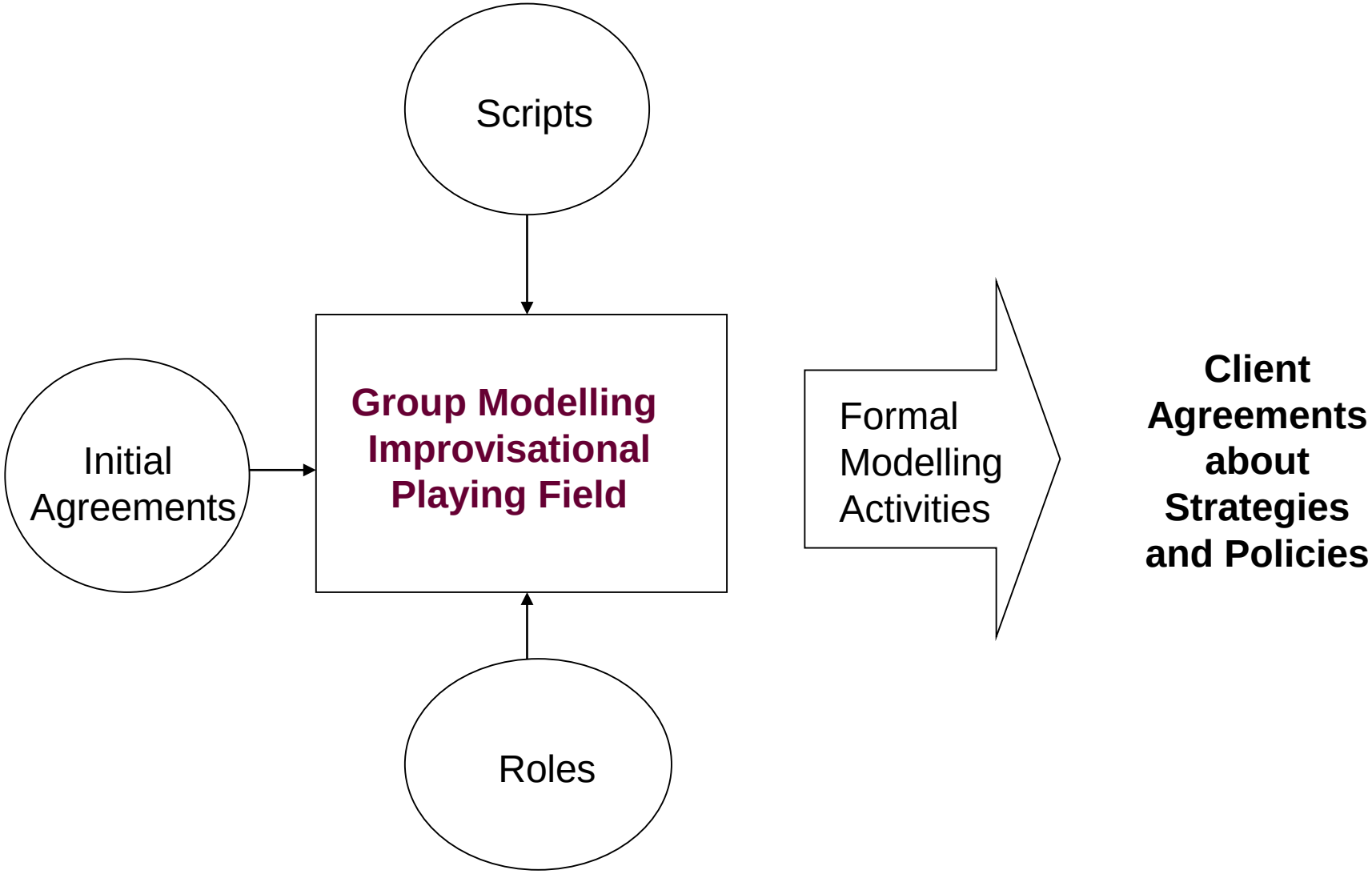
- Introductions:  Hopes and Fears
- Stakeholders
- Introduction to simulation:  Concept models
- Client flow elicitation
- Policy resources and clusters
- Mapping policy influences
- Next steps for client group and modeling team

# Improvisation as the "Third Leg"

- Introductions:  Hopes and Fears
- Stakeholders
- Introduction to simulation:  Concept models
- Client flow elicitation
- Policy resources and clusters
- Mapping policy influences
- Next steps for client group and modeling team

How do we manage these conversations?

# Improvisation as a Key Activity in Group Modelling

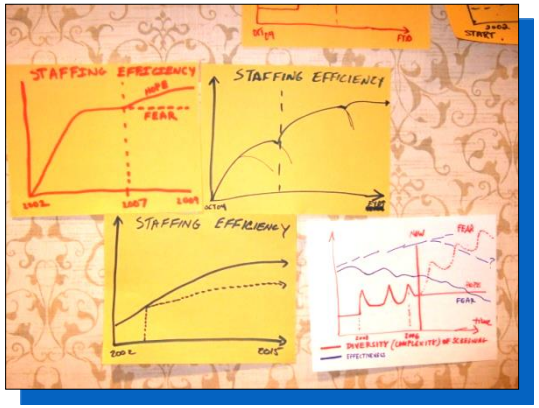


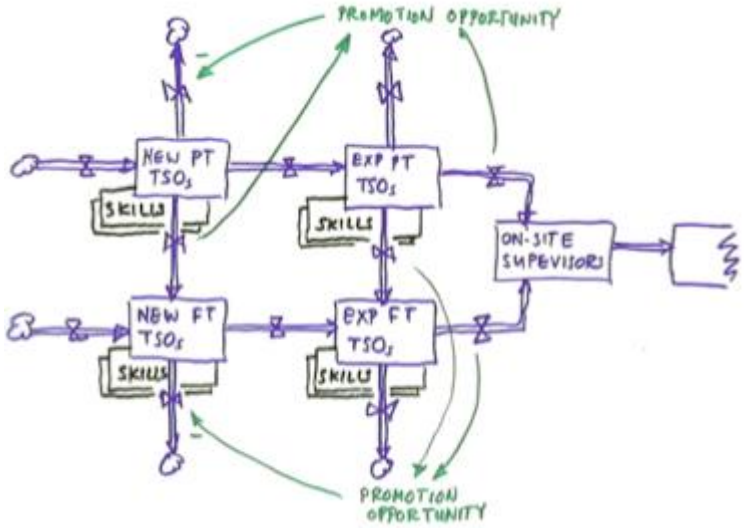
# Tensions in Group Model Building

- Client Mental Models ⟷ System Dynamics Modeling Principles
- Natural Language ⟷ Model Equations
- High Semantic Requirements ⟷ High Syntax Requirements
- Correspondence ⟷ Coherence

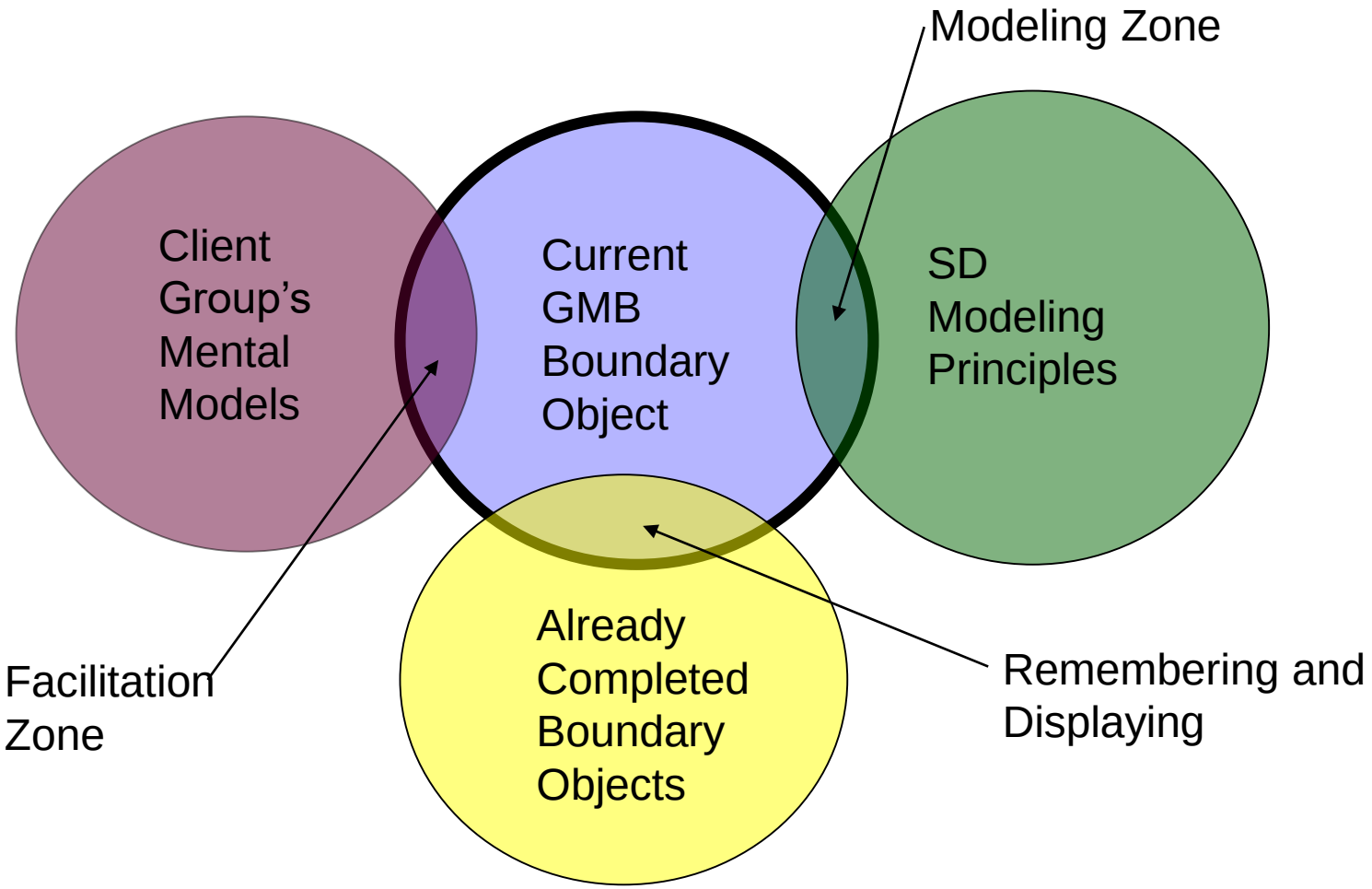
# Examples of Boundary Objects in SD GMB

- Client-Authored such as…
  - Variable Graphs Over Time
  - Stakeholder Power X Interest Grid
- Facilitator-Authored such as…
  - Sketches of Model Feedback
  - Structure on the White Board
- Modeler-Authored such as…
  - Refined Sketches of Model Structure in Modeler Feedback Script

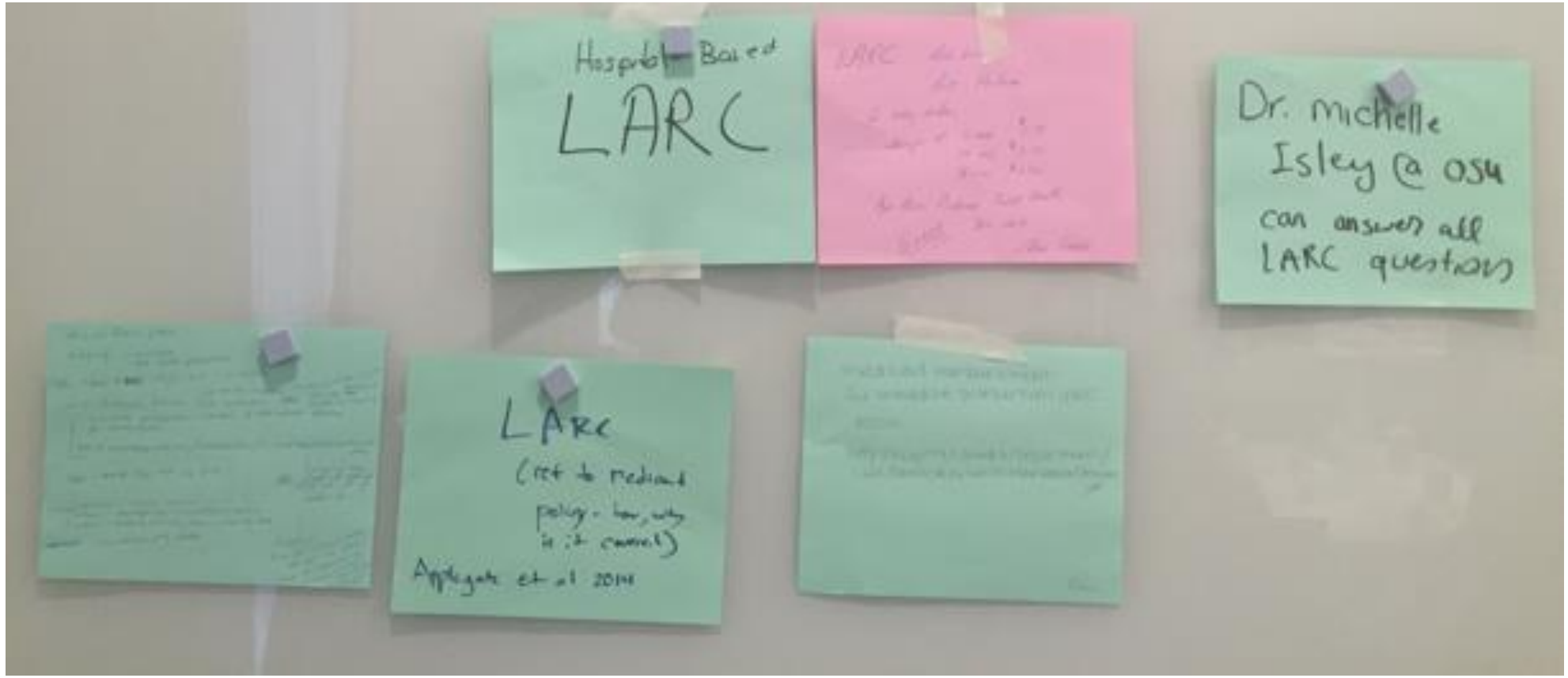


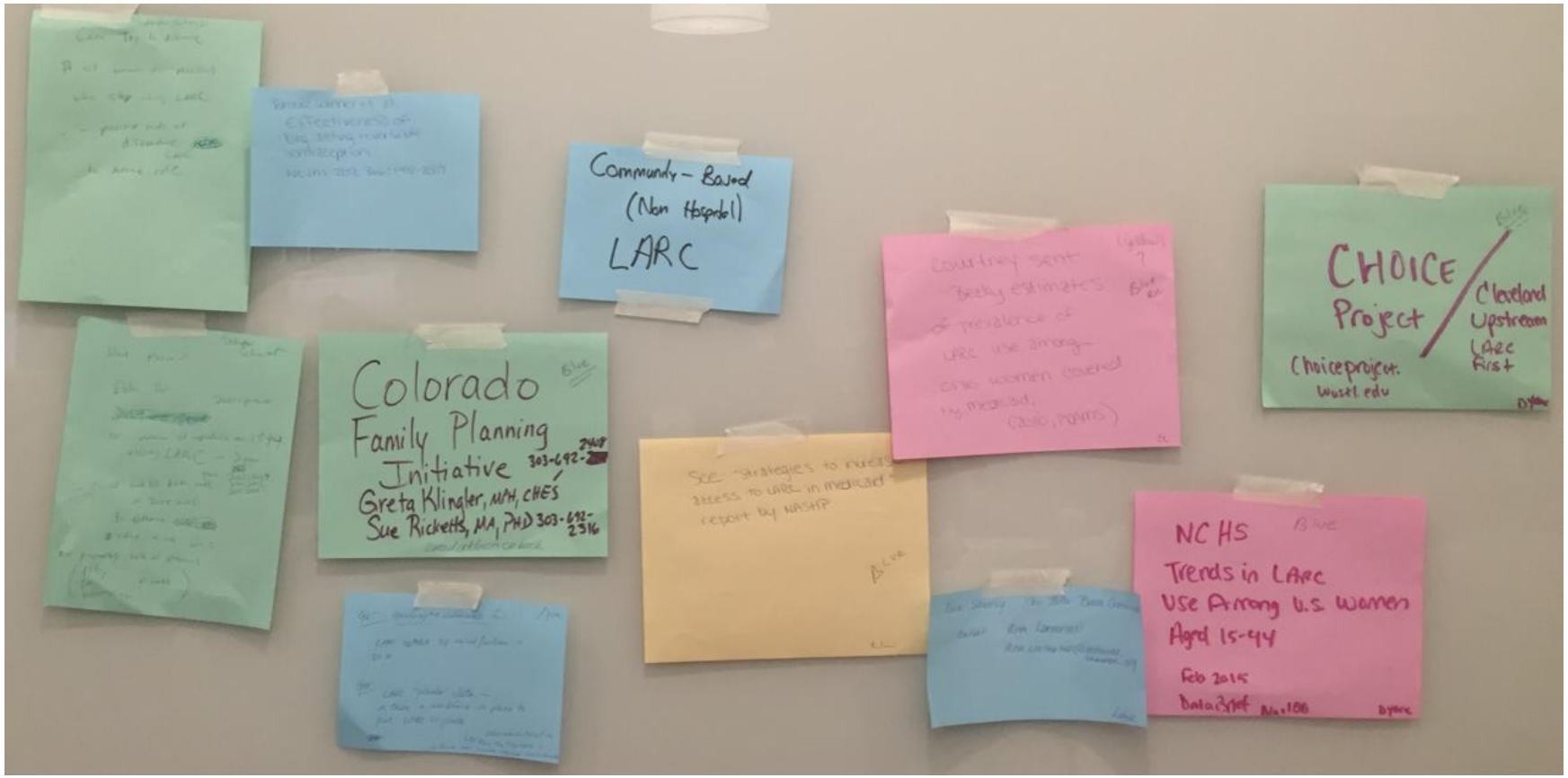
# Boundary Objects Manage Tensions Between Mental Models and Good Modeling Principles



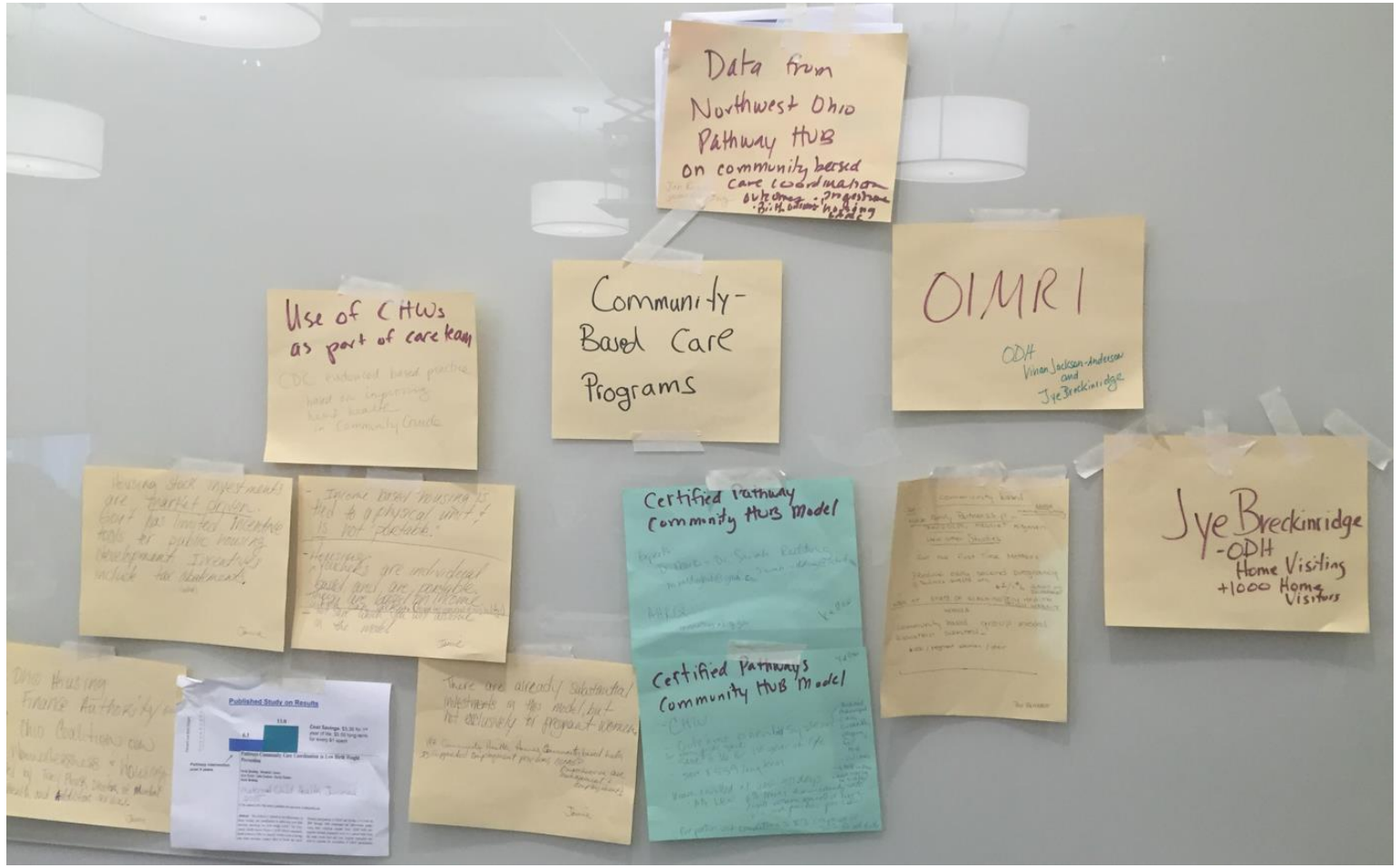
# Evidence for LARC (11:30 AM Day Two)



# Evidence for Community-Based (Non Hospital) LARC (11:30 AM Day Two)



# Evidence for Community-Based Care Programs (11:30 AM Day Two)



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