Methods and Results from Parameter Estimation Exercises Used in 2-Day Group Modeling Session for Ohio Infant Mortality Study

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***Abstract**: Much of the existing group model-building literature focuses on approaches to defining model boundary and conceptualizing overall model structure including the creation of a backbone stock-and-flow structure as well as mapping key feedback structures into the model. Detailed formulation and parameter estimates are often left to back room techniques. This paper reports on the use of three scripts designed to engage groups in tasks related to model parameterization. The paper describes the context of the study—a group model building session hosted by the Ohio State University and focusing on infant mortality in the state of Ohio—and then proceeds to lay out the agenda for the two-day group modeling project. We discuss in detail how three scripts were used and also present a summary of the data that was collected to parameterize the final model. The paper sketches how that data has been used to support the rapid prototyping of the first phase of a running simulation model.*

1. Adding a Quantitative Emphasis to Group Model-Building Techniques

Over the past three decades, system dynamics group model-building (GMB) has evolved by introduction of multiple scripts and applying them to diverse projects. These scripts combine the related group decision-making methods and system dynamics modeling approach to address issues arising when clients are directly involved in the development of a system dynamics model. The use of scripts in group model building was initiated by Andersen and Richardson (1997) and was extended by others (Hovmand et al., 2012; Luna-Reyes et al., 2006). Current scripts have been designed to define model boundaries and to conceptualize overall model structure. Parameter estimations were retained with specific values determined after the GMB. However, the GMB participants are subject matter experts and policy makers who are likely to contribute good estimates of parameter values or know where the values can be found.

This article presents three scripts intended to elicit rough estimates of parameter values from participants, identify data sources, and set the scope of the model. These scripts were tested in a GMB conducted at The Ohio State University (OSU) for the Infant Mortality Research Partnership (IMRP) project. We apply the framework suggested by Hovmand et al. (2012) to document these scripts and explain the sequence in which they should be used.

The paper is organized into six sections. The second section provides an overview of the IMRP and the third section summarizes the two-day GMB session conducted in Ohio. A description of the scripts used in the GMB is provided in the fourth section. The fifth section presents the results of a parameter estimation exercise and the final section provides concluding remarks and suggest next steps.

2. Infant Mortality in the state of Ohio

Ohio ranks 45th out of 50 in the United States with an overall infant mortality rate (IMR) of 6.8 per 1,000 live births in 2014. More alarmingly is the racial disparity in terms of IMR. The rate among White and Black babies was 5.3 and 14.3, respectively. These dramatic statistics have incentivized Ohio to carry out various initiatives at multiple levels to reduce the overall IMR and remove racial inequities in birth outcomes and infant mortality among Ohioans. At the state level, initiatives have mainly focused on the following: i) increased sharing of data across multiple agencies, such as the Ohio Department of Medicaid, Ohio Department of Health and Ohio Department of Jobs and Family Services, ii) addressing the social determinants of health, iii) implementation of evidence-based community interventions, and iv) quality improvement initiatives in the health care system. At the county level, public health departments have implemented several maternal and child health programs to improve the coordination of care and allocation of resources. One example is the Celebrate One initiative, which is a partnership with Columbus Public Health that aims to educate pregnant women and connect them with resources before, during and after the birth of their baby to reduce the risk of adverse outcomes, such as preterm birth and post-neonatal death. At the city level, there are more focused programs such as Moms2B, which is a group prenatal care education initiative targeting very low income Black women in Columbus, Ohio through clinics in the poorest neighborhoods. The integration of these interventions may improve the effectiveness of individual and multi-pronged approaches to reduce infant mortality throughout the state.

In March 2016, the State of Ohio released a request for proposal that sought research in multiple areas related to infant mortality using various methodologies. This broad research program, the Infant Mortality Research Partnership (IMRP), is administered and managed by the Government Research Center (GRC), a biomedical research center within OSU's Wexner Medical Center. The IMRP consists of four projects briefly described, below:

- Systems modeling of infant mortality to identify optimal interventions for reducing infant mortality in Ohio;
- Predictive (statistical) modeling of clinical and non-clinical factors to predict the probability of preterm birth, neonatal death and post-neonatal death;
- Spatial analysis of infant mortality cases in Ohio to identify hotspots and geographical risk factors; and,
- Evaluation of a home-visiting program for prenatal care among vulnerable communities.

Our team was funded to conduct research in the area of systems modeling of infant mortality. The three primary objectives of our proposal include:

1. Conduct a group model building workshop and develop a system dynamics model of infant mortality in Ohio,
2. Develop a causal structural model of infant mortality interventions, and
3. Develop an agent-based model of infant mortality in Ohio.

Members of our team include one principal investigator and multiple co-investigators, leading the research for each of the three objectives. The team also consists of graduate students and postdoctoral researchers. The diversity of research expertise of our team members was perhaps the greatest strength of our proposal. This expertise includes knowledge of multiple modeling methodologies (e.g., system dynamics, agent-based modeling, and causal modeling), numerous disciplines (e.g., perinatal epidemiology, social work, public policy, and education) and broad ranging experiences (e.g. working with state agencies, federal programs, and healthcare partners). This diversity in expertise has also served our team members in being able to translate and bridge gaps in our individual knowledge regarding modeling and the clinical and non-clinical determinants of infant mortality.

3. Two-day Group Modeling Session for Infant Mortality Project

The GMB in Ohio was conducted to collaboratively develop a system dynamics model of infant mortality in the state for examining the effects of different interventions intended to reduce infant mortality. To achieve this purpose, the two-day session was designed in alignment with GMB best practices (Andersen & Richardson, 1997; Luna-Reyes et al., 2006; Richardson, 2013). The number of participants was limited to 12-15 experts with relevant background/disciplines on the topic of infant mortality to encourage direct engagement. The project team strove to achieve balanced representation from relevant stakeholder groups, and to ensure that individuals with different content expertise relevant to infant mortality and its contributing factors were present. The facility chosen for the GMB event provided a flexible, convenient, and supportive space for the sessions. Members of the research team were assigned specific roles *a priori*, to ensure that the process and documentation of the model building session were seamless.

In preparing for the GMB, the research team consulted with the client to identify appropriate candidates to recruit as participants, thereby assuring key stakeholder constituency representation. Individuals selected for invitation included those invested in addressing Ohio’s infant mortality problem in one of three sectors: medical (including researchers and practitioners), policy, and community-based/non-profit organizations. Every effort was made to balance representation between these three groups, such that no stakeholder group was overrepresented. Additionally, consideration was given to the content expertise of each participant. Given the scope of the project it was critical that expert knowledge was inclusive of both medical contributors to infant mortality and social determinants of health, as both mechanisms are considered to be priorities by the IMRP. Thirteen content experts, or “core participants,” were present during the full two days. The client and funder also requested the presence of seven additional attendees, or “participants.” Participants observed activities early on the first day and at the conclusion of the second day.

Integrated technology and the availability of white boards were prioritized in the facility selection process; the room had white boards spanning three walls and had two large screens for projecting (Andersen & Richardson, 1997). Tables were arranged in small clusters throughout the room to provide participants with ample working space while also fostering social interaction (Hovmand, Rouwette, Anderson, Richardson, & Kraus, 2013). Facility selection for the GMB session was designed to encourage all-day attendance by being somewhat removed from attendees’ workplaces, but still convenient for the majority of participants to travel to the session.

Prior to the two-day model building session, interviews were held with three major constituency groups. Representatives from Medicaid and the Ohio Department of Job and Family Services were engaged, as well as a nationally renowned clinical researcher with content expertise relevant to infant mortality. These interviews had several purposes. First, they provided an opportunity to acquaint the model building team with some of the key concepts related to infant mortality. They also provided some background relevant to the context of infant mortality efforts in Ohio, including who “owned” the problem of infant mortality. This helped to elucidate some of the complexity around the topic, and the intersections of many of the ongoing local and state-wide efforts to address infant mortality. These interviews also provided a critical opportunity to ensure the proper stakeholder balance was achieved at the two day GMB session. Following these interviews, the research team worked closely with the interviewees and client to identify additional individuals, whose presence at the model building sessions was essential.

Prior to the model building session the team met to finalize the two-day agenda, and to identify roles for the project team (Richardson & Andersen, 1995). The group was led by one facilitator, and one of the research team members served as a gatekeeper. There were two modelers on staff who presented an initial example of a systems dynamics model, and captured the group’s models in Vensim (Ventana Systems, 2006) throughout the two days. Two individuals acted as recorders, keeping an ongoing log of the group activities and transcribing them electronically, to be presented back to the group at several checkpoints, and in the final document highlighting the activities of the model building session. The remaining project staff served as support for the facilitator, and in some cases clarified terminology used by participants for the model building team.

Over a two-day period, the group was led through a series of activities (i.e., scripts) designed to develop a model that was inclusive of some of the key drivers of infant mortality which were identified and prioritized by participants. During this time, the model building participants grappled with deciding the most important interventions to include, both in recognition of the importance of each variable in reducing infant mortality and in order to be responsive to the priorities identified by the IMRP. The two-day model building session concluded by discussing next steps both for the model building process and the IMRP research project on systems modeling. A more detailed discussion of the scripts including the three new proposed scripts follows, below.

4. Using Three Scripts to Support Parameter Estimation and Elicitation of Data to Support Effect-Size Formulations

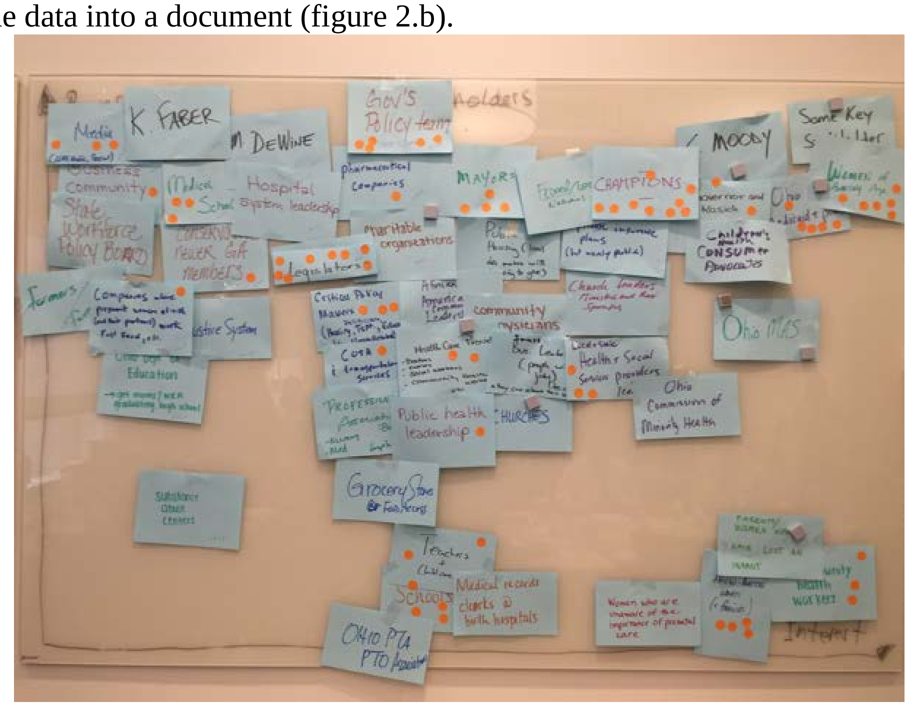
In this section, we explain the scripts used to elicit model boundaries and to conceptualize the model structure. These scripts were developed and facilitated by previous modelers (Andersen & Richardson, 1997; Luna-Reyes et al., 2006). In addition, we introduce three scripts to set the scope of modeling projects, to collect values of model parameter, and to identify sources of data. Explanation of each script includes its objective, processes to conduct it, and outputs generated in the infant mortality GMB.

4.1. Model Boundary Elicitation:

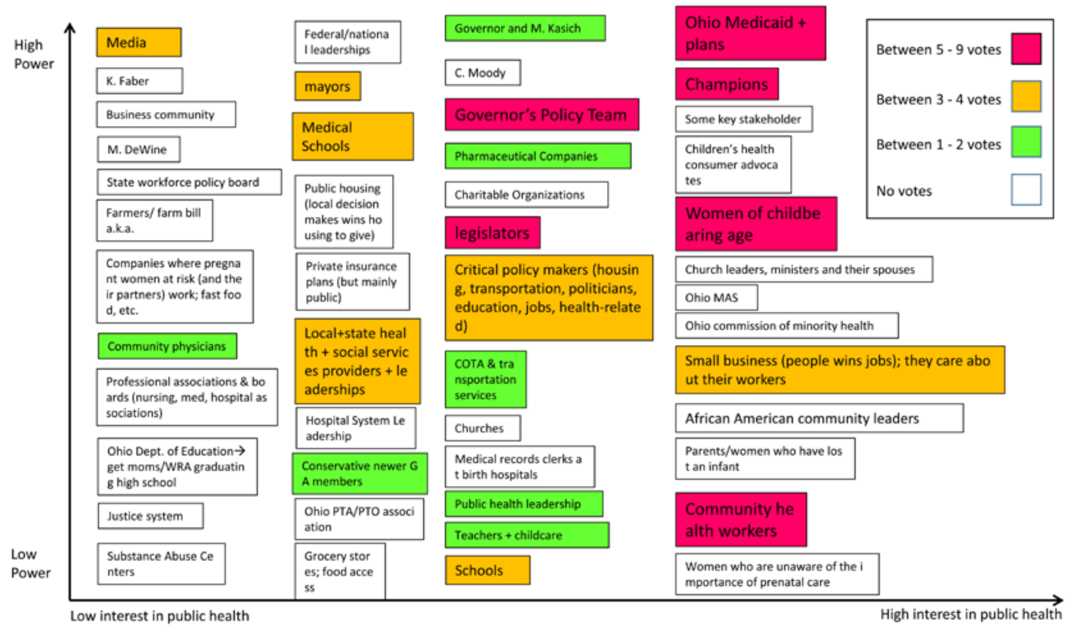
Objectives: The GMB was opened by conducting the “hopes and fears” script (Luna-Reyes et al., 2006). The facilitator then moved on to the “model boundary elicitation” exercise, which includes two separate activities: identifying key stakeholders and policy levers. The key stakeholders exercise intends to generate a list of important stakeholders and identify their power and interest. The policy levers exercise gathers policy options from subject matter experts and suggests policy interventions for inclusion in the model. Both of these tasks are divergent, providing an array of diverse information about stakeholders and policy options.

Process: In the key stakeholder exercise, participants are given sheets of colored papers and instructed to write stakeholders on them, (i.e., one per sheet). Participants work individually to maximize the diversity of collected information and to avoid anchoring (i.e., focusing on a piece of information offered by others). The facilitator sketches a diagram in which power and interest of stakeholders are written on the vertical and horizontal axes of the diagram, respectively. Then the facilitator asks each individual to read their selected stakeholder and tell where on the diagram it should be posted. The facilitator gathers participants’ input in a round-robin fashion (Figure 1.a). This process may be repeated multiple times until all participants read their candidates. Finally, the facilitator distributes colored dots and asks participant to vote for the most important stakeholders. Those with the highest number of votes are recorded as the main takeaway of the script. A recorder captures photos of the script and types the results into a MSWord or MS PowerPoint document (figure 1.b).

The same processes are followed for the policy levers exercise. Each participant reads their policy lever in a round-robin fashion until all participants have shared their thoughts. One of the modeling team member clusters collected information by topic on the board (figure 2.a). Then a recorder types the data into a document (figure 2.b).

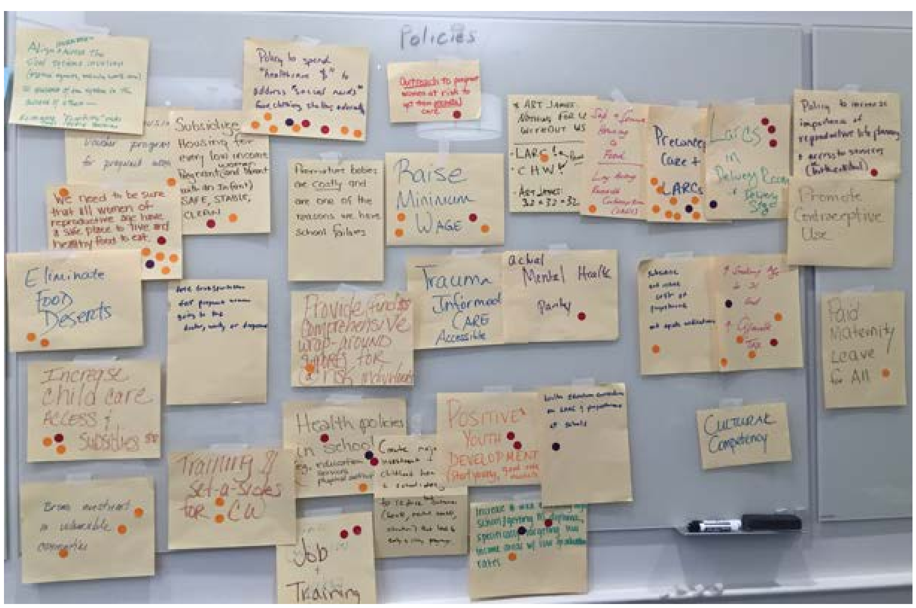


a) Stakeholders written and voted on by participants

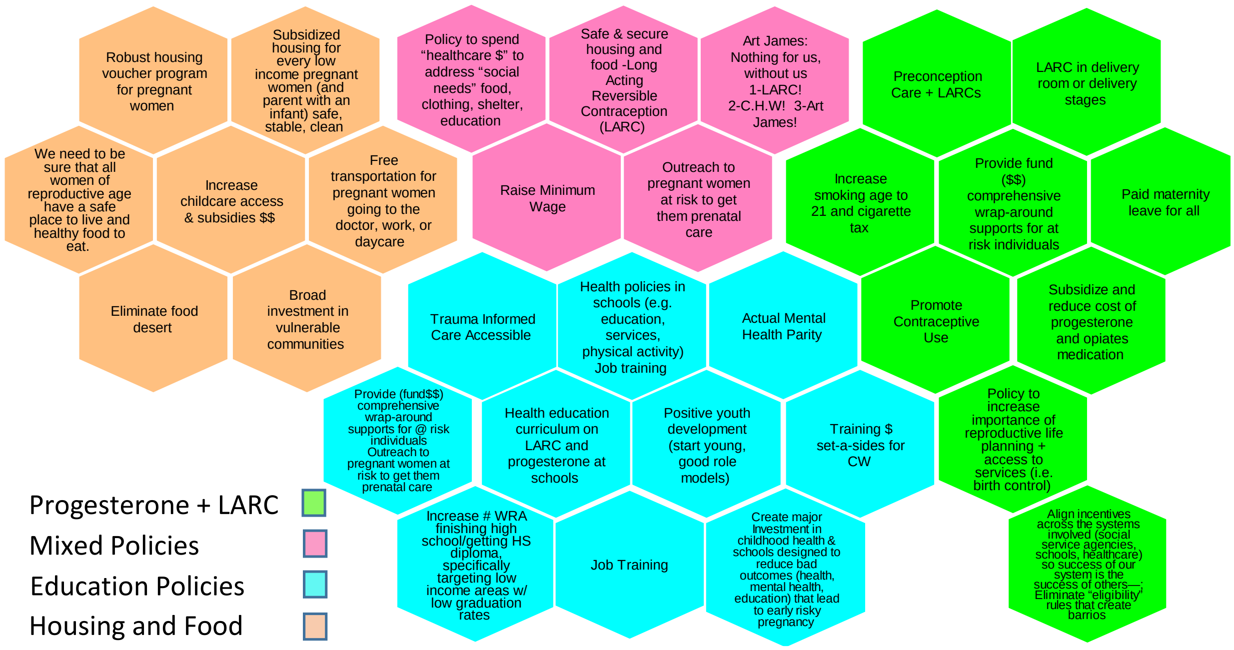


b) Stakeholders information transferred to a MSWord document

Figure 1: Key stakeholders collected in the morning of the first day. The x-axis represents interest of the stakeholders in public health; the y-axis depicts their power. Stakeholders on the right have higher interest and those in top have higher power.



a) Policy levers written and voted on by participants



b) Policy levers transferred and clustered by the recorder

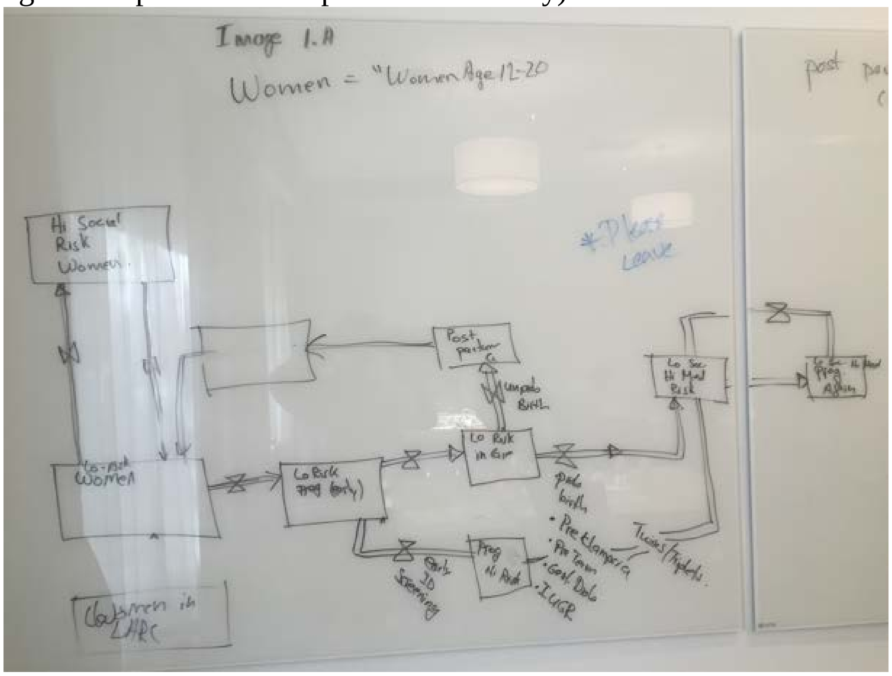
Figure 2. Policy levers collected in the morning of the first day. Policy levers are color coded and categorized into progesterone and LARC, educational, housing and food, and other policies.

After eliciting stakeholders and policy levers, the session moves to the "concept model" script—an exercise in which the modeling team presents a very simple model with few stocks and flows and two or three feedback loops. This exercise introduces basic SD modeling concepts including stock and flow, sets the expectation of the GMB session by exemplifying the final GMB product, shows how behavior of the model is driven by its structure, and encourages participants to develop their own conceptual model (see Luna-Reyes et al. (2006) for the full description of the script and read Richardson (2013) for choosing an appropriate concept model). After this step, the session moves to collecting "graphs over time", which identifies important variables that should be included in the model and their expected dynamic behavior. The "conceptualizing model structure" script comes after the "graphs over time" exercise.

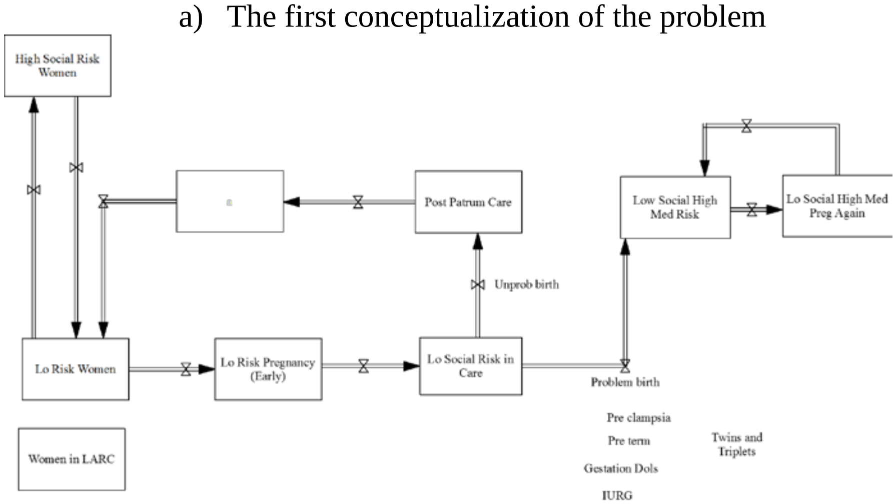
4.2. Conceptualizing Model Structure—Stock and Flow and Feedback Effects.

Objectives: During this exercise the structure of the problem is conceptualized using subject matter experts' knowledge and the skills of the modeling team. In addition, discussion during this exercise aids to define the scope of the modeling project. This is a convergent task aimed at achieving consensus on how to model the problem and it may take hours or days to generate this script's output.

Process: The script is usually run after the lunch break. The modeling team uses the break to wrap up the morning session and discuss a possible skeleton of the conceptual model. After the break, the facilitator begins the exercise by pointing out that the concept model presented represents their mental model of the problem, and then asks the participants to help conceptualize the model structure based on their expertise. In the infant mortality GMB, the first conceptualization of the model was captured after participants' suggestion to separate women based on their social risk, and medical risk, followed by a discussion about identifying women at medical risk (figure 3 captured at 1:30 pm of the first day).



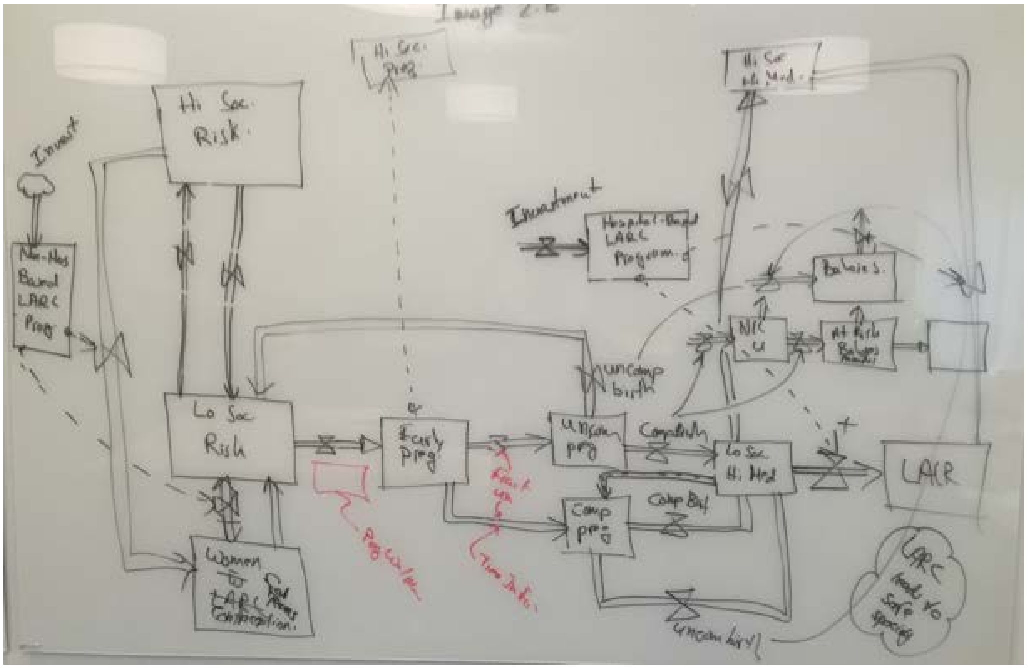
a) The first conceptualization of the problem



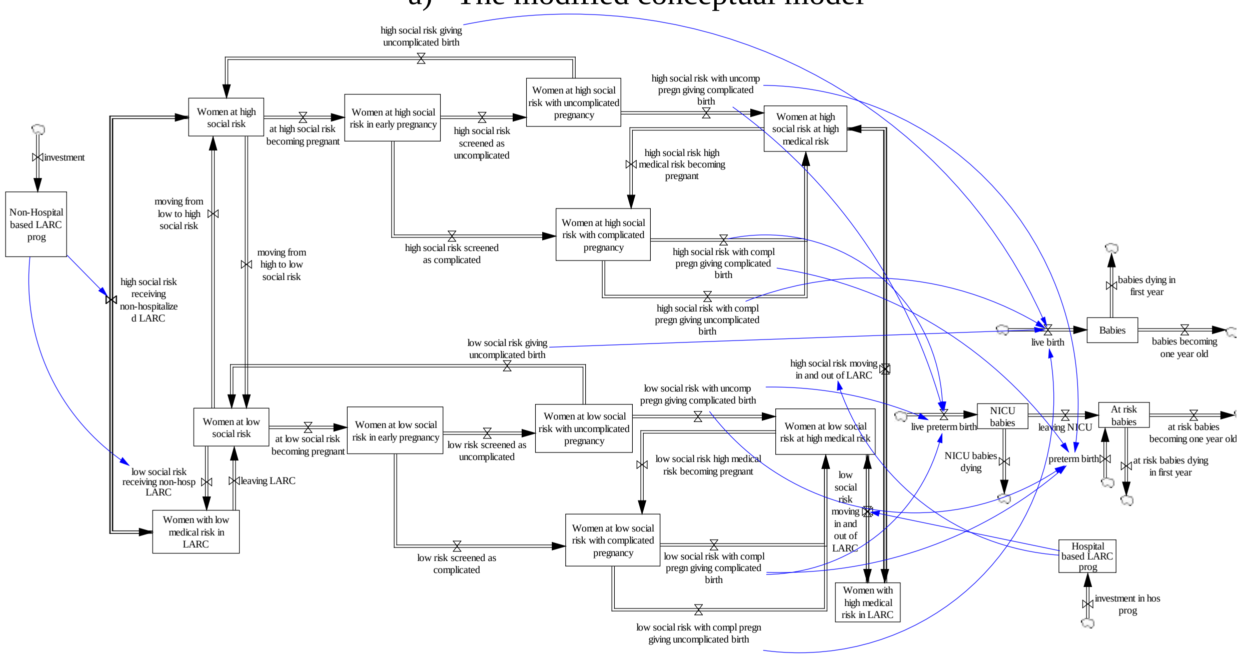
b) The first conceptualization of the problem transferred to Vensim®

Figure 3. The first conceptualization of the problem completed at 1:30 pm on the first day

Then the group discussed the age group and layers needing to be considered in the model. The group agreed to include two age groups: school-age and non-school-age groups. In addition, the first layer will be developed for women with Medicaid benefits. Then the initial conceptual model was refined, the baby sector was included, and one of the policy levers, LARC (Long Acting Reversible Contraception), was added (figure 4).



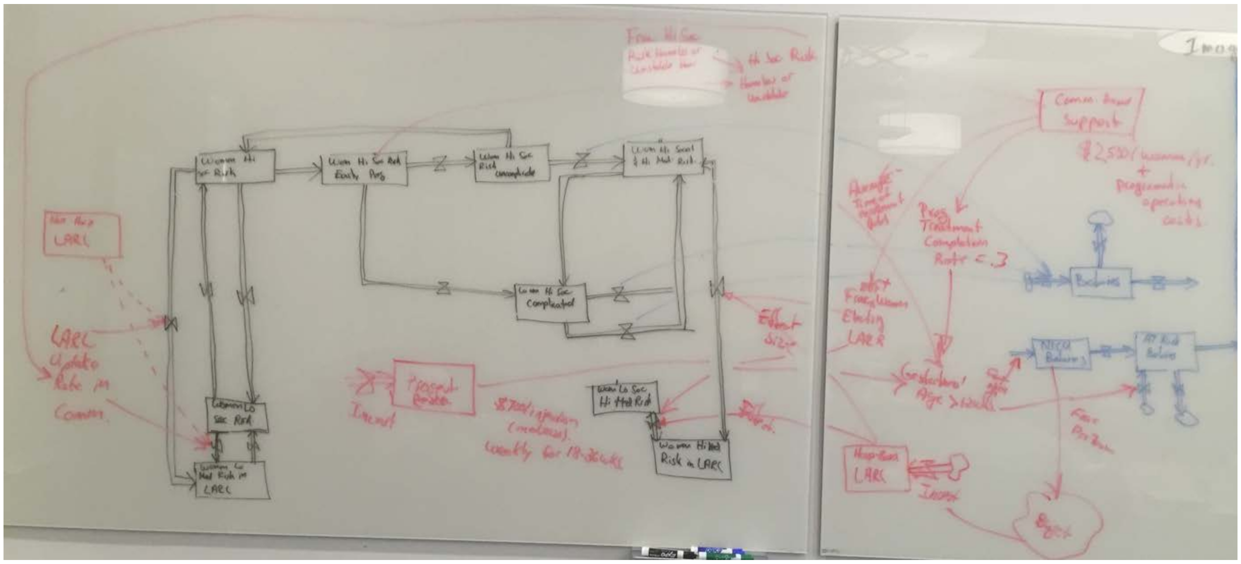
a) The modified conceptual model



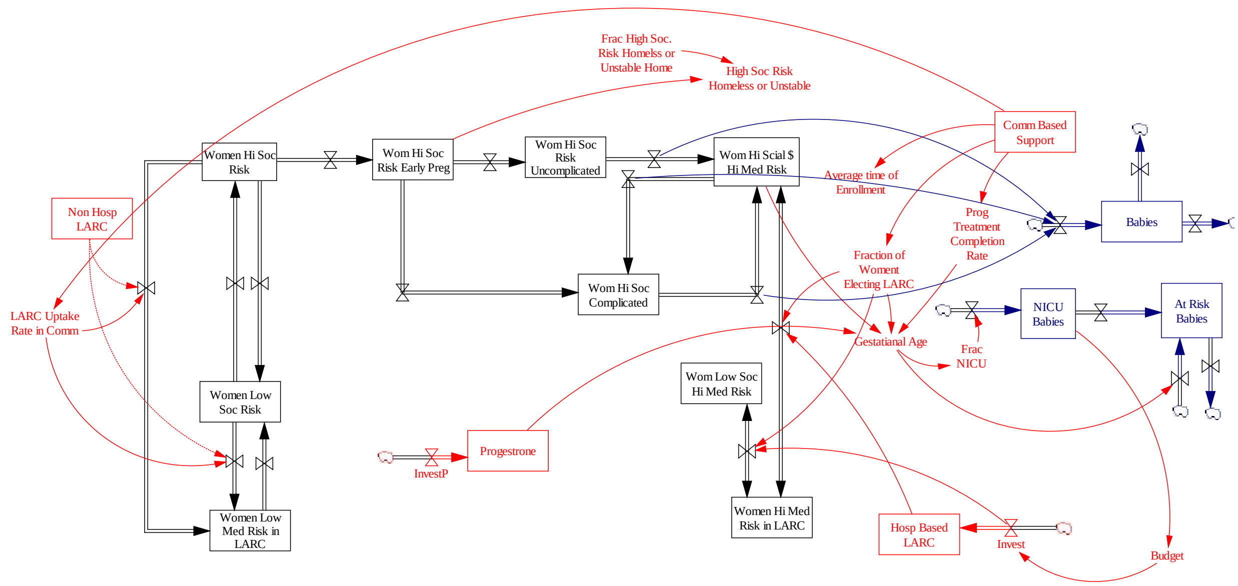
b) The modified conceptual model transferred to Vensim®

Figure 4. The modified conceptualization of the problem completed by 4 pm on the first day

On the second day, the conceptualization of the model structure continued by identifying additional policy interventions. By 10 am on the second day, the group discussed all policy interventions and developed the conceptual model shown in figure 5.



a) The conceptual model completed on the second day



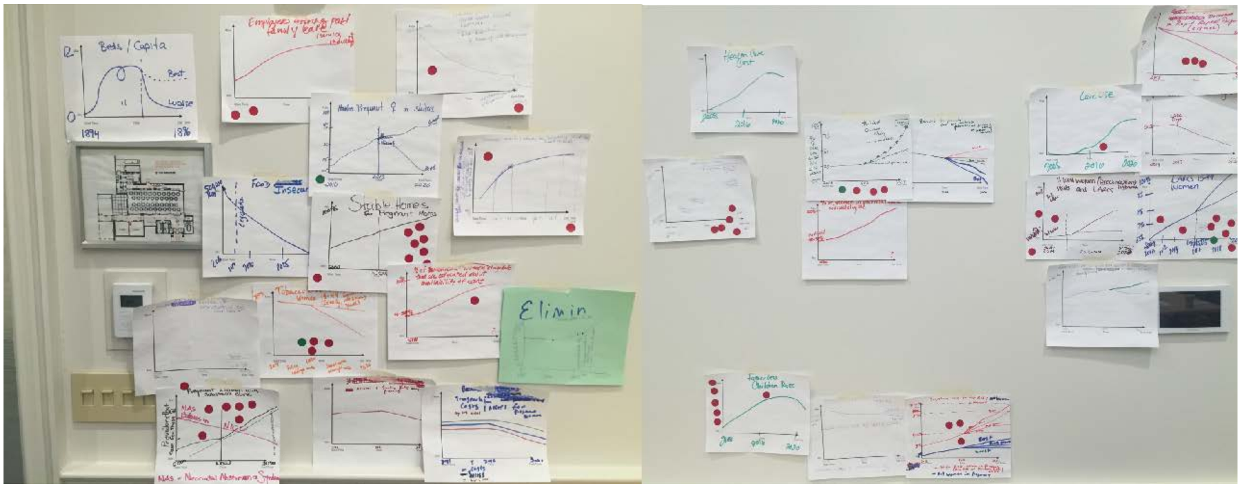
b) The conceptual model completed on the second day transferred to Vensim®

Figure 5. Final conceptual model with babies (blue), women (black), and policy levers (red)

4.3. Using the "Key Takeaway/ Scope Agreement Script"

Objective: After conducting any script, the main takeaway of the script need to be recorded and reported in the final presentation. In addition, it is critical to record the scope of the work after reaching any agreement and present it multiple times during a GMB session. This script explains how the key take away from other scripts can be identified and how a modeling team and participants together define the scope of a modeling effort. The main take away/scope agreement script is a convergent task intended to summarize the key agreements.

Process: The key take away can be generated after conducting a script by asking participants to vote and then record those with the highest votes. For instance, after collecting graphs over time of key variables, we asked participants to prioritize variables by their votes (Figure 6.a). Then the facilitator wrote those with the highest votes on the board and the recorder took photos of the variables posted on the wall, and transferred the data into the power point file (Figure 6.b). In the final report, the image of the board and a slide with typed take away are presented.



a) Graphs over time and assigned votes

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

b) The slide in the presentation that shows the prioritized variables and number of votes

Figure 6. Generating key take away for the graphs over time script made in the morning on the first day

Usually, the discussion about the scope of the model begins after the first conceptualization of the problem and during the model development. A recorder writes the final decision and a summary of the discussion that led to the decision in the final report.

4.4.Parameter Booklet Script

Objectives: The purposes of this script include, (1) eliciting the expert parameter estimates to be used in rapid model building, (2) identifying the possible sources of the data, (3) finding the minimum, maximum, and the median of parameters from a group of experts, and (4) initiating discussions on how a concept is, or should be, measured. This script is a divergent task aimed at producing an array of different ideas and estimations. The mean of experts' parameter estimates provide a starting point for simulating a model before using empirical data analyses to estimate them.

Process: The steps to implement this script are (1) the modeler begins by creating a Vensim® sketch of the model structure that has been agreed upon by the client group, (2) the modeler identifies the parameters of the developed model in the GMB sessions (figure 7). This step may require that the modeling team complete some off line work on the preliminary formulation of key rates to more clearly define key parameters, (3) The modeler inserts all identified parameters into the Vensim® map using a different color, such as green, to distinguish them from non-parameters, (4) All key parameters identified in the Vensim® map are typed into the first column of a spreadsheet or parameter booklet (table 1). The second column indicates the units of the parameter, and the third column is left blank for members of the client group to fill in using their best judgement. The final column is used to collect additional information about the parameter being elicited in any given row, including information about who has the best data or where accurate values can be found, (5) The facilitation team prints both the structure of the model with green parameters and the parameter booklet, printing a copy for each member of the client team, and (6) Finally, the team distributes the parameter booklet to participants and asks them to populate the last two columns (table 1). Our experience suggests that the mean value of participants' estimates typically provides reliable values for rapid prototyping of the model (Hosseinichimeh et al., 2017).

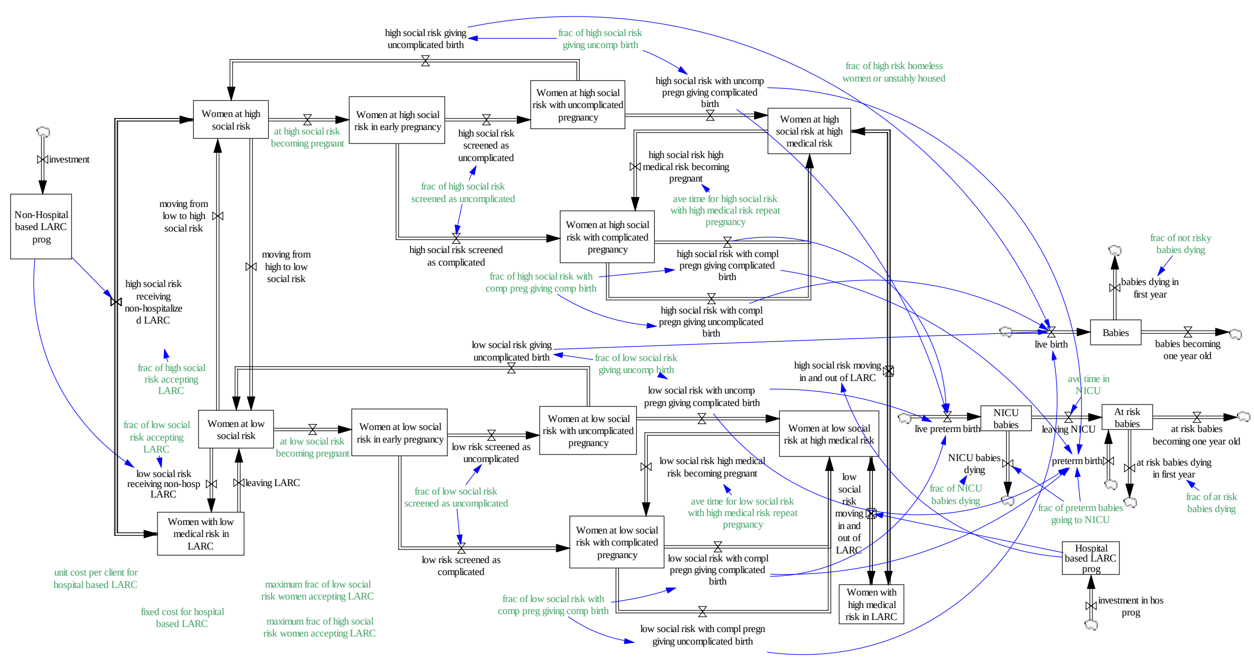


Figure 7. Model structure developed in the first day of the GMB session with model parameters

	Variable name from model	Unit	My estimate	Data type, availability, and sources
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

Table 1. Parameter Booklet

This script should be used toward the end of the GMB workshop, after the group makes the core structure of the model and before wrapping up the project. It is important to have consensus from the group regarding the overall model structure for the script to work effectively, including key stocks and flows. Materials required for facilitating the script include markers, colored papers, and tape. In addition, the script requires that a laptop with printing capabilities be available, as well as a color copier to duplicate the parameter booklet for distribution to participants.

4.5. Creating a Wall of Evidence Script

Objective: This script elicits expert knowledge of model parameters and policy interventions after developing the structure of the model in a GMB session. The purposes of the scripts include, identifying (1) possible data sources, (2) parameter values or effect sizes, (3) useful citations that report effect sizes, cost, or parameter values, (4) subject matter experts who can be reached to determine parameter value, and (5) any cautions or caveats about measures used in the model. This script is a divergent task aimed at producing an array of different ideas, knowledge, and estimations.

Process: The steps to implement this scripts include, (1) a modeler starts by creating a Vensim® sketch of the model structure that has been agreed upon by the client group, (2) the modeler identifies the parameters of the developed model and policy interventions discussed in the GMB sessions, (3) facilitator writes the name of each identified parameter or policy intervention on colored sheets and posts them on multiple boards, (4) facilitator distributes colored sheets among participants, (5) participants write their information on the associated colored sheets and post them around the subject on the board.

Figure 8 depicts a sample “Wall of Evidence”. The facilitator wrote progesterone policy on a pink sheet and with the input that the modeling team needed from the participants listed on a large white sheet. Then participants were asked to write their responses on pink sheets and post them around the progesterone sheet. Upon completion, this information is transferred into a MSWord document (Appendix 1 shows the information recorded from the “Wall of Evidence” for the progesterone policy).

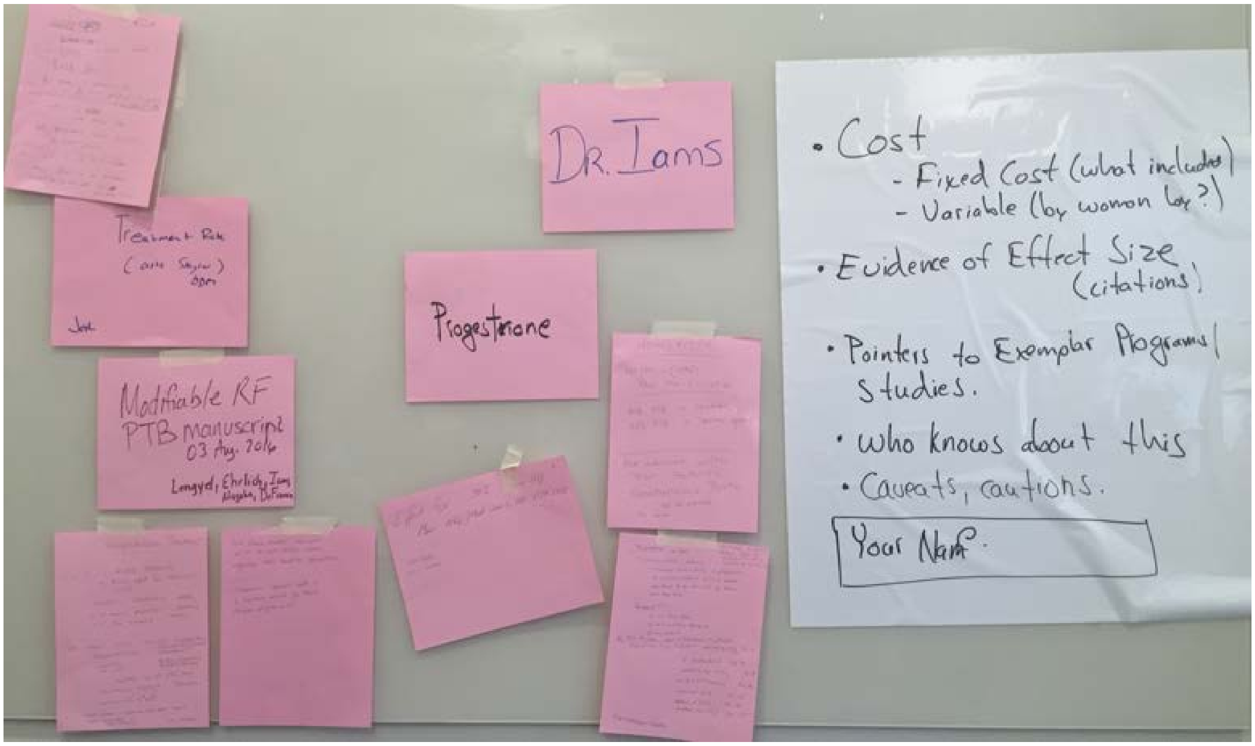


Figure 8. The “Wall of Evidence” for the progesterone policy intervention

This script can be executed using only 30 minutes of group time. Although it requires that model structure be well-developed, the modeling team does not need to devote much time to setting up the exercise. The targeted parameters or policies are simply written on the board and participants post their knowledge pertaining to each parameter or policy. The only supplies needed are markers, colored papers, and tape.

5. Summary of Data Collected and Next Modeling Steps

The modeling team calculated the median, mean, minimum, and maximum of all parameter values reported by the participants and used the means to formulate the first initial SD model (table 2). Usually, it takes a considerable amount of time for clients to provide such data or for modelers to locate and access accurate data; thus, fast elicitation of parameter values in a GMB allowed the modelers to address main structural issues of the simulation model while they wait to receive the accurate data. In addition, formulating the model using the subject matter experts’ estimates before getting the accurate data helps the modelers to refine the list of relevant data and, therefore, save time. For the IMRP, we conducted the GMB in August and we formulated the model immediately after the session using parameter values collected by the “Wall of

Evidence" and "Parameter Booklet" scripts. Formulating the model before sending the list of required parameters to the Ohio Department of Health helped us to rapidly develop the simulation model, resolve the modeling problems, and modify the list of parameter values. We have not received the data that we requested yet. After we get the data, we will compare them with the data gathered in the GMB and evaluate the effectiveness of the proposed scripts.

Variable Name from Model	**Units**	**Median**	**Min**	**Max**	**Mean**
Women					
At low social risk becoming pregnant	Women per month	3500	600	6000	3695 (2022,5368)
Fraction of low social risk screened as uncomplicated	Fraction	0.8	0.5	0.9	0.78 (0.63,0.92)
Fraction of low social risk giving uncomplicated birth	Fraction	0.8	0.7	0.9	0.83 (0.77,0.88)
Fraction of low social risk with complicated pregnancy giving complicated birth	Fraction	0.2	0.1	0.8	0.35 (0.13,0.57)
Average time for low social risk with high medical risk for repeat pregnancy	Month	24	12	24	20 (15,25)
At high social risk becoming pregnant	Women per month	5400	1500	6000	4619 (3411,5827)
Fraction of high risk screened as uncomplicated	Fraction	0.3	0.075	0.8	0.35 (0.18,0.51)
Fraction of high social risk giving uncomplicated birth	Fraction	0.45	0.2	0.9	0.49 (0.30,0.68)
Fraction of high social risk with complicated pregnancy giving complicated birth	Fraction	0.55	0.15	0.9	0.53 (0.31,0.75)
Average time for high social risk with high medical risk for repeat pregnancy	Month	12	8	42	16.5 (8.6,24.4)
Babies					
Fraction of pre-term babies going to NICU for low social risk	Fraction	0.1	0.035	0.95	0.28 (0.02,0.54)
Average time in NICU for low social risk	Days	7	0	34	12 (4,20)
Fraction of NICU babies dying for Low Social Risk	Fraction	0.055	0.005	0.25	0.079 (0.002,0.155)
Fraction of at risk babies dying from low social risk	Fraction	0.05	0.004	0.3	0.074 (0,0.152)
Fraction of pre-term babies going to NICU for High Social Risk	Fraction	0.25	0.075	1	0.47 (0.21,0.74)

Average time in NICU for High Social Risk	Days	20	7	35	21 (13,28)
Fraction of NICU babies dying for High Social Risk	Fraction	0.15	0.01	0.4	0.168 (0.063,0.272)
Fraction of at risk babies dying from high social risk	Fraction	0.08	0.008	0.3	0.096 (0.018,0.173)
Long Acting Reversible Contraception (LARC)					
Unit cost per client for hospital based LARC	Dollars per women	794	400	2500	1039 (293,1784)
Non hospital based unit cost per client	Dollars per women	600	250	1000	595 (364,825)
Fixed cost for hospital based LARC	Dollars per year	500	500	1000	667 (340,993)
Fixed cost for non-medical based LARC		500	250	1000	583 (151,1015)
Fraction of low social risk women accepting LARC	Fraction	0.125	0.068	0.3	0.16 (0.07,0.24)
Maximum fraction of low social risk women accepting LARC	Fraction	0.2	0.12	0.7	0.279 (0.07,0.49)
Fraction of high social risk women accepting LARC	Fraction	0.1935	0.05	0.55	0.25 (0.10,0.40)
Maximum fraction of high social risk women accepting LARC	Fraction	0.2	0.125	0.7	0.31 (0.10,0.53)
Fraction of high risk homeless women or unstably housed	Fraction	0.3	0.25	0.5	0.35 (0.25,0.44)
Others					
Fraction of high risk women accepting LARC	Fraction	0.137	0.1	0.4	0.20 (0.08,0.31)
Cost of progesterone per women	Dollars per woman	9000	120	14000	7624 (2998,12249)
Effect size of hospital based LARC	Dollars per women per year	0.5	0.5	0.95	0.95 (-,-)
Cost of LARC per woman per year	Dollars per women per year	400	100	1000	532 (145,919)
Effect of progesterone on average gestation	Fraction	0.3	0.3	0.3	2 (0.04,3.96)

Effect of increased gestation on fraction going to NICU	Fraction	0.325	0.05	0.5	0.3 (0.12,0.48)
Cost of community support per woman per year	Dollars per women per year	2750	2000	3000	2625 (2156,3094)
Effect of community based support on LARC uptake	Fraction/ Year	0.5	0.5	2	0.875 (0.14,1.61)
Average cost of NICU babies	Dollars/Baby	53000	3000	55000	43200 (23420,62979)
Fraction of women electing to take LARR (Community Based Effect)	Fraction	0.2125	0.068	0.4	0.22 (0.11,0.34)

Table 2. Parameter estimates of subject matter experts

6. Discussion and Future Work

This paper introduces three new scripts, Parameter Booklet, Wall of Evidence, and Key Take Away/Scope Agreement. The first two scripts engage participants in model parametrization and provide modelers with input to formulate the initial model and refine the structure while they are waiting to obtain data. The third script facilitates setting the scope of the modeling effort and records main takeaway outcomes of each script. The processes of implementing each script are explained and the outputs generated in a GMB session for the IMRP in Ohio are presented.

Previous modelers developed and facilitated scripts mostly to define boundaries of the model and elicit the overall structure of the model. Our contribution is to design and test exercises that collect subject matter experts' estimates of parameters for the model. These scripts are fast and easy to implement. Our experience in the GMB conducted in August 2016 showed that these scripts are effective in engaging participants and elicit very useful outputs for the SD modeling of the problem. After we obtain the data from the Ohio Department of Health, we will compare the experts' estimates and empirical data and report to determine the accuracy of the "Parameter Booklet" scripts. Parameters that are different from empirical data are key candidates for further empirical investigation and sensitivity testing in subsequent model development efforts. Estimation methods such as partial model calibration (Ghaffarzadegan, Ebrahimvandi, & Jalali, 2016; Homer, 2012; Hosseinichimeh, Rahmandad, & Wittenborn, 2015), minimum mean square error estimator, and simulation-based estimation methods (Hosseinichimeh, Rahmandad, Jalali, & Wittenborn, 2016; Jalali, Rahmandad, & Ghoddusi, 2013) can be used to estimate such parameters.

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Appendix 1. Wall of Evidence for the Progesterone Policy

Progesterone
- Prg. Gp 1 - Schuyler Schmidt - Connect Tasks – Use Task 2 for Medicaid effect size for use of progesterone on gestational age and IM rate? of High Risk Pregnancy - Also I will check rates of progesterone course completion for Medicaid pregnancies - Also I will try to compute Medicaid effect size of progesterone on gestational age and IM rate for High Risk Women
- Prg Gp 2 - Treatment Rate (ask Skyler) 6DM - JorL?
- Prog. GP 3 - Modifiable RF PTB manuscript 03 Aug. 2016 Lengyel, Ehrlich, Iams, Muguha, DeFranco
- Prog GP 4 Progesterone Treatment 17 – P (Lumara – Makena) ~ $700/inject for Medicaid costs Weekly starting ideally 16-20 weeks gestation – continue till 36 weeks – <u>weekly</u> OR Now using vaginal suppository progesterone <u>nightly</u> – (Prochiere and Crinone) (Prometrium) $1.00 - $2.00/suppository per day starting 16 – 20 weeks and continuing through 36 weeks. Monthly costs @ $60.00 - Most women on Medicaid start later I expect, from 20-24 weeks (not optimal) Dr. Pat Gabbe
Prog. GP 5 - Jane Hamel-Lambert requested SE OH ob-gyn practice data regarding rates completion progesterone - JH Lambert requested data re: # completers served by Family Navigator program in SE
Prog. GP 6 Effect size 34% (low 25%) Meis? New]Med 2003; 348.2379-2385 Dr. Steve Gabbe
Prog. GP 7 Progesterone completion in Central Ohio - Ohio Better Birth Outcomes alicia.leatherman@nationwidechildrens.org
Prog. GP 8 - Published 31 July 2013 Authors Sidd? JM, Jones L, Flonady V, Cincotta R, Crouther CA - Progesterone from JHL <u>Cochrane citation</u> – Library – “Prenatal administration of progesterone to prevent preterm in birth in women considered to be at risk of having their baby early” <u>Beneficial results?</u>

- lower risk baby dying - lower need ventilation after birth - lower NICU admiss % Prior preterm- effect of progesterone vs placebo statistically significant reduction perinatal mortality RR. 50 lower preterm birth RR. 31 infant birth wt? < 2500 g RR.58 use of assisted ventilation RR. 40 Neonatal death RR. 45 Admit to NICU RR. 24 Preterm (del<37) RR. 55
Prog. GP 9 Progesterone NEJM – (1996) Paul Meis et al 55% PTB in Controls 33% PTB in Treated Group - For women with prior preterm spontaneous birth Dr. Pat Gabbe Dr. Gabbe
Prog. GP 10 Dr. Iams