**Additional File 2: Actions and Outcomes of Group Model Building Activities in Case Study**

| Goals | Actions: Session Activities | Time | Actions: Preparation Activities (Modeling Team) | Actions: Follow-Up Activities (Modeling Team) | Outcomes/ Products |
|---|---|---|---|---|---|
| **Individual Sessions** | | | | | |
| Develop a shared level of system dynamics and systems thinking vocabulary and concepts | "Concept Models" script, Learning Lab with lead modeler using exemplar resources from Donella Meadows (1999) and previous core modeling team projects such as the flu. Key concepts included "fixes that fail," dynamic relationships developed through feedback loops, surprising behavior, and system archetypes. Key definitions reviewed included: stocks, flows, leverage points, and feedback loops. | 30 minutes | Tailor "Concept Models" script by preparing example causal loop diagram (CLD) and stock and flow diagram around child flu spread in a classroom. | Refine any language or concepts in the PowerPoint that could be improved for the next partner. | Individual Definitions of systems, child maltreatment and well-being, and prevention that were later synthesized (Additional File 4) |
| Create "mental maps" to make mental models explicit | "Variable Elicitation" Script. Partners were asked to place the phrase "child maltreatment" or "child well-being" in the center of a small white board. They selected whichever concept aligned with their perspective. Next, they were asked to write a few (approximately 5-10) key factors that influenced the concept on their board and arrows of influence between them, denoting whether the relationship was characterized by variables moving in the same (+) or opposite (-) direction. Partners could use either +, - or "S", "O" notation. We chose the generic language of "factors" because saying "risk and protective factors," which are often referred to in the scientific literature, did not resonate with most partners.<br><br>They then extended three to four concepts or key factors from the first high-level CLD on whiteboard to poster paper and expanded on the number of interconnections to have their second CLD depicting a mental model of child maltreatment risk and protective factors in their community. | 90 minutes | Obtain individual-sized white boards for partners to use as they draw initial CLD; tailor "Variable Elicitation" script by identifying prompts to initiate thinking around child maltreatment, child well-being. | Transfer physical maps to modeling software for preservation and then synthesize in online modeling software into one CLD across participants. | Individual Mental Maps: Initial and "Deep Dive" on 3-4 factors<br><br>Initial Synthesized CLD |
| Develop shared | Tailored version of "Creating a Shared Vision" script for individual format. Participants were | 15 minutes | Tailor "Creating a Shared Vision" script for current | Synthesize individual | Vision statement (Additional File 4) |

| definition of problem to be solved and shared vision for project and participation | asked questions from the script and verbally reported answers to the modeling facilitator. | | project that was focused on child maltreatment prevention | statements to draft a shared vision statement. | |
|---|---|---|---|---|---|
| Understand partner perspectives about project participation | Adaptation of "Hope and Fears" Script for individual format. Participants were asked questions from the script and verbally answered the modeling facilitator. | 5 minutes | Tailor "Hopes and Fears" Script to project goal by adjusting prompt to reflect hopes and fears related to child maltreatment in North Carolina. | Synthesize partners' vision statements. | Vision statement (Additional File 4) |
| **Group Session 1** | | | | | |
| Reflect on synthesized project vision, focus population, and shared definition of prevention | Group discussion after presentation of proposed definitions and vision. | 15 minutes | Synthesize individual definitions. | Update definitions based on feedback. | Vision statement (Additional File 4) |
| Reflect on synthesized "mental maps" or Causal Loop Diagram (CLD) | "Structure Elicitation" Script; GMB partners interacted with paper and online versions of synthesized CLD and a Loop Story Table (Additional File 3) to trace feedback loops, correct inaccuracies, and identify missing links and factors. To help participants orient to the CLD, the modeling team first described four feedback loops that were important across participant's interviews in the Individual Session. | 45 minutes | Tailor "Structure Elicitation" script by highlighting feedback loops most often discussed in the Individual Sessions.<br><br>Prepare synthesized CLD in online modeling software (available at: https://kumu.io/gcruden/synthesized-initial-cld#working-map-simplified) and paper copies for participants.<br><br>Create a "loop story table" (Additional File 3) with a row for each partial or complete loop and columns for the | Modify existing synthesized CLD based on immediate feedback and create new, simplified CLD and associated Stock and Flow structure to begin translating the CLD into a quantifiable simulation model. | Refined CLD (Figure 3)<br><br>Refined Loop Story Table (Table 2, including further validation with literature by research team) |

| | | | | | |
|---|---|---|---|---|---|
| | | | pathway elements and a story describing loop behaviors. Stories described why factors were linked and outlined assumptions important for understanding the directionality of interconnections (i.e., why change in one variable caused and increase or decrease in the connected variable). These stories were later triangulated with the scientific literature (Table 2) to increase rigor and generalizability of this learning object. | | |
| Identify key stories shaping trends of child maltreatment | "Behavior Over Time Graphs" Script. Participants drew their "hoped" and "feared" trajectories of factors that they perceived as contributing to child maltreatment in their state. Factors could include individual-level influences such as parental substance use, or meso-level factors such as mental health services funding. The facilitator explained that these graphs can improve quantitative model validity by providing references for how the model output (e.g., trends) should behave. | 30 minutes | Tailor "Behavior Over Time Graphs" Script by preparing a behavior over time graph example that is indirectly related to current project (child grades) so as not to bias examples and multiple, related examples that were verbally explained so that participants can envision stories on different contextual levels (e.g., individual, family, policy, community). | Adapt existing CLD based on new stories eliciting during this script. | Refined CLD (Figure 3) |
| **Group Session 2** | | | | | |
| Review initial structure of a stock and flow system dynamics model | "Presenting the Reference Mode" Script. The modeling team shared the model structure in a piece-wise fashion, noting first the key stock and flow structure that was replicated throughout the model and then showing the expanded structures to: 1) demonstrate how the group's synthesized CLD was translated into a system dynamics simulation model, and 2) obtain feedback on the model boundaries and structural decisions. The modelers also presented key modeling decisions | 45 minutes | Prepare stock and flow structure (Figure 2) and associated Powerpoint slides for walking through model based on the "Presenting the Reference Mode" Script. Tailor script by identifying key dynamics modeled (e.g., families accumulate risk) and decision points, such as how | Adapt CLD into a Stock and Flow structure to prepare for simulation by identifying salient factors and stories brought forth during individual | Refined Stock and Flow structure for quantified simulation |

| | | | | | |
|---|---|---|---|---|---|
| | that were made, including which types of maltreatment were modeled, how maltreatment rates would be calculated, the population being modeled, and time step as well as the time horizon. | | to define risk and model levels of risk. | interviews and Group Session 1. | |
| Select evidence-based prevention programs for simulation | "Dots," "Initial Policy Options," and "Action Ideas" Scripts. First, partners reviewed the Excel spreadsheet prepared by the modeling team and original links to the registries from which the EBP information was drawn (Additional File 6). Second, partners completed an online survey that asked them to rank their top four preferred interventions, to share their logic for why they selected each intervention, and to propose their top four leverage points or action ideas, such as parent stress or childcare subsidies, which may or may not have been targeted by the EBPs. Finally, the modeling team reviewed the surveys to select two of the three EBPs (Nurse Family Partnership and SafeCare) based on partner rankings. A third EBP, Incredible Years was selected from outside of the initial list by the partners due to its peer support component. | 45 minutes | Prepare descriptions of evidence-based prevention programs to be reviewed from multiple resources and compile into an Excel spreadsheet, and create online survey to complete.<br><br>Tailor each script for online completion (e.g., virtual voting instead of physical stickers placed on action ideas for "Dots" script; tailor prompts in "Initial Policy Options" to reflect on the preliminary list of EBPs). | Review online survey to see top three programs prioritized and incorporate program targets into Stock and Flow structure. | 3 identified evidence-based programs: Incredible Years, Nurse Family Partnership, SafeCare<br><br>Video of how selected evidence-based programs impact risk and protective factors in refined CLD (Available at; https://youtu.be/XzGcdafW87M?si=zIX8ZD5VdIXUbkHv) |
| **Group Session 3** | | | | | |
| Reflect on current system dynamics model structure and missing pathways or factors | "Presenting the Reference Mode" Script. Present new Stock and Flow structure and refined CLD (Figure 3). The modeling team highlighted how the previous structure fed into the current one, the same key modeling decisions, such as the population being modeled and time horizon, and key stock and flow structures as well as parameters that influenced those structures. | 60 minutes | Translate refined CLD into Stock and Flow Structure based on Group Session 2 feedback. Update the tailored Script for "Presenting the Reference Mode" from Group Session 2 accordingly. | Refine Stock and Flow Structure. | Refined Stock and Flow structure for quantified simulation (Available at: https://exchange.iseesystems.com/public/gcruden/childneglectlearningmodel/index.html - page2)<br><br>Refined Loop Story Table (Table 2) |