Modeling and Decision Support in Public Health Preparedness:
Overview of the ASU Simulation-Driven Exercise Program

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PHP Summit
The Decision Theater is a technology platform for enhanced decisionmaking environments.

- Interactive & immersive workspace for 25 people
- Library of public-health tabletop exercises to practice decision-making during public health emergencies
- Systems science and decision mapping
Decision Theater Approach to Evidence-based Emergency Preparedness

- Technology
  - Modeling
  - Simulation
  - Visualization

- Decision Sciences
  - Decision-Making Frameworks
  - Decision-Making Environments
  - Decision-Making Tools

- Stakeholder Perspectives
  - Planning
  - Experimental Exercises
  - Evaluation
ASU emergency preparedness group serves local needs for evaluating capabilities

• Supply content expertise relevant to simulating a public health emergency
• Develop exercise scenarios and supporting documentation
• Design decision-making environment
• Create evaluation plans and corresponding instruments
• Provide trained personnel to facilitate exercise play
• Evaluate participants’ collective performance
Simulation-driven exercise portfolio provides evidence for decisionmaking research.
The state needed to review and assess emergency plans for schools to prepare for, respond to, and recover from an influenza pandemic in accordance with state, local, and school pandemic preparedness plans.
We developed a simulation-driven tabletop exercise for the Arizona Department of Health Services. During the 2009 H1N1 outbreak, we traveled around the state and met with local leaders to test and revise their pandemic response plans.
When is the right time to close schools to protect lives?

How can we reduce transmission in our communities without hurting the economy?

What metrics drive school closure decisions?

What other social and economic consequences result from these policies?
Pandemic Influenza Simulation Model

- Age structured and geo-spatial disease spread model of a novel flu for the state of Arizona

- Model has five age groups in each county (preschool, elementary school, middle school, high school aged children and adults)

- Model parameters are flexible

- The simulation model allows users to evaluate the impact of several possible school closure policies
Interactive scenario ingredients link decisions to outcomes

- A Yuma elementary student dies— the first Novel fatality in Arizona
- Additional Novel cases are reported in several middle
Pandemic Flu: Decision Support System
Comparison of different closing/reopening scenarios

<table>
<thead>
<tr>
<th>Comparison Metrics</th>
<th>No Intervention Case</th>
<th>Exercise Result 1</th>
<th>Exercise Result 2</th>
<th>Early Closure/ Limited Reopening</th>
<th>Sequential Closure/ Reopening</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Infected Population</td>
<td>3,073,305</td>
<td>2,681,579</td>
<td>2,501,459</td>
<td>2,679,016</td>
<td>2,641,158</td>
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<tr>
<td>Infected Population (%)</td>
<td>51.70</td>
<td>45.12</td>
<td>42.08</td>
<td>45.07</td>
<td>44.43</td>
</tr>
<tr>
<td>Total Students Infected</td>
<td>653,752</td>
<td>232,087</td>
<td>37,917</td>
<td>229,133</td>
<td>188,362</td>
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<tr>
<td>Students Infected</td>
<td>55.03</td>
<td>20.50</td>
<td>3.35</td>
<td>20.24</td>
<td>16.64</td>
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<tr>
<td>Total Deaths in Population</td>
<td>81,017</td>
<td>68,969</td>
<td>63,427</td>
<td>68,882</td>
<td>67,707</td>
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<tr>
<td>Deaths in Population (%)</td>
<td>1.36</td>
<td>1.16</td>
<td>1.07</td>
<td>1.15</td>
<td>1.14</td>
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<tr>
<td>Total Student Deaths</td>
<td>18,672</td>
<td>6,623</td>
<td>1,083</td>
<td>6,538</td>
<td>5,363</td>
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<tr>
<td>Student Deaths (%)</td>
<td>1.65</td>
<td>0.59</td>
<td>0.10</td>
<td>0.58</td>
<td>0.47</td>
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<tr>
<td>Peak Student Infections (%)</td>
<td>10.00</td>
<td>1.33</td>
<td>1.57</td>
<td>1.31</td>
<td>3.72</td>
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<tr>
<td>Peak Day</td>
<td>57</td>
<td>174</td>
<td>27</td>
<td>173</td>
<td>40</td>
</tr>
<tr>
<td>Number of days closed</td>
<td>0</td>
<td>56</td>
<td>285</td>
<td>42</td>
<td>Varies by county</td>
</tr>
<tr>
<td>Students Day Missed</td>
<td>0</td>
<td>61,592,768</td>
<td>340,965,880</td>
<td>49,695,880</td>
<td>49,695,880</td>
</tr>
</tbody>
</table>
Participants’ Confidence in Performing Public Health Capabilities Before and After the Exercise
Simulation-driven exercise portfolio provides evidence for decisionmaking research.

- Evidence-based Emergency Preparedness
  - Modeling, Simulation, Visualization and Decision-Sciences
    - Pandemic Influenza School Closure Tabletop
    - H1N1 Risk Communication
    - Point of Dispensing Sites
    - Public Health Legal Preparedness
    - Agent-based Influenza Model
EMERGENCY PREPAREDNESS

POINT OF DISPENSING

CHALLENGE

In the event of an large scale bioterrorism event, medical treatment and supplies must be distributed to all affected citizens within 48 hours as part of the Cities Readiness Initiative.
We developed a web-based simulation tool that helps counties allocate resources and set up POD sites. We also developed a tabletop exercise for public health officials and first responders to test medical countermeasure dispensing capabilities.
Important questions that the POD simulation tool will answer:

• How do I set up a POD site?
• How many POD locations?
• How many staff?
• Where should they be located?
• Will there be bottle-necks and long waits?
• How long will dispensing take?
System Overview

- POD Selection (GIS)
- POD Simulation
POD Planner in Decision Theater environment
How Modeling Can Enhance PHEP Programs

- **Process & Collaboration**: Simulations allow leaders to make political tradeoffs and use flexible strategies to optimize outcomes in confidential learning environment.

- **Tools & Dynamic Modeling**: Ability to manipulate science-based models enable general strategic discussion/planning without a requirement for exact predictive capability.

- **Outcomes**: Real-time feedback to leaders on their knowledge gaps and areas of suggested improvement.

- **Efficiency**: Larger return on time and resource investment for simulation-driven exercises.
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