Would You Trust Agent-Based Models With Your Health?

Patricia L. Mabry
Office of Behavioral and Social Sciences Research
National Institutes of Health

April 28, 2010
• The **National Institutes of Health (NIH)** is an agency of the U.S. federal government within the Department of Health and Human Services. With a **$30.5 billion budget**, it is the steward of medical and behavioral research for the Nation. ([http://www.nih.gov/](http://www.nih.gov/))

• NIH is made up of **27 Institutes and Centers (ICs)** - each covering a specific domain of research, which is conducted both at NIH (**intramural**) and at grantees universities (**extramural**). See a directory of the ICs at [http://www.nih.gov/icd/index.html](http://www.nih.gov/icd/index.html)

• The **Office of Behavioral and Social Sciences Research (OBSSR)** stimulates behavioral and social sciences research across the ICs. ([http://obssr.od.nih.gov/index.aspx](http://obssr.od.nih.gov/index.aspx))
OBSSR Strategic Areas

1. Trans-/inter-disciplinary science
2. “Next generation”, basic science (OppNet)
3. Problem-based, outcomes oriented, strengthen the science of dissemination
4. Systems science for population impact
The Complex Problem Space of Human Health

Figure 1. Health as a continuum between biological and social factors across the lifespan. (Adapted from Glass & McAtee, 2006).
Potential Areas of Modeling at NIH

- Pandemic flu, HIV/AIDS, Hepatitis B and other infectious disease
- Tobacco use/substance abuse/addiction
- Obesity
- Health disparities/inequalities/social determinants of health
- Chronic disease – cardiovascular, cancer, diabetes
- Health care delivery
- Stress, mental illness
- Gene x environment interaction
- Demography and population health
- Climate Change and Health
- Developmental issues over the lifespan
- Culture
Would You Trust Agent-Based Models With Your Health?

Patricia L. Mabry
Office of Behavioral and Social Sciences Research
National Institutes of Health

April 28, 2010
Would You Trust Models With Your Health?

YES!

Compared to what? …

Mental models, naked brain, Gut instinct?

Other forms of modeling?
Would You Trust Models With Your Health?

NO!

Not excluding traditional reductionist methods

Not a replacement for judgment

Not a crystal ball
Would You Trust Models With Your Health?

It depends on the question, and to what degree

Models are useful when…

The model is built to address the question
Questions are appropriately complex – beyond comprehension of naked brain
Impractical/impossible to do real world experiment
Want to try out a hypothesis
Not over-relying on the model

Better question: what are the steps to leverage modeling/simulation?
Modeling/simulation is hard, but...

Changing people is harder!
Policy Resistance

- **What it is:** effects of an intervention are delayed, diluted or defeated by forces in the system
- **What to do:** back up and consult system stakeholders to identify mutual goals

Tragedy of the Commons

- **What it is:** Each actor in the system acting in his or her self interest depletes a shared resource, resulting in worse conditions for all
- **What to do:** 1) Educate users about the impact of individual behavior on shared resources, 2) create feedbacks so that users pay for their behavior

Success to the Successful

- **What it is:** The system rewards the successful, leading to disparities/inequalities
- **What to do:** Limit gains, change the rules of the game

Shifting Burden to the Intervenor

- **What it is:** Solutions that reduce or disguise symptoms without fixing the problem
- **What to do:** Take the focus off short term relief and apply long term solution.

How can we best take advantage of modeling? (Change people!)

- Build good models
  - Modeling standards
  - Think big – open source – take advantage of Crowdsourcing
  - Develop core engines that can be continually updated and shared Hall and Chow, Kaufman’s STEM
  - Validation
- Welcome and encourage all modeling methods - hybrids
- Transparency
How can we best take advantage of modeling?

• Gain acceptance among public health scientists as a legitimate form of inquiry
  – Education – what modeling is and isn’t – another tool in the toolbox, not a crystal ball, assist with insight, aid decisions, not “baseless”, cannot make tough decisions easier
  – Publish in public health journals
    • American Journal of Preventive Medicine (March 2010)
• Foster cross fertilization – SBP10
How can we best take advantage of modeling?

- Develop good decision making tools- accessible to policymakers
  - C-ROADS Sterman et al. [www.Climateinteractive.org](http://www.Climateinteractive.org)

*Group model building – beyond policymakers – community members... along the lines of user centered design

*Comparative modeling

*Iterative and near real-time

*Model driven data – new measures, methods of collection

*Core engines –How should we evaluate our models

*Develop methods of evaluating model utility – e.g., goodness of fit
  See Rodgers, American Psychologist, January 2010

Challenges - far beyond modeling

• Working across disciplinary divides
  – multiple levels of analysis
  – Cross discipline lack of communication, ability to think across disciplines, translation – speaking different languages

• Seeking different goals
  – U.S. Congress – what does compromise look like? How do we get something useful to come out?
  – Food and beverage industry vs. public health on obesity
  – Tobacco industry vs. tobacco control
What we are doing... Comparative modeling

National Collaborative on Childhood Obesity Research (NCCOR)

- Feb 2009
- Goal: accelerate progress on reversing the epidemic of overweight and obesity among U.S. youth.
- Partners:
  - Centers for Disease Control and Prevention (CDC)
  - National Institutes of Health (NIH)
  - Robert Wood Johnson Foundation (RWJF)
  - USDA (March 2010)

NCCOR will support the evaluation of new and existing prevention approaches, rapidly assess promising policy changes and speed the application of interventions that work.

ENVISION

- COMNet
- COMPMod
What we are doing... education, training

Institute on Systems Science and Health

June 13-18, 2010
Columbia University

Training needs:

Schools of Public Health (11 principles of systems thinking)
Feds: NIH and CDC program staff and review staff
BSSR investigators, Policymakers, K-12
Other activities

- NIGMS Modeling Infectious Disease Agents Study (MIDAS)
  http://www.nigms.nih.gov/Initiatives/MIDAS

- IMAG Interagency Modeling and Analysis Group NIH NSF NASA DOE DOD USDA USDVA
  http://www.nibib.nih.gov/Research/MultiScaleModeling/IMAG

- CISNET http://cisnet.cancer.gov/ Model profiler

- SBP10 Social Computing Behavioral Modeling & Prediction


- PAR-10-038/039/040 Dissemination and Implementation Research in Health (R01, R21, R03) and annual conference
Selected funded systems science research at NIH

Joshua Epstein, Director’s Pioneer Award, NIGMS, OBSSR, 2008. Project Title: *Behavioral Epidemiology: Applications of Agent-Based Modeling to Infectious Disease.*

David Lounsbury, R03, NIDA, 2008. Project Title: *Dynamics Modeling as a Tool for Disseminating the PHS Tobacco Treatment Guideline*

David T. Levy, U01, NCI, 2002-2010. CISNET. Project Title: *A Simulation of Tobacco Policy, Smoking and Lung Cancer.*


Daniel Rivera, K25, NIDA, OBSSR. *Control Engineering Approaches to Adaptive Interventions in Drug Abuse Prevention.*

Joe Messina R21 NIH Roadmap. *Dynamic Ecological Simulation Model Of Tsetse Transmitted Trypanosomosis In Kenya*
Selected funded systems science research at NIH

Joe Eisenberg, Jim Trostle, R01 NIAID/NSF.
   Project 1 Title: Environmental change and diarrheal disease.
   Project 2 Title: Ecology of Infectious Disease.

Yasmin Said, F32, NIAAA. A Social Network Model of Ecological Alcohol Systems

RFA-HD-08-023 (R01), Innovative Computational and Statistical Methodologies for the Design and Analysis of Multilevel Studies on Childhood Obesity (R01). Michael Rendall, RAND; David Shoham & Amy Luke, Loyola Chicago.

Laurette Dube/Ross Hammond U01 Multi-level Modular Agent-based Modeling For The Study Of Childhood Obesity

Margaret Brandeau- NIDA HIV/AIDS network

Areas ripe:
   - Climate Change  - Global Health
   - CBPR and modeling - Comparative Effectiveness
Open Funding Opportunity Announcements at NIH in Systems Science

- **PAR-08-224** *Using Systems Science Methodologies to Protect and Improve Population Health (R21).*
- **PAR-10-145/146** *Social Network Analysis and Health (R01, R21)*
- **PAR-08-212, -213, -214** *Methodology and Measurement in the Behavioral and Social Sciences (R01, R21, R03).*
- **PAR-10-136** *Behavioral and Social Science Research on Understanding and Reducing Health Disparities (R01, R21)*
- **PAR-08-023** *Predictive Multiscale Models of the Physiome in Health and Disease (R01).*
- **PA-07-427 (R01) ; PA-07-428 (R21) ; PA-07-429 (R03)** *Research on Alcohol-Related Public Policies such as Those Detailed in the Alcohol Policy Information System*
- **PA-10-106** *Scientific Meetings for Creating Interdisciplinary Teams (R13)*
Final Thoughts

Join the BSSR-Systems Science Listserv

- To join, contact the listowner, Patty Mabry at mabryp@od.nih.gov

Ask me for my “Resource Page” for applying for NIH grant funding

mabryp@od.nih.gov
The “S” Curve of Science

Search for Unifying Theories

From Large to Small scales (and back)

From Qualitative to Quantitative

About 150 years

Empirical Observations

Reductionist Phase

Data explosion
Growing Understanding

Of Subsystems

Rise of Partial Theories

Interventions on real complex systems

Search for Unifying Theories

From Large to Small scales (and back)

From Qualitative to Quantitative

About 150 years
What we might do in the future....
What assets do we have at the ready?

- IBM –
- NIH/CDC
- RWJF
- Public-Private Partnerships?
- NCCOR