May 20th, 4:00 PM

Systems Science and Health: Using Analytical Approaches to Evaluate Healthcare Policy Decisions

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Keywords
systems science, computer simulation, healthcare delivery

Comments
Presented at the 2014 UMass Center for Clinical and Translational Science Research Retreat, held on May 20, 2014 at the University of Massachusetts Medical School, Worcester, Mass.

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Systems Science and Health
Using Analytical Approaches To Evaluate Healthcare Policy Decisions

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SYSTEMS SCIENCE

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What is Systems Science?

• Systems Science is a family of methodologies
  – System Dynamics; Agent Based Modeling; Discrete Event Modeling; Social Network Analysis; Hybrid Modeling
• Enable the study of complex problems
• Take a holistic view, i.e. models include physiological, economic, behavioral, etc. components
• Allow the big picture view of a complex problem, while modeling components of the system
• Based on computer modeling and simulation
Systems Science Sims may Include...

- Socioeconomic Perspectives
- Behavioral Perspectives
- Cognition Perspectives
- Integrating Life Course Perspectives
- Institutional Perspectives
- Neighborhood Perspectives
- Health Care Elements
- Effects of Networks
- Big Data
Supplemental Issue: Systems Science Applications in Health Promotion and Public Health

October 2013; 40 (1 suppl)

“Systems Science: A Good Investment for the Public’s Health”
Patricia L. Mabry, PhD, and Robert M. Kaplan, PhD
What is a System?

Health Care Delivery: Patient Experience

National

Local / Regional
“The function of systems engineering is to **guide** the **engineering** of complex systems.”

**Guide** ⇒ *Lead, manage, direct ... to show the way*

**Engineering** ⇒ *The application of scientific principles to practical ends*

**System** ⇒ *A set of interrelated components working together towards a common objective*

**Complex** ⇒ *Elements of the system are diverse and tightly coupled*
Healthcare Delivery Institute

Care Giver
- Nurses
- Physician
- Physical Therapist

Treatment Protocol

Review

Changes

Recognize

Interacts with

Affects

Parents

Patient

Disease Progression
USE OF LOW-FIDELITY SYSTEMS FOR HEALTHCARE POLICY DESIGN

Khalid Saeed, PhD, Economics and System Dynamics, WPI
Policy formulation process

High Fidelity Models

Cannot be verified

Forecasts of Future

Simple Policy Paradigms

Often buckets of ignorance

Works in short run
Fails in long run

Aimed at alleviating symptoms
Pest control
(pests, germs, diseases)
Breakdown repair
(healthcare delivery)
How models are used

• Forecasts given by complex instruments determine service budgets.
• Service budgets create allocations for the service.
• Models serve mainly as justification for the budget.
• Problems continue to persist.
Alternative modeling approach (elaborate latent structures)

Visible system

Policies addressing symptoms

Latent system

Policies addressing Root causes
Latent Capacity Support

Diagram:
- pest creation
- pest population
- pest destruction
- latent capacity support
Example of transforming a forecasting model into a policy tool

- Large complex model created by a consultant.
- Client never understood the model.
- Model output was large array of magical numbers, and a large accompanying bill.
- Use of those numbers in policy was an article of faith
- Our assignments was to make some sense out of it.
Stroke patient chain

- Total TIA incidence
- New enrollment non-event
- TIA to first stroke
- First stroke to recurrent stroke
- Recurrent stroke non-stroke deaths

Non-stroke deaths:
- TIA non-stroke deaths
- Event transfer to TIA
- Event transfer to TIA (non-fatal)
- TIA to first stroke (non-fatal)
- First stroke (non-fatal)
- Recurrent stroke (non-fatal)

Event deaths:
- First stroke (fatal)
- Recurrent stroke (fatal)
- Event transfer to TIA (fatal)
Example of transforming a forecasting model into a policy tool

- Model demo
• Use of metaphors in development of models for healthcare delivery can help focus attention to root causes of problems that create policy resilience.

• Low fidelity metaphorical models can help conceptualize high fidelity systems for specific cases

• Use of metaphors can also help to educate public and assist policy actors

• A word of caution: Reductionism is a double edged sword. Recognize its limitations
DISCRETE EVENT SIMULATION

Tze Chiam, PhD, Quantitative Health Sciences, UMMS
UMass Memorial Example 1: Co-locating Clinical Services

• Explore opportunities to co-locate clinical services in order to
  – Improve coordination
  – Improve care
  – Efficiently utilize available footprint
  – Minimize use of resources and maximize outcome

• Discrete-Event Simulation used to evaluate various co-location options
UMass Memorial Example 1: Co-locating Clinical Services
UMass Memorial Example 2:
Capacity requirements for Observation patients

- Decline of inpatients, increase in Obs patients, decline in reimbursement for Obs
- Obs patients outside of “Obs unit”:
  - Higher average LOS
  - Higher cost per case
- “Obs unit” purity compromised due to:
  - Clinical decisions
  - Operational decisions
  - Mis-matched supply and demand
- Discrete-Event Simulation used to study beds requirement
Simulation Results
(41 beds vs 35 beds)
UMass Memorial Example 3: Pediatrics 5E configuration

• Reduction of Pediatrics acute care (5E) footprint from 41 beds to ___ beds
• 5 configurations of single and double beds available
• Due to various isolation needs for pedi patients (age group, clinical reasons, gender, etc), unknown impact due to:
  – Reduced # of beds
  – Each configuration
  – Potential needs to “flex” beds due to fluctuation in volume
Simulation Results (Ave Volume)

Average Monthly Performance Measures based on Ave volume
(4/1/13 to 4/1/14)

- a) 5 singles, 10 doubles
- b) 10 singles, 5 doubles
- c) 7 singles, 7 doubles
- d) 2 singles, 10 doubles
- e) 6 singles, 10 doubles

Average Monthly Performance Measures based on Ave volume (4/1/13 to 4/1/14)
FUNDING
Funding: NIH

NIH Budget: ~ $31B

Division of Program Coordination, Planning and Strategic Initiatives

Sources: http://www.nih.gov/icd/index.html
http://dpcpsi.nih.gov/about
OBSSR functions:

- Funding initiatives for research
- Training and career development for behavioral and social scientists
- Organizes conferences, workshops, and lectures

“We want to aid investigators in using systems science methods to address important public health problems...”
## Funding Opportunities and Notices Search

**Search Results**
- Matching Records: 7
- Show: Active Only
- Include Notices: Yes
- Include Expired: Yes

### Search Results Table

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<th>Title</th>
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We are looking for collaborators

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