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

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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

Treatment Protocol → Review

Changes → Recognize

Disease Progression

Care Giver

Nurses

Physician

Physical Therapist

Affects

Interacts with

Parents

Patient
USE OF LOW-FIDELITY SYSTEMS FOR HEALTHCARE POLICY DESIGN

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

- Often buckets of ignorance
- Works in *short run*
- Fails in *long run*
- Cannot be verified

Aimed at alleviating symptoms

HIGH FIDELITY MODELS

FORECASTS OF FUTURE

POLICY

SIMPLE POLICY PARADIGMS
Pest control
(pests, germs, diseases)
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)

Policies addressing symptoms

Visible system

Policies addressing Root causes

Latent system
Latent Capacity Support
Aging chain
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

WPI
Healthcare Delivery Institute
Example of transforming a forecasting model into a policy tool

- Model demo
Conclusion

• 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)

% geo and util vs # of beds (Univ, Obs + ExtRec)
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):

- # flex med surg beds
- # flex PICU beds
- # flex ED obs beds
- # admits off geo
- Ave bed util

Ave # flex beds

Ave bed util
FUNDING
Funding: NIH

NIH Budget: ~ $31B

27 Institutes and Centers

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  
Search Terms: systems science  
Include Notices: □ Yes □ No  
Include Expired: □ Yes □ No

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This page last updated on March 26, 2014  
Technical Issues: E-mail OER Webmaster
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