May 20th, 4:00 PM

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

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Worcester Polytechnic Institute

Et al.

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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*

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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

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Health Education & Behavior

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

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What is a System?

Health Care Delivery : Patient Experience

National

Local / Regional

Designing Systems with Systems Engineering

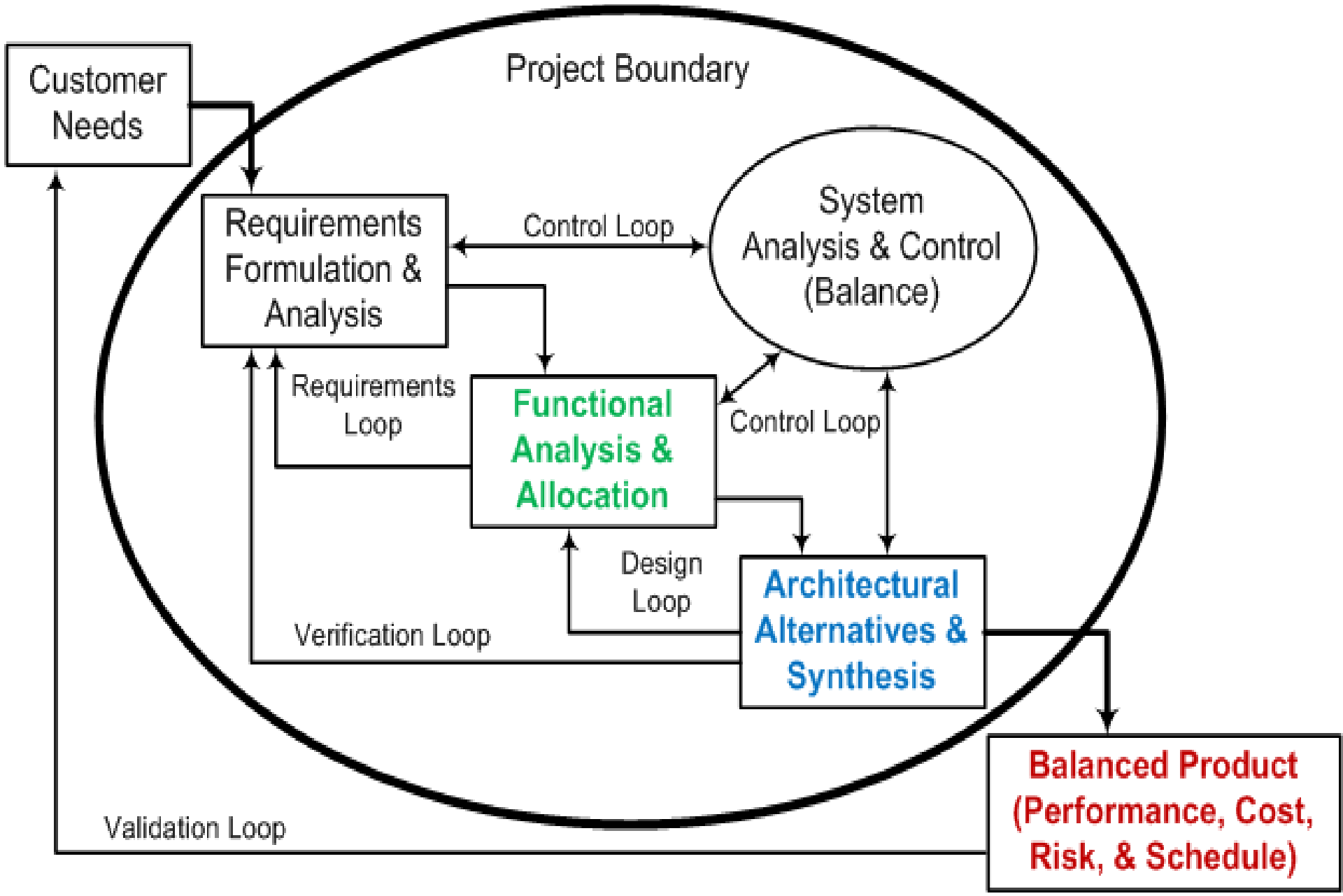
"The function of systems engineering is to guide the engineering of complex systems."

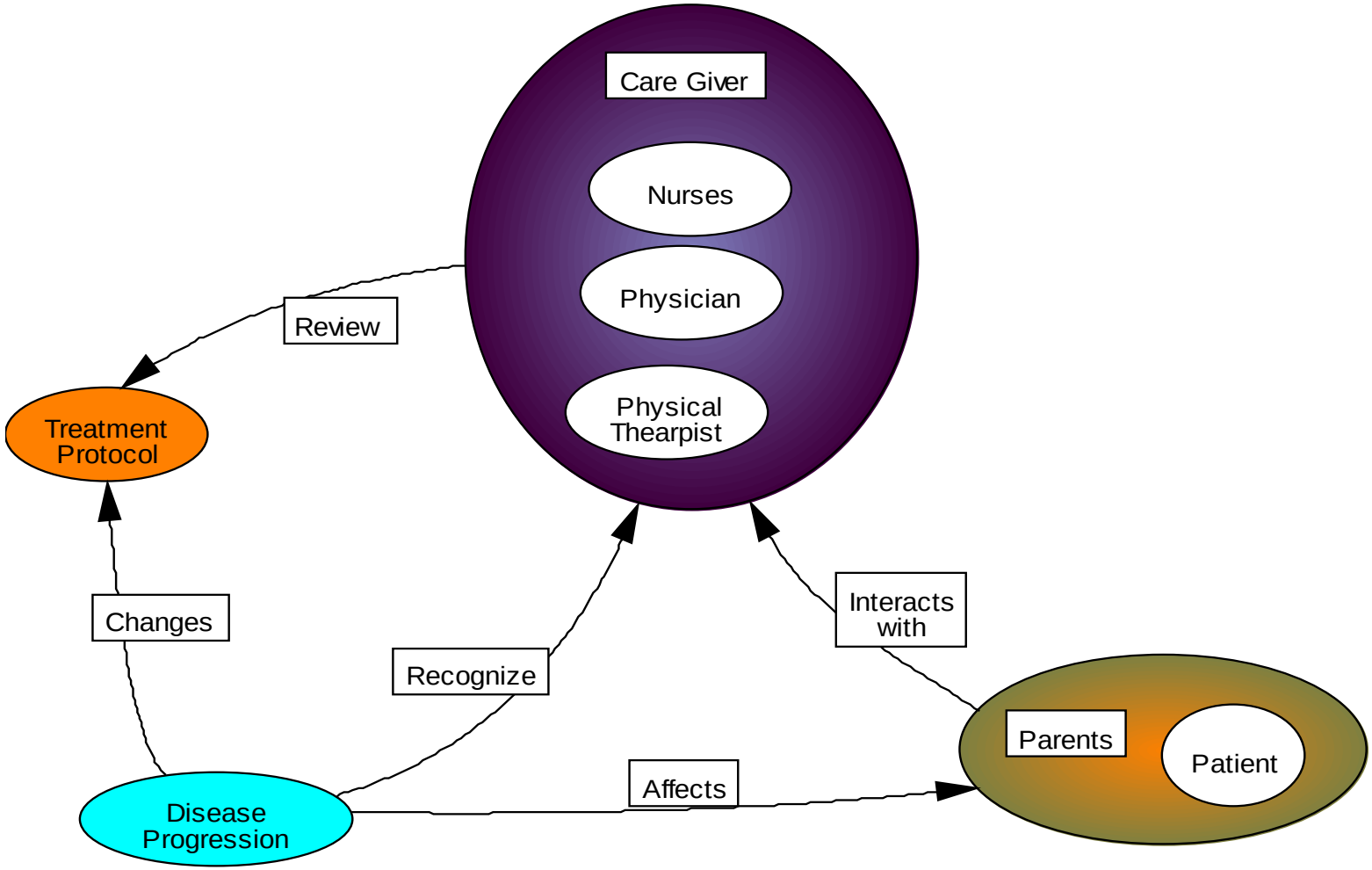
Guide ⇒ *Lead, manage, direct … to show the way*

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*


Customer Needs
Project Boundary
Requirements Formulation & Analysis
Control Loop
System Analysis & Control (Balance)
Requirements Loop
Functional Analysis & Allocation
Control Loop
Design Loop
Architectural Alternatives & Synthesis
Verification Loop
Balanced Product (Performance, Cost, Risk, & Schedule)
Validation Loop


Care Giver
Nurses
Physician
Physical Thearpist
Review
Treatment Protocol
Changes
Recognize
Interacts with
Parents
Patient
Affects
Disease Progression

USE OF LOW-FIDELITY SYSTEMS FOR HEALTHCARE POLICY DESIGN

Khalid Saeed, PhD, Economics and System Dynamics, WPI

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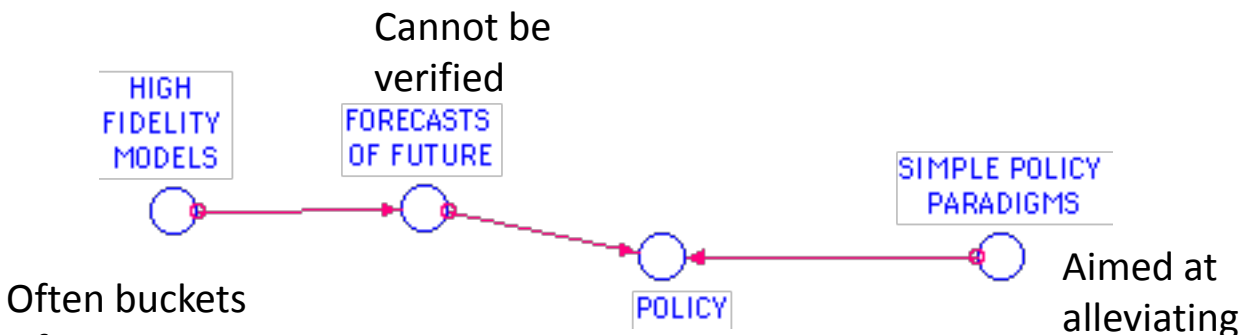
Policy formulation process



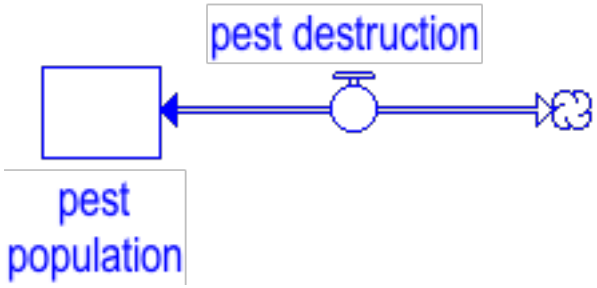
Cannot be verified

Often buckets
Of ignorance

Works in ***short run***
Fails in ***long run***

Aimed at alleviating symptoms

Pest control (pests, germs, diseases)



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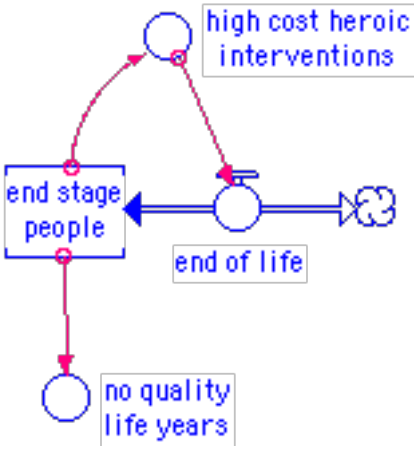
Breakdown repair (healthcare delivery)



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.

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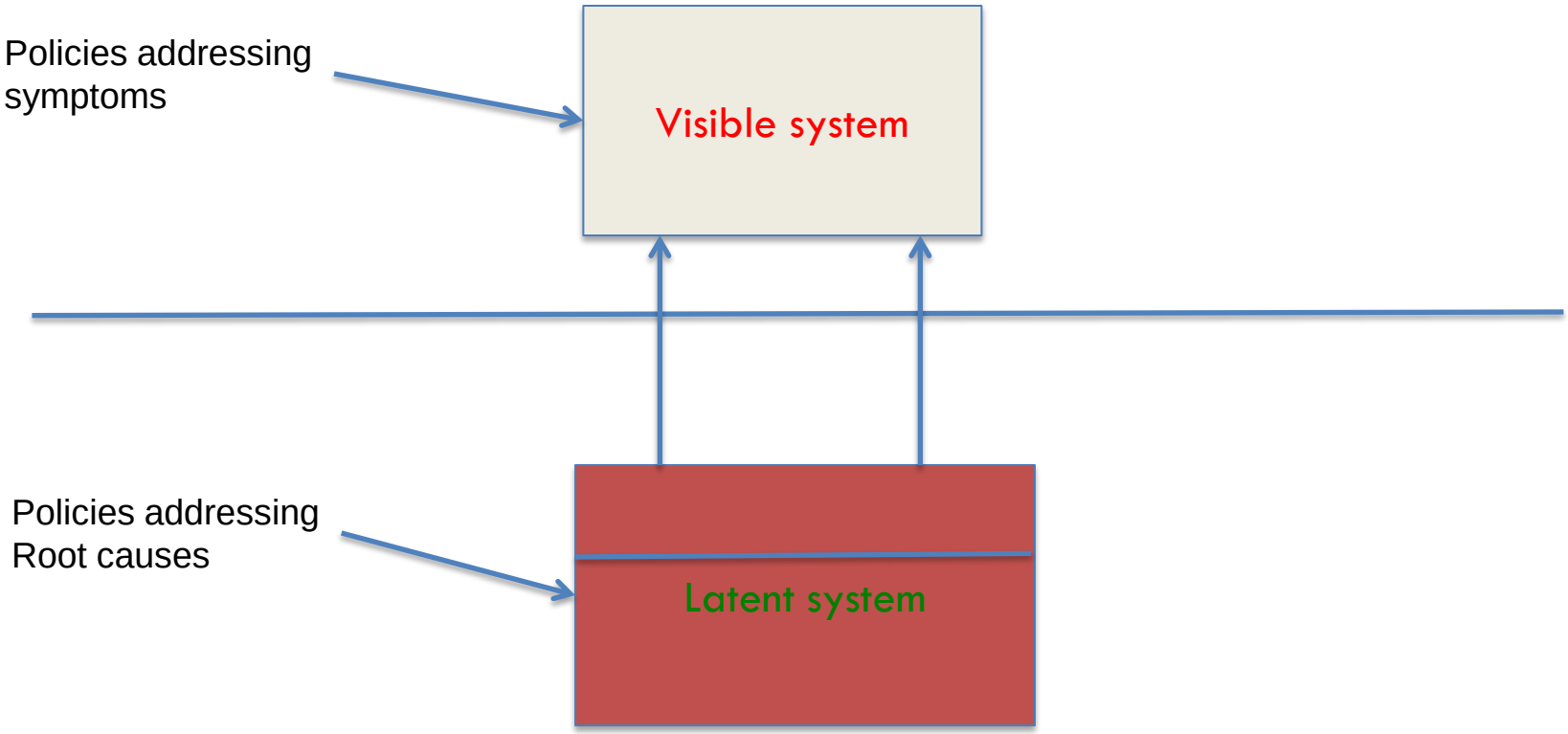
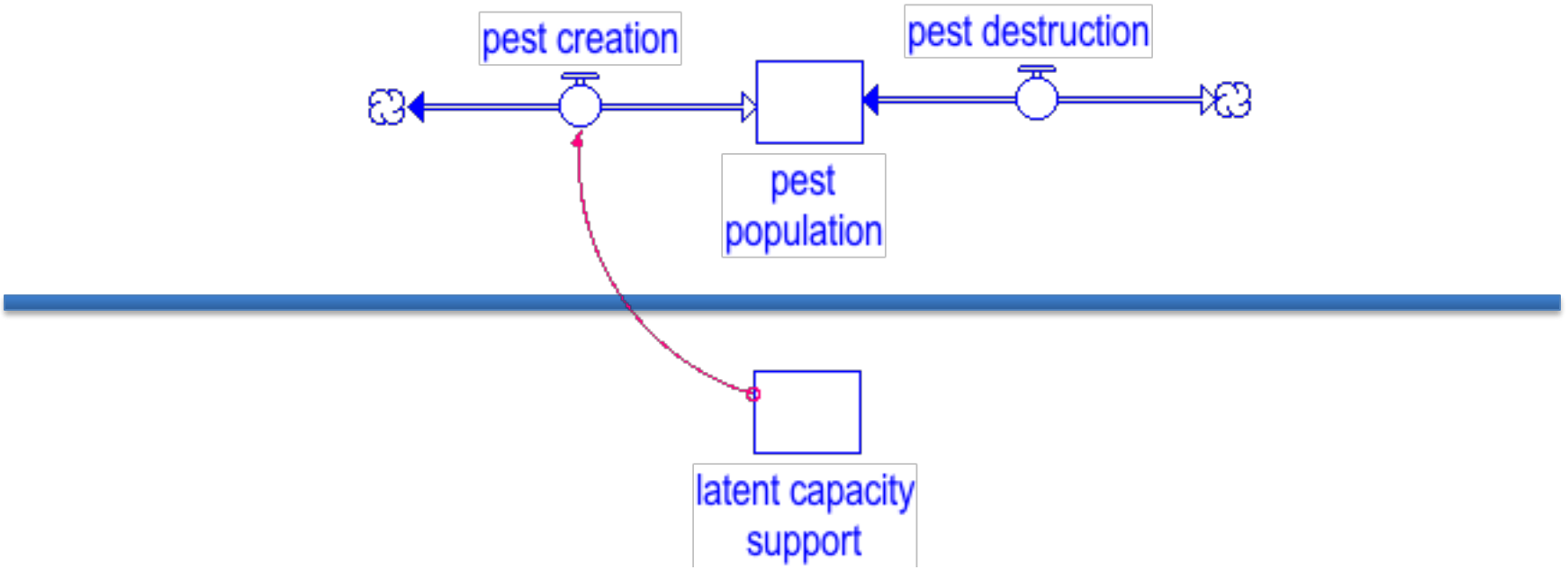
Alternative modeling approach (elaborate latent structures)



Latent Capacity Support



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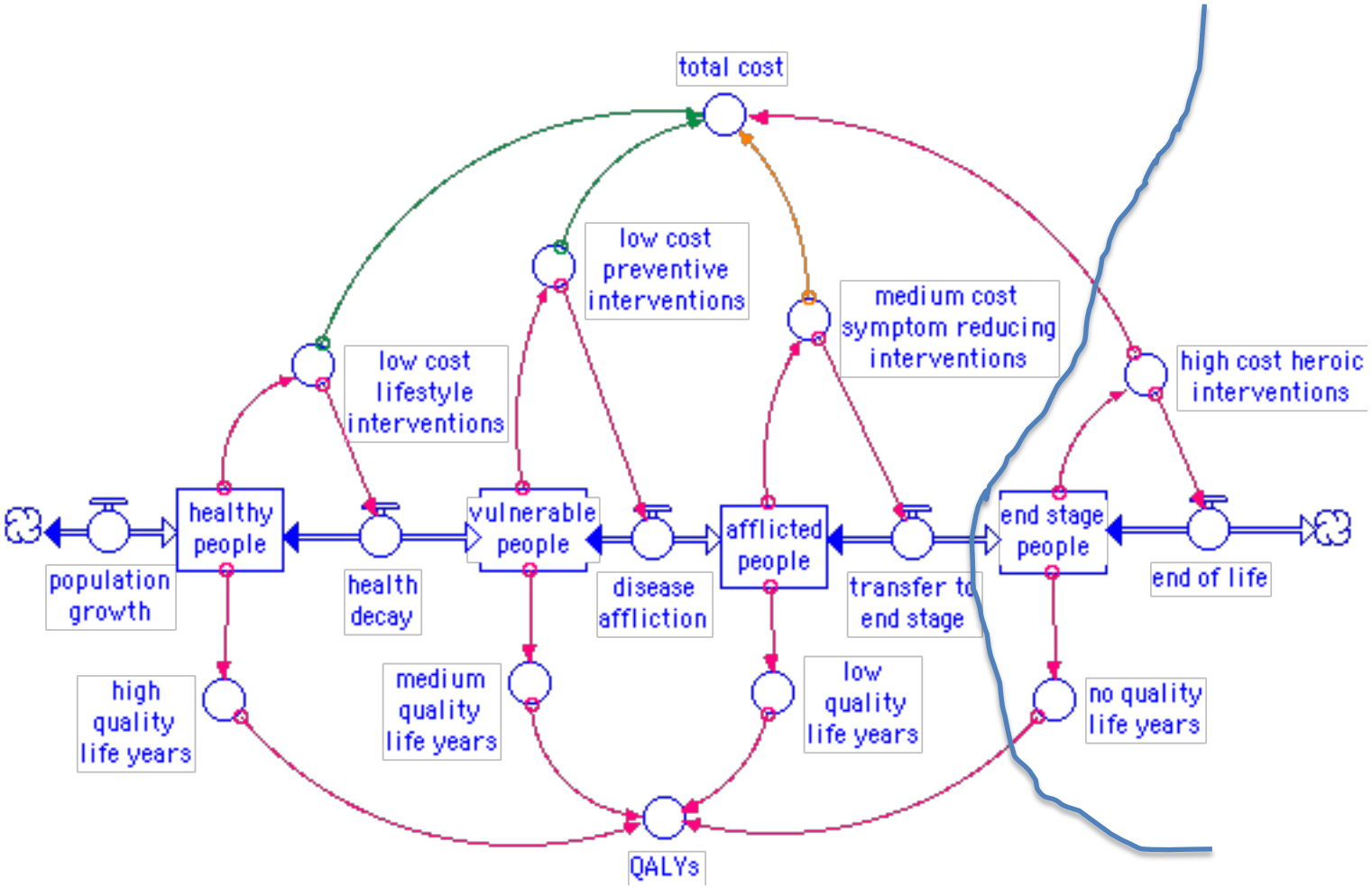
Aging chain



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.

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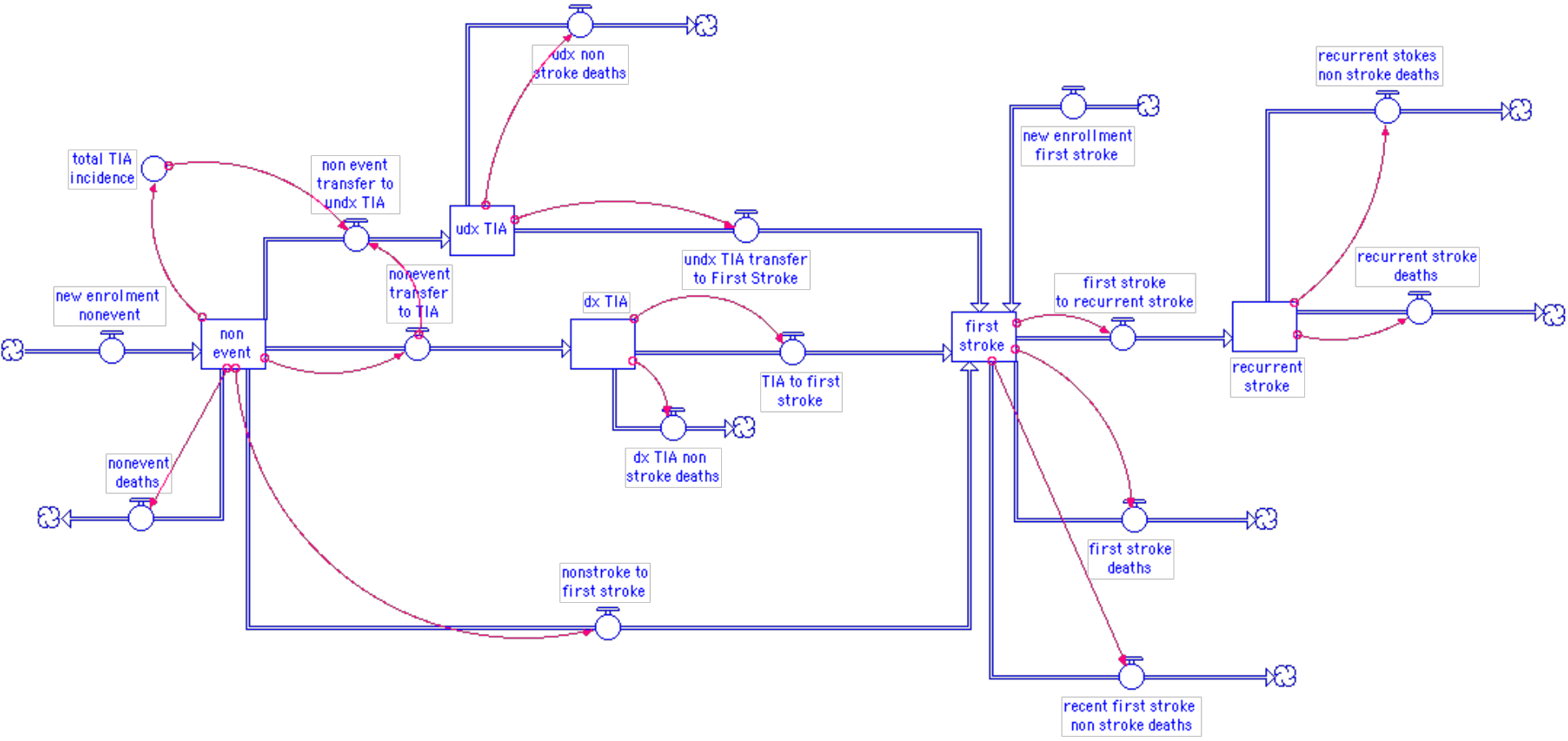
Stroke patient chain



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

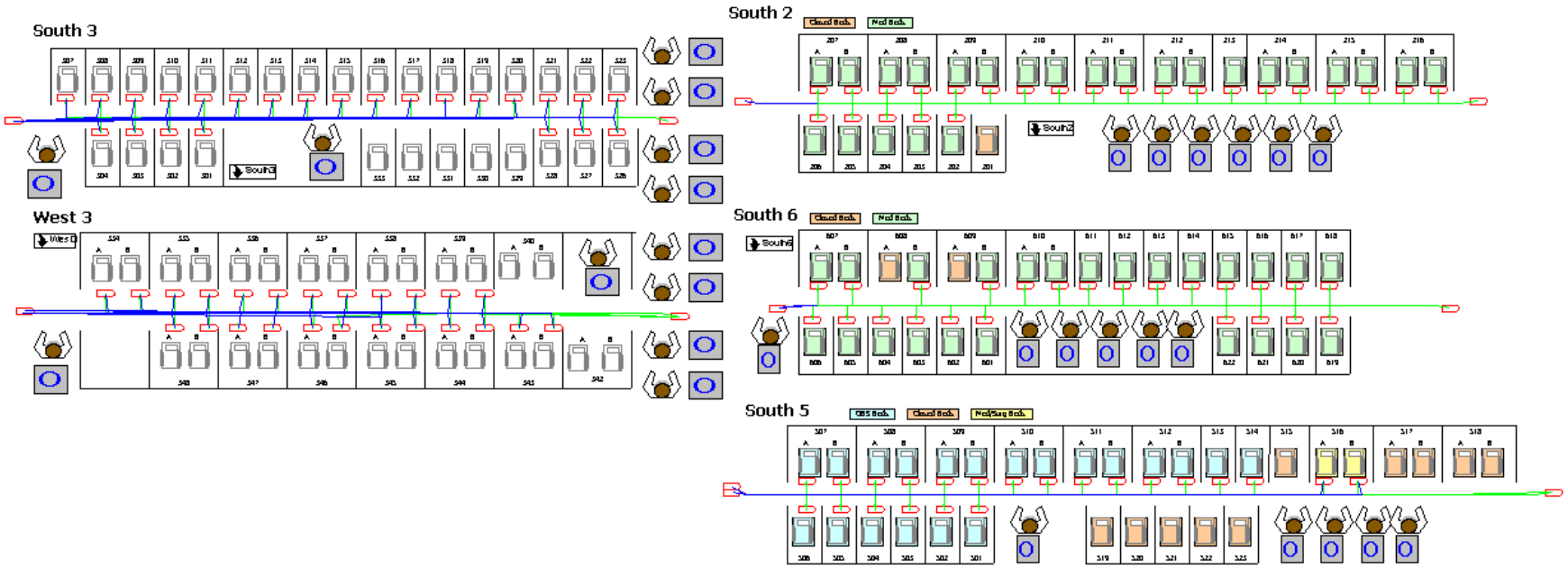
DISCRETE EVENT SIMULATION

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

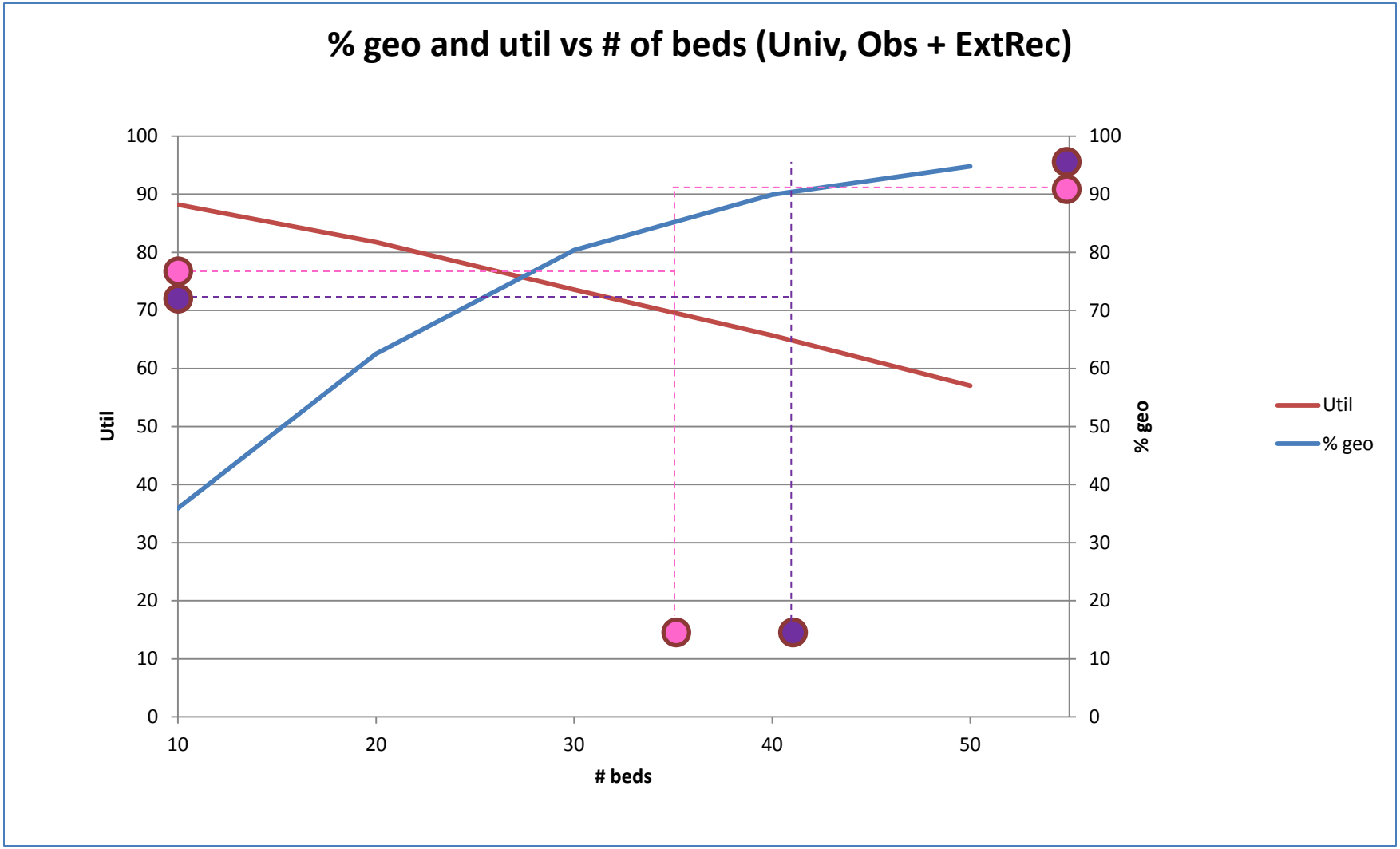
UMass Memorial Example 1: Co-locating Clinical Services



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

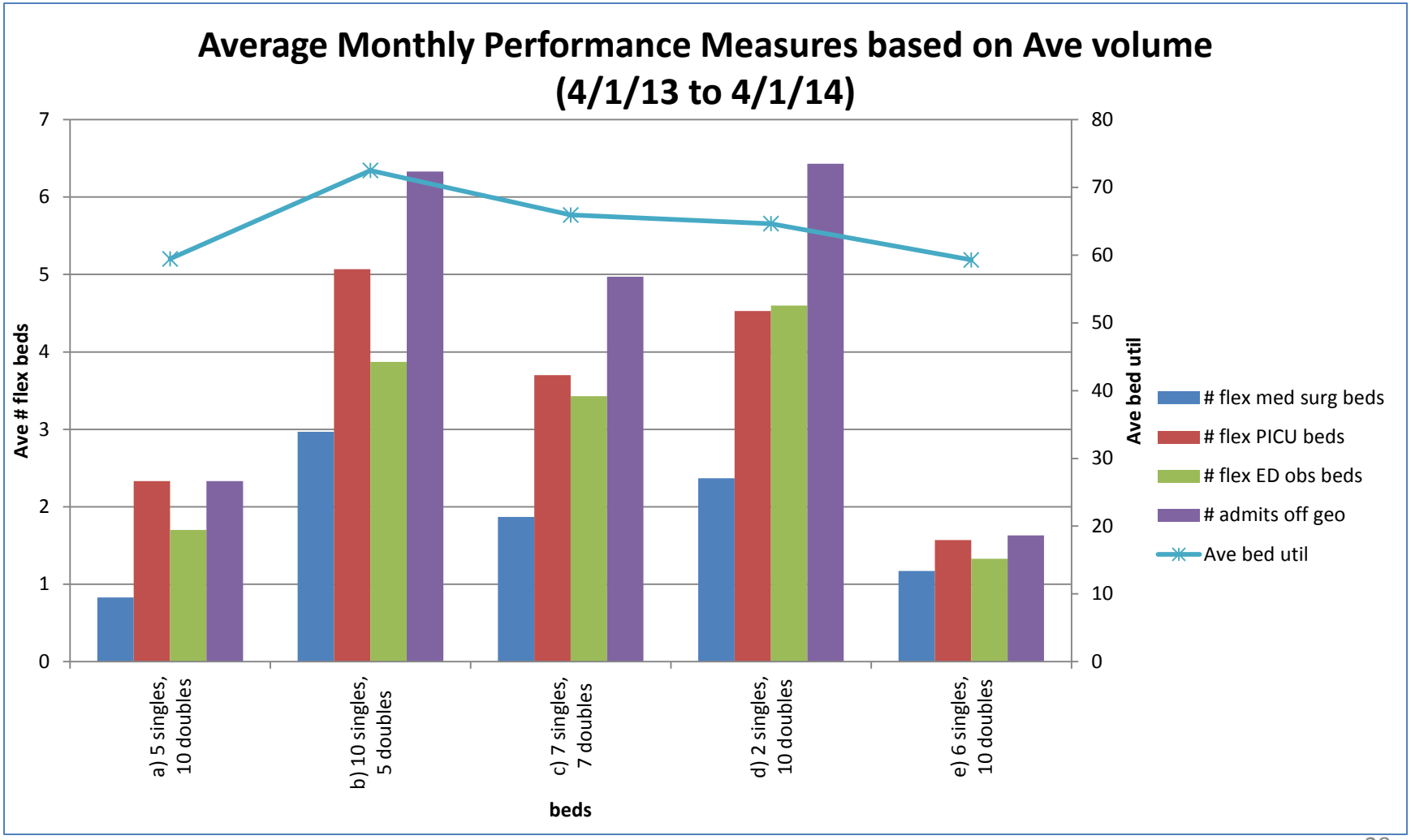
Simulation Results (41 beds vs 35 beds)



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)



FUNDING

Funding: NIH

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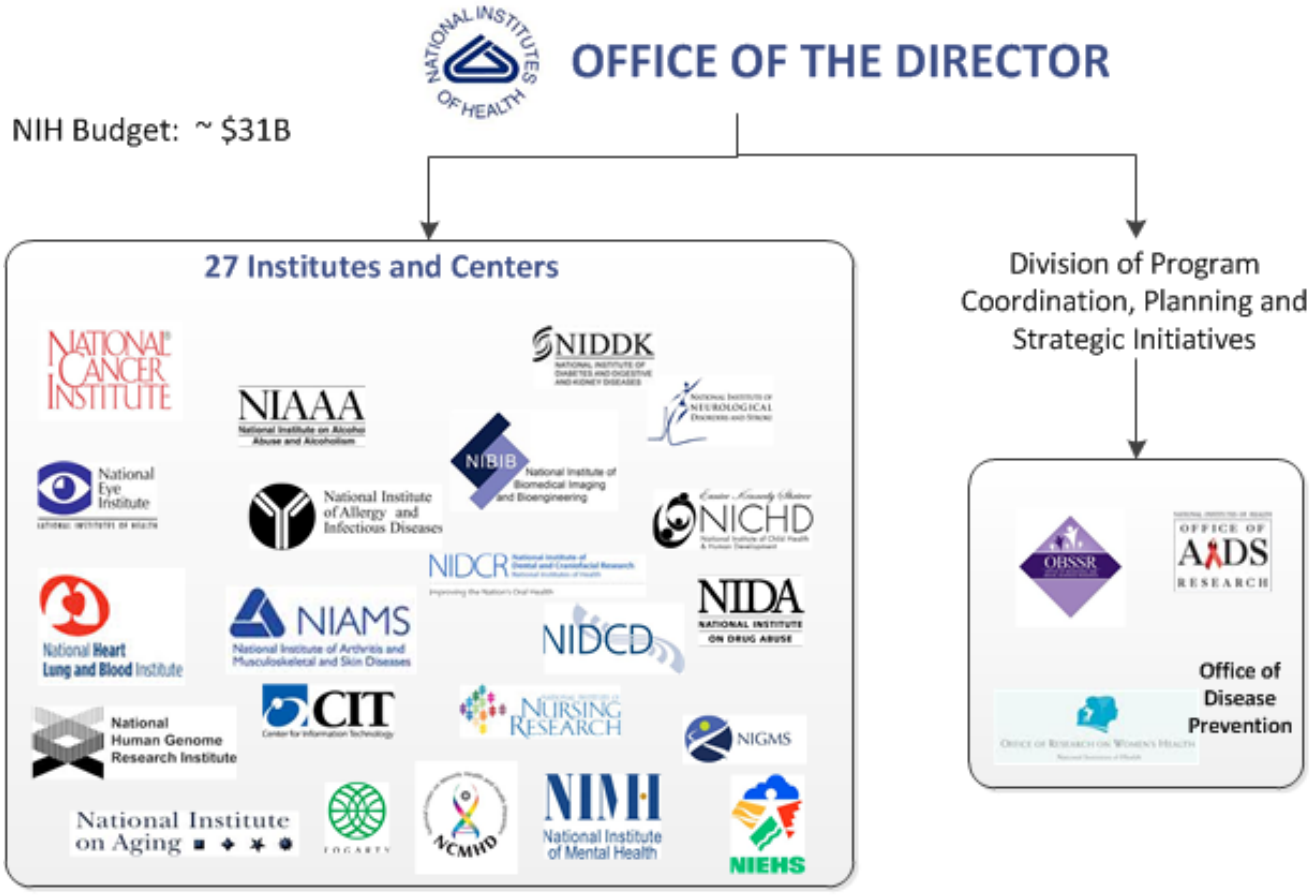


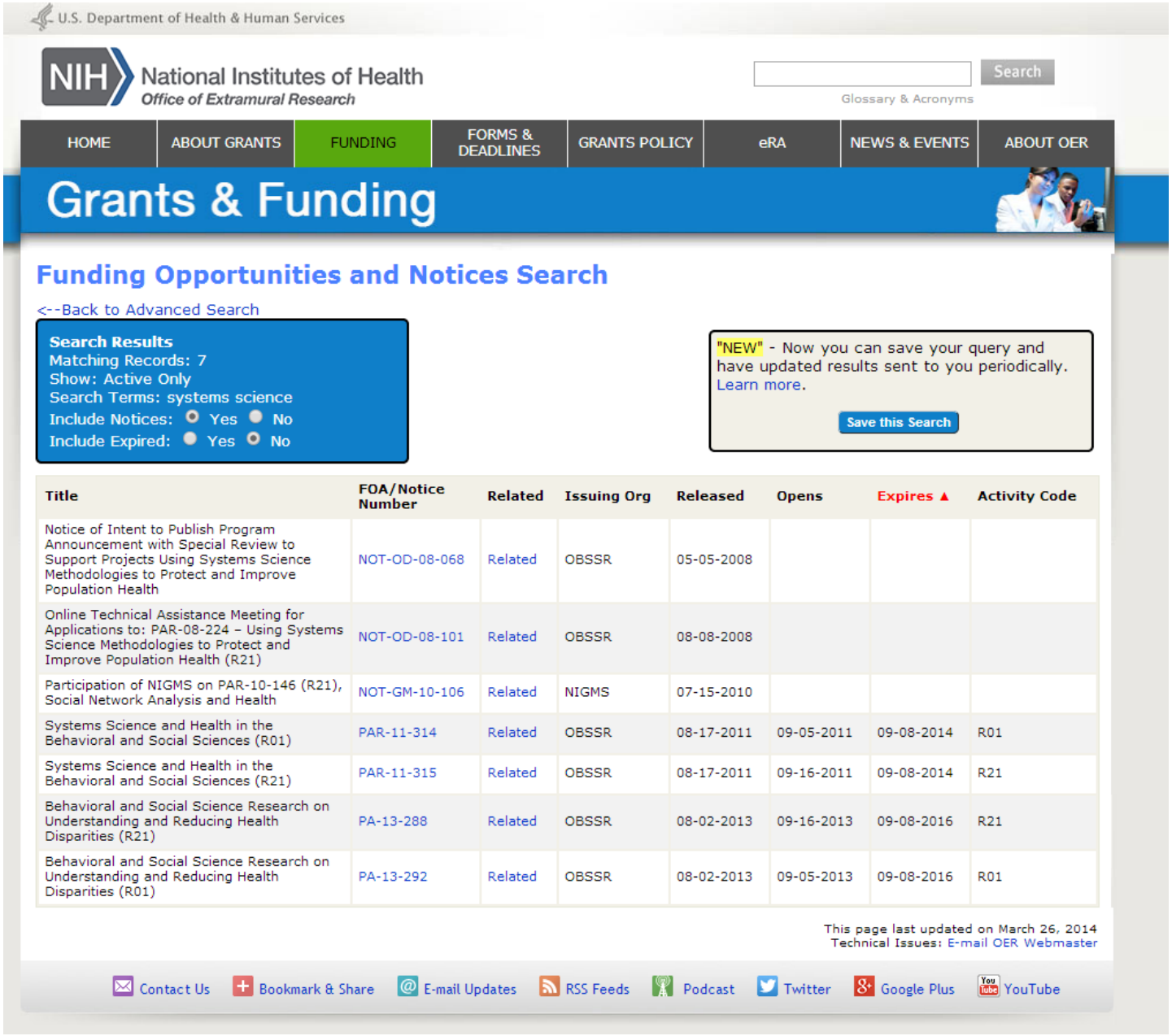
Sources: http://www.nih.gov/icd/index.html ; http://dpcpsi.nih.gov/about

The Office of Behavioral and Social Sciences Research (OBSSR)

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…"



U.S. Department of Health & Human Services

NIH National Institutes of Health
Office of Extramural Research

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Title	FOA/Notice Number	Related	Issuing Org	Released	Opens	Expires ▲	Activity Code
Notice of Intent to Publish Program Announcement with Special Review to Support Projects Using Systems Science Methodologies to Protect and Improve Population Health	NOT-OD-08-068	Related	OBSSR	05-05-2008			
Online Technical Assistance Meeting for Applications to: PAR-08-224 – Using Systems Science Methodologies to Protect and Improve Population Health (R21)	NOT-OD-08-101	Related	OBSSR	08-08-2008			
Participation of NIGMS on PAR-10-146 (R21), Social Network Analysis and Health	NOT-GM-10-106	Related	NIGMS	07-15-2010			
Systems Science and Health in the Behavioral and Social Sciences (R01)	PAR-11-314	Related	OBSSR	08-17-2011	09-05-2011	09-08-2014	R01
Systems Science and Health in the Behavioral and Social Sciences (R21)	PAR-11-315	Related	OBSSR	08-17-2011	09-16-2011	09-08-2014	R21
Behavioral and Social Science Research on Understanding and Reducing Health Disparities (R21)	PA-13-288	Related	OBSSR	08-02-2013	09-16-2013	09-08-2016	R21
Behavioral and Social Science Research on Understanding and Reducing Health Disparities (R01)	PA-13-292	Related	OBSSR	08-02-2013	09-05-2013	09-08-2016	R01

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We are looking for collaborators

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Khalid Saeed, PhD
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