

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



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What is a System?

Health Care Delivery : Patient Experience

National



Local / Regional





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Designing Systems with Systems Engineering

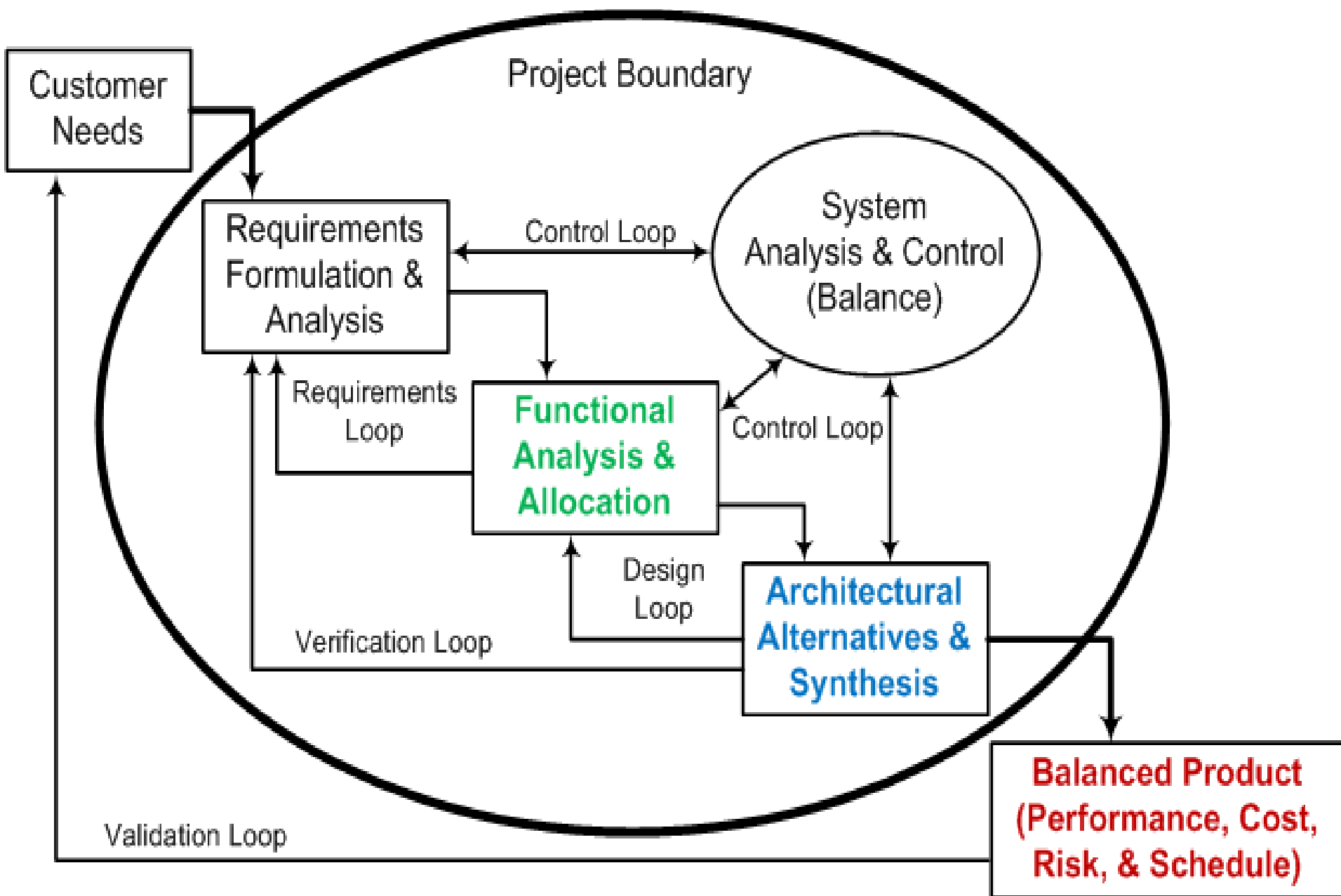
*“The function of systems engineering is to **guide** the **engineering** of **complex systems**.”*

Guide \Rightarrow *Lead, manage, direct ... to show the way*

Engineering \Rightarrow *The application of scientific principles to practical ends*

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

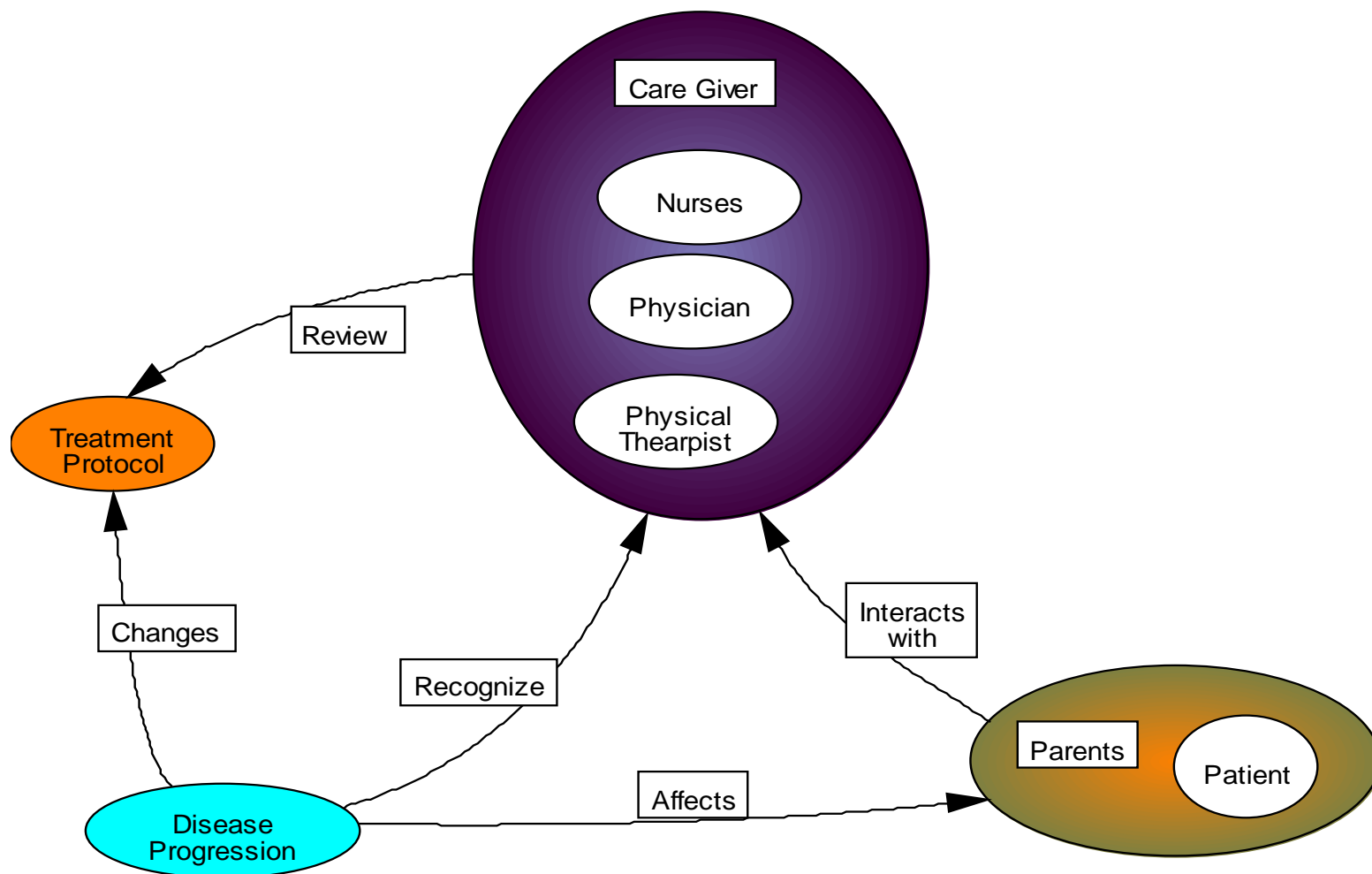
Complex \Rightarrow *Elements of the system are diverse and tightly coupled*





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USE OF LOW-FIDELITY SYSTEMS FOR HEALTHCARE POLICY DESIGN

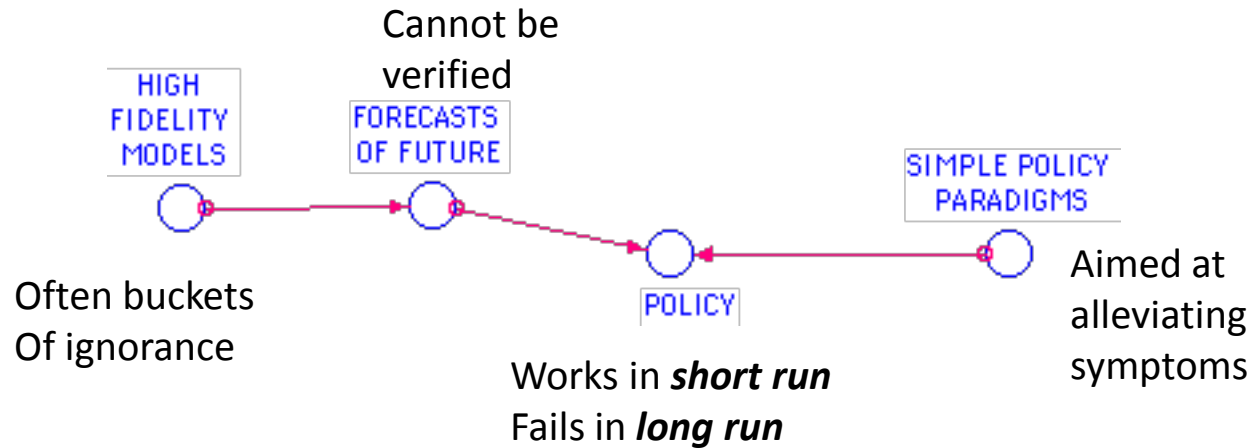
Khalid Saeed, PhD, Economics and System Dynamics, WPI



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Policy formulation process

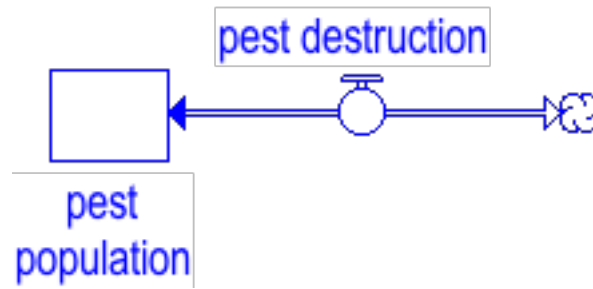




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Pest control (pests, germs, diseases)

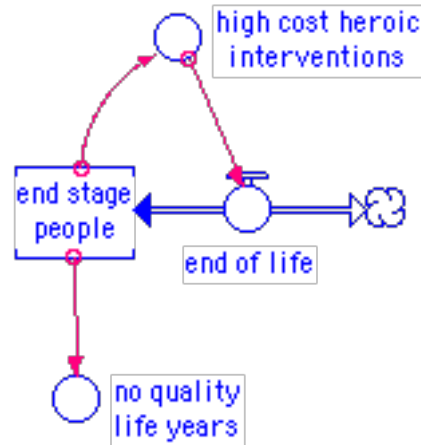




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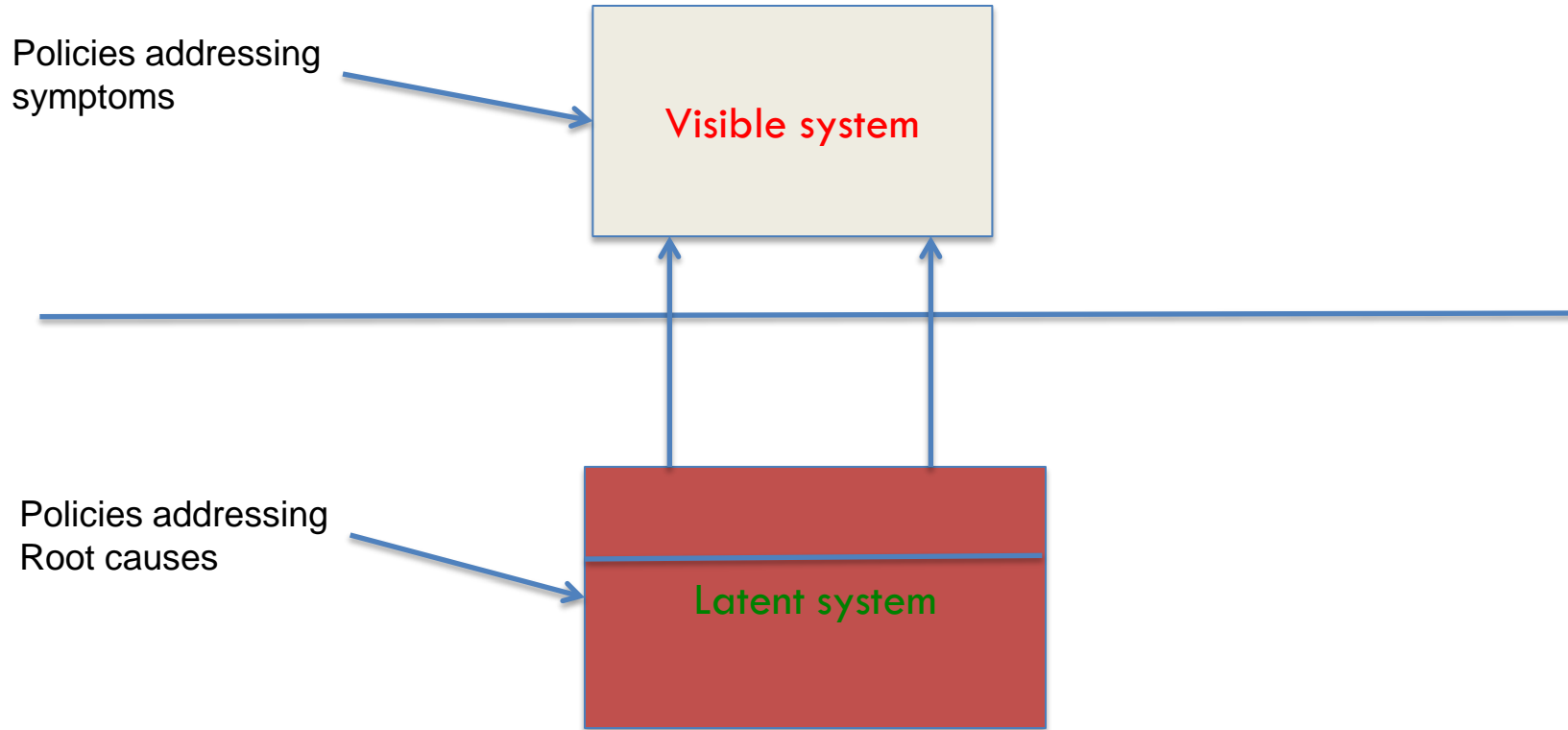
Breakdown repair (healthcare delivery)



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.

Alternative modeling approach (elaborate latent structures)

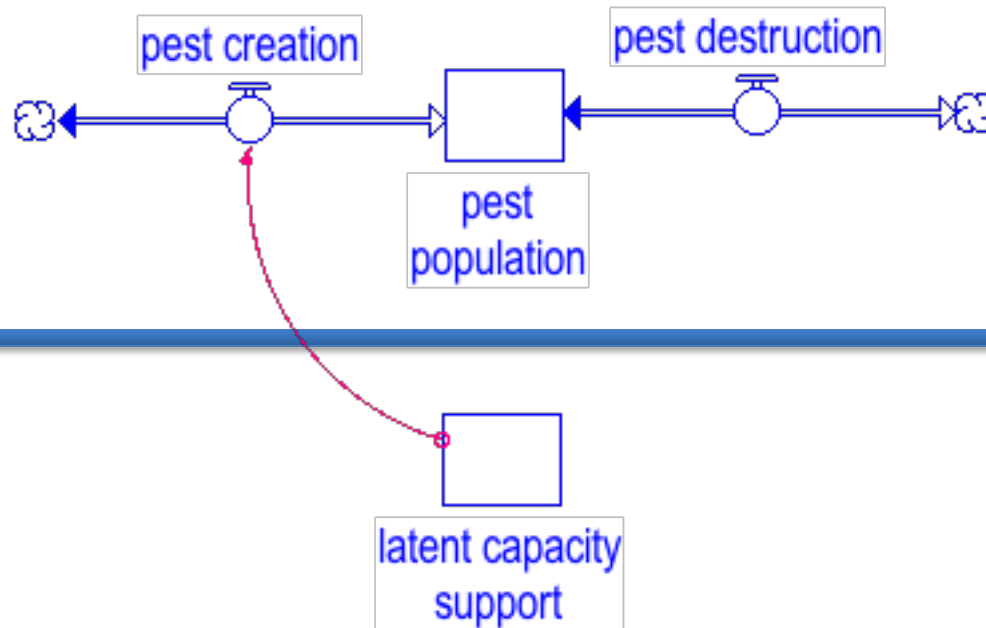




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Latent Capacity Support

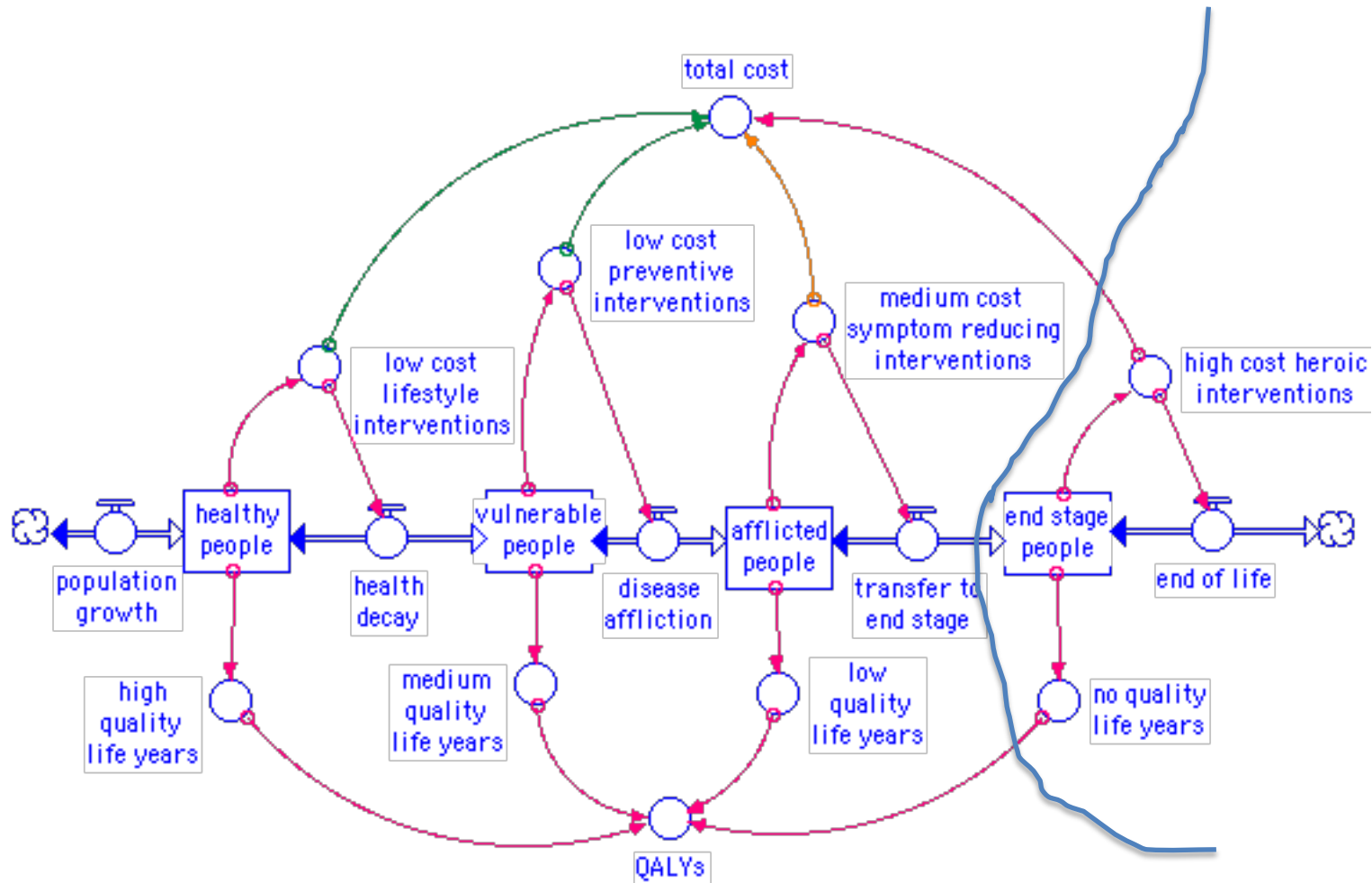




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Aging chain





Example of transforming a forecasting model into a policy tool

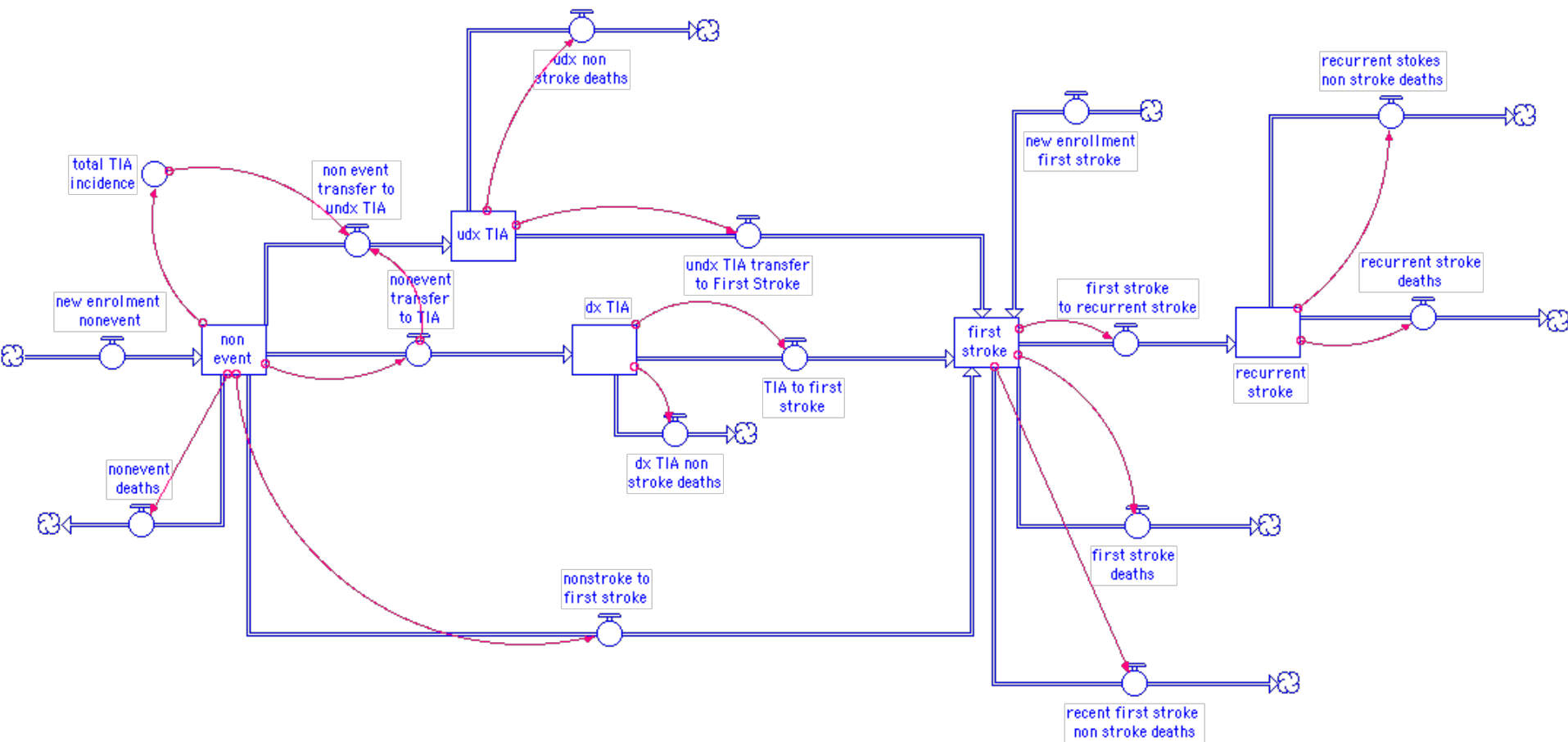
- Large complex model created by a consultant.
- Client never understood the model.
- Model output was large array of magical numbers, and a large accompanying bill.
- Use of those numbers in policy was an article of faith
- Our assignments was to make some sense out of it.



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Stroke patient chain





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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

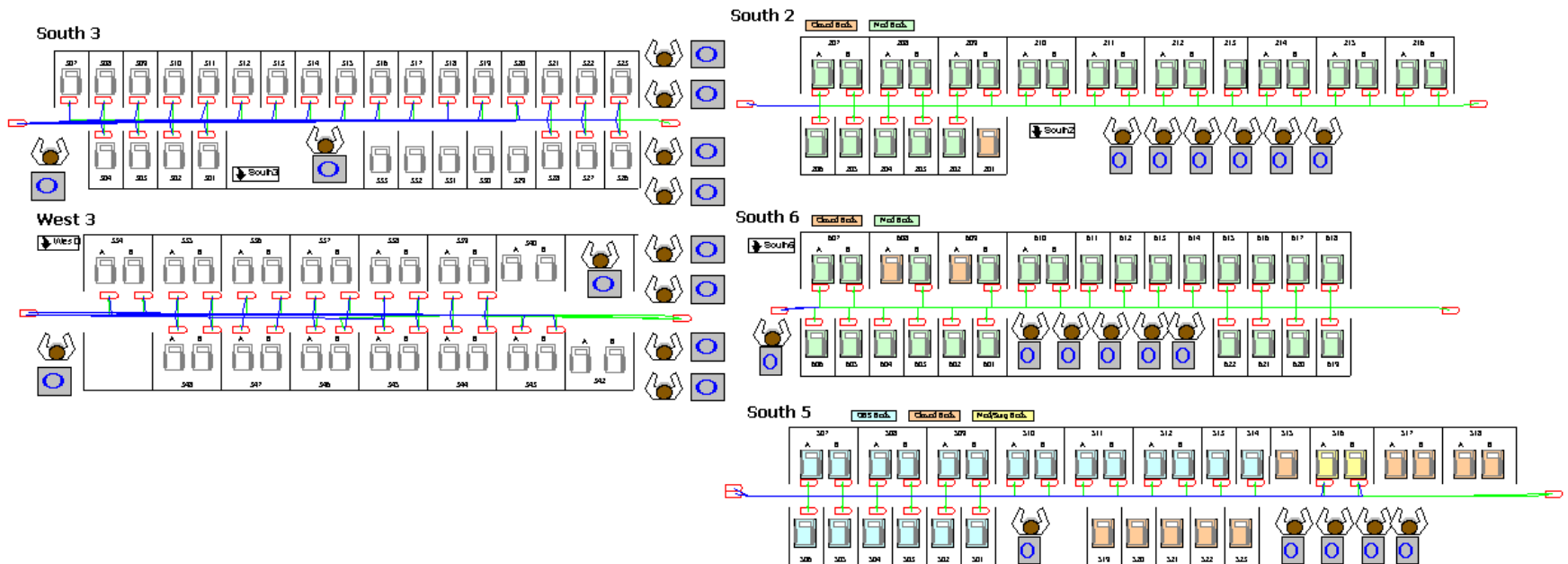
DISCRETE EVENT SIMULATION

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



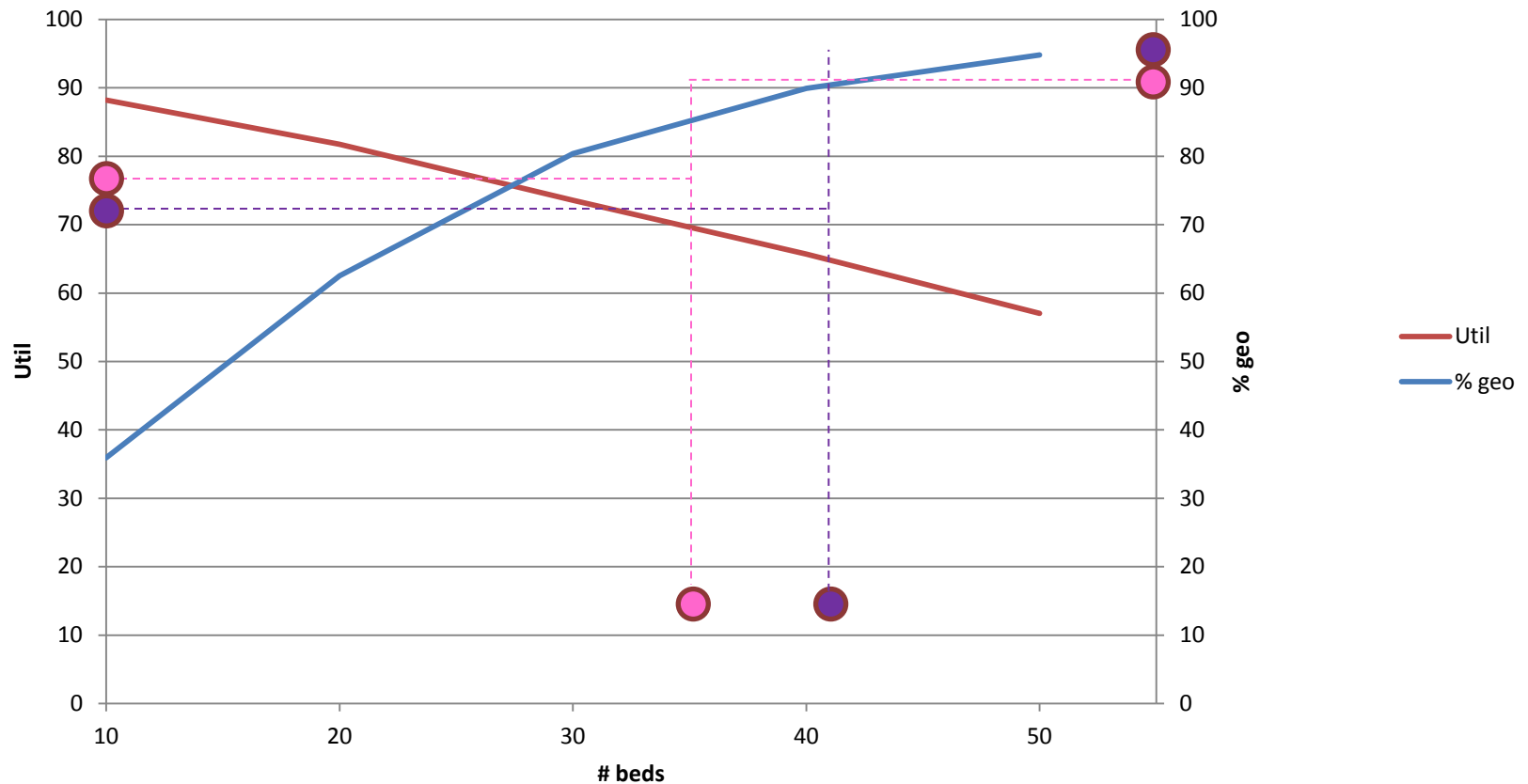
UMass Memorial Example 2:

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)

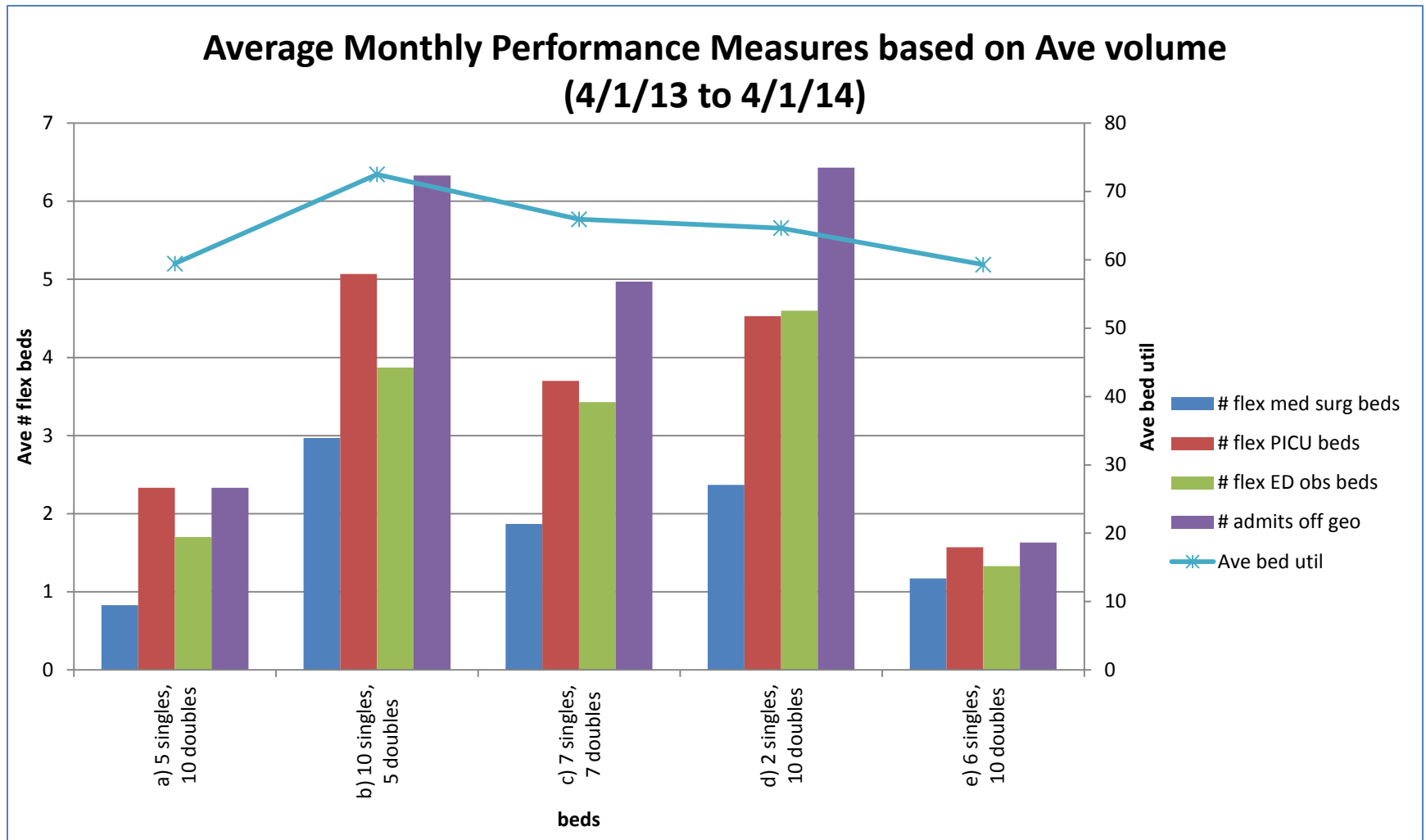
% geo and util vs # of beds (Univ, Obs + ExtRec)



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)



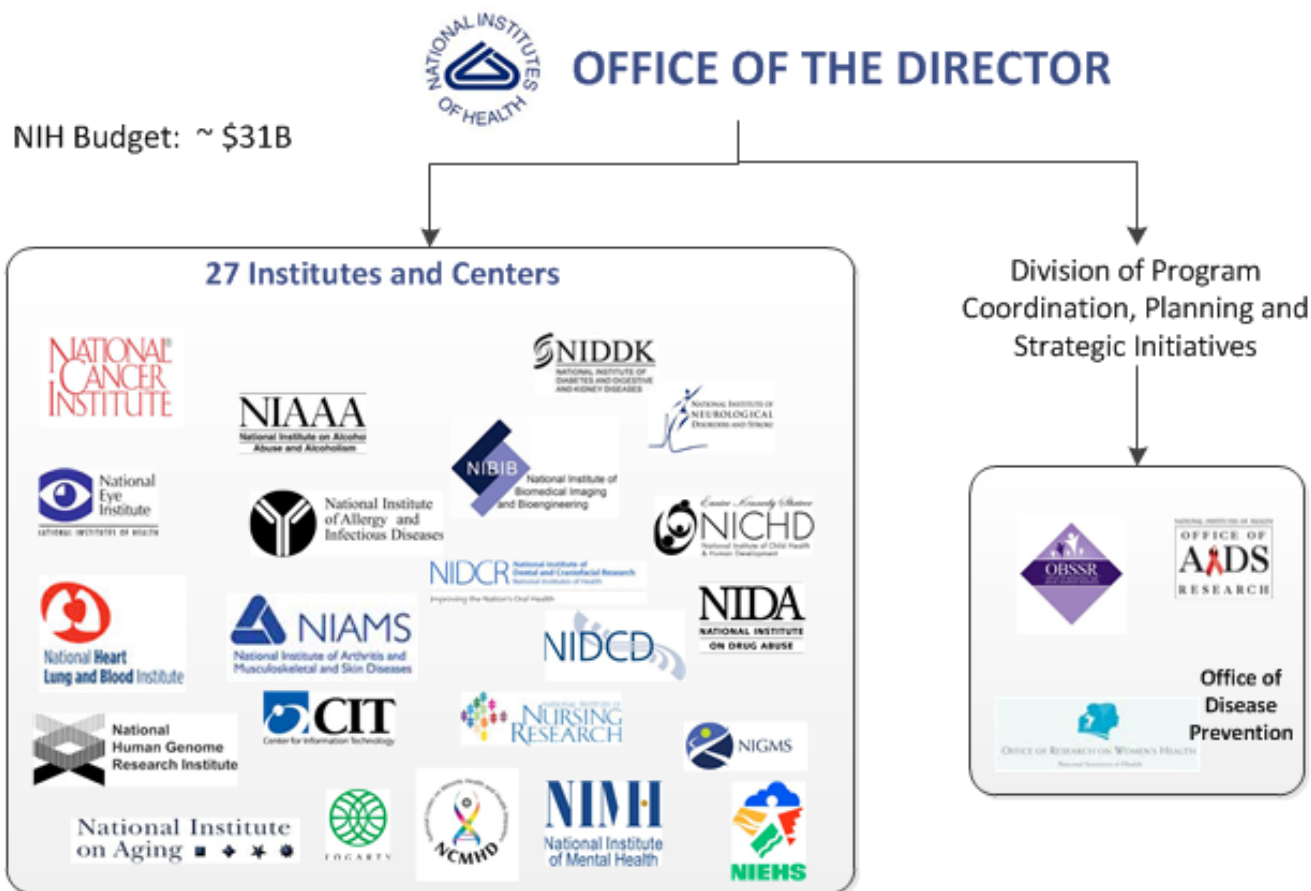
FUNDING



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Funding: NIH



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...”

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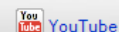
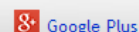
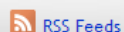
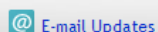
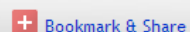
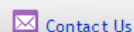
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Title	FOA/Notice Number	Related	Issuing Org	Released	Opens	Expires ▲	Activity Code
Notice of Intent to Publish Program Announcement with Special Review to Support Projects Using Systems Science Methodologies to Protect and Improve Population Health	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

This page last updated on March 26, 2014
 Technical Issues: [E-mail OER Webmaster](#)



We are looking for collaborators



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