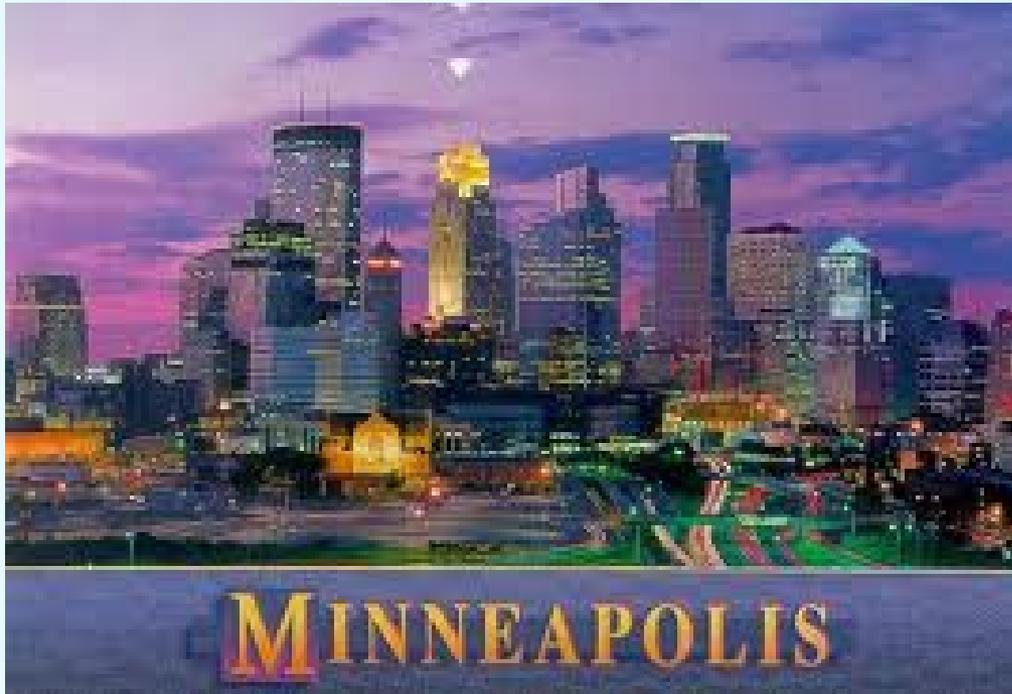


# Program Science: A New Initiative; A New Approach to STD Prevention Programs

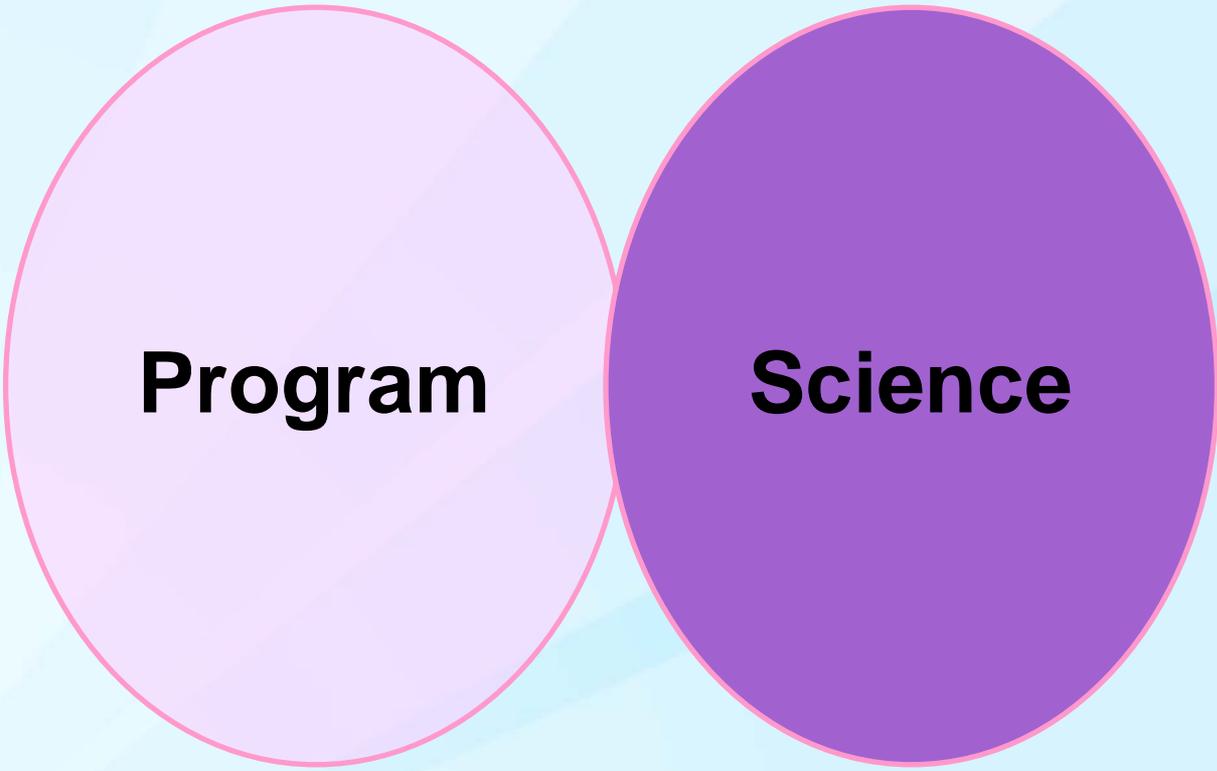


**Sevgi O. Aral**

March 12, 2012

(2012 National STD Prevention Conference)

Minneapolis, MN



**Program**

**Science**

# Today's Outline

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- Initiative timeline
- Initial conceptualization of the Program Science approach
- The need for “systems thinking” in public health
- Systems science methodologies
- Program Science definition





**June 2007**

**OAR Funding**

**Present**

**Formation of Core Advisory Group**

**Initiation of Country Programs  
(India, Kenya, Nigeria)**

# Program Science Core Group of Advisors

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Willard (Ward) Cates

Geoffrey Garnett

Marelize Gorgens-Albino

King Holmes

David Peters

Thomas Quinn

Charlotte Watts

David Wilson

## Two Needs

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- Closing the gap between science and programs
- Recognizing the “systems” nature of transmission; communities; health delivery and prevention programs

Program Science – now not alone  
in recognizing the need for a  
“systems thinking” based approach  
to public health

# Call for Papers for a Special Issue of Health Education & Behavior: Systems Science Applications in Health Promotion and Public Health

Posted on February 24, 2012 by Gary Holden

Call for Papers for a Special Issue of Health Education & Behavior: Systems Science Applications in Health Promotion and Public Health

**Manuscripts due: May 1, 2012**



..... The issue will showcase the application of various systems science methodologies to health promotion and public health research questions.....

....Methodologies of interest include system dynamics modeling, agent-based modeling, network analysis, microsimulation, operations research, and various engineering approaches.

....Interest in this topic springs from the recognition that

→ traditional research methods, which typically feature narrow problem definitions and linear analytic representations are by themselves insufficient to adequately address the full complexity of our most pressing population health challenges.

Systems science offers a complementary approach, capable of addressing more complex, interactive phenomena, while also attending to the practical constraints and opportunities that shape the social, physical, and organizational settings in which responses to those health challenges will occur.

**Program Science – an application  
of systems science to STD/HIV  
prevention programs.**

# CALL FOR PAPERS

## Society for Prevention Research 20<sup>th</sup> Annual Meeting “Promoting Healthy Living through Prevention Science”

May 29 – June 1, 2012, Hyatt Regency Washington, Washington, DC

**Pre-conference Workshops May 29, 2012**

SPR abstract submission website is at: <http://spr2012.abstractcentral.com/>.

Deadline for Abstract Submission: October 26, 2011



## Conference Theme

Dissemination / Implementation Science:

....dissemination strategies, adoption of interventions, intervention fidelity and adaptation, effectiveness, and sustainability of interventions and outcomes – at the individual, provider, organizational and system level.

Operations research can inform how best to effectively and cost effectively overcome the real world challenges of implementation.

## Conference Theme

### Systems Science Perspectives:

....Systems science involves taking into account the big picture in all its complexity (a system view) while also taking into account the important relationships between components of a system and changes in the system over time.

The Centers for AIDS Research  
Social and Behavioral Sciences Research Network

Annual Meeting  
North Carolina  
February 29 – March 2, 2012

Theme: Social Determinants and Structural  
Interventions



While NIH is putting all this money into implementation science, trying to develop Program Science is a losing battle.

Growing recognition that... most major threats to the public's health are complex

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→ each arises from an intricate mix of behavioral, economic, and social factors interacting with biological factors, over the life span and across an array of settings

## Until now these complex problems have been approached

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- correlation based analytic methods (e.g. regression)
- useful for identifying linear relationships but limited in their ability to set up and test a web of causal relationships
- used alone they are insufficient for addressing complex problems that are dynamic (change over time) and complex (large number of relationships in the system).

**Correlation based analytic methods  
are not designed to put all  
the pieces together for a big picture view.**

# Systems Science Methodologies:

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- address complex problems
- take into account the big picture
- take into account the context
- allow examination of dynamic interrelationships of variables at multiple levels of analysis simultaneously (causal feedback processes)
- make implicit assumptions about complex phenomena explicit
- expose gaps in knowledge about the problem
- help explain why programs and interventions fail to have their intended effects

**Conclusions** Declines in HIV prevalence have leveled off and prevalence is beginning to rise. HIV incidence has declined but only modestly. The proportion of men with NMP increased, but non-use of condoms declined. Use of other services that can affect incidence (e.g. MC, ART) has risen gradually. Findings underscore the need for long-term combination interventions to significantly decrease HIV incidence.

Conclusions A circumcision program which achieved 25.3% coverage of non-Muslim Men over 4 years reduced HIV acquisition in these men by 37%. There was no secular change in incidence among already circumcised Muslim men and no significant change in female HIV acquisition.

# Systems Science Methodologies include:

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Systems dynamics modeling

Agent based modeling

Discrete event simulation

Network analysis

Dynamic microsimulation modeling

Markov modeling



Connections between a system's structure and its' behavior over time

Unintended and counter intuitive consequences of interventions

Short and long-term effects of policy options

(integrating data from multiple studies and surveillance systems)

<b>Homer &amp; Hirsch</b>	<b>2006</b>
<b>Gerberding</b>	<b>2007</b>
<b>Madon et al</b>	<b>2007</b>
<b>Mabry et al</b>	<b>2007</b>
<b>Milstein</b>	<b>2008</b>

→ Calls to address public health problems with systems science

# Population health as complex adaptive system

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- Location
- Life course perspective/ path dependence (chains of consequences)
- Mutual determination  
feedback loops (feedback – feed forward)
- Dynamic aspects
- Spatial aspects
- Multilevel aspects
- Interactions between levels

## Population health as complex adaptive system (con't)

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- Interactions between determinants
- There is heterogeneity and heterogeneity counts
- Variance is important – it is the distribution (not central tendency) and tail of distribution that plays a real big role
- Adaptation to feedback
- Emergence; emergent properties



Need for agent-based modeling

**“The reason to look at epidemiology from a complex systems approach is that it does not make sense to try any other approach”**

Carl Simon

# Choices as we delve into our knowledge base

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interventions	<u>or</u>	programs
scale-up	<u>or</u>	resource allocation
generalities	<u>or</u>	specificity / heterogeneity
randomization	<u>or</u>	context appropriate specificity

## Choices ..... (con't)

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individual behaviors	<u>or</u>	subpopulation behaviors mixing patterns
averages (means, medians)	<u>or</u>	shapes of distributions concentration patterns
Biostatistics	<u>or</u>	mathematical modeling
standardized intervention packages	<u>or</u>	custom built intervention mix

# “Program Science” for HIV/STI Prevention: A Component Model

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## Spheres of Knowledge

- Epidemiology
- Transmission dynamics
- Policy analysis
- Health systems research

- Efficacy / effectiveness
- Operations research

- Surveillance
- Monitoring/evaluation
- Operations research
- Health systems research

## Spheres of Practice

Strategic Planning  
Policy Development

Program  
Implementation

Program  
Management

## Intended Outcomes

### Choose:

- The best strategy...
- The right populations...
- The right time...

### Do:

- The right things...
- The right way...

### Ensure:

- Appropriate scale...
- Efficiency...
- Change when needed...

# Program Science – FAQs

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- **How is “program science” different from “implementation science”?**
  - Implementation science, focuses on identifying and scaling up a single “evidence-based” intervention
  - Program science is concerned with the totality of a program, including an appraisal of the epidemic transmission dynamics, setting appropriate prevention objectives by sub-population, selecting and combining interventions and allocating resources between interventions accordingly

# Program Science – FAQs

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- **How does PS differ from “translational research”?**
  - Translational research focuses on how to get scientific “evidence into practice”. The process tends to focus on single interventions and a unidirectional process of knowledge translation.
  - In addition to focusing on multiple interventions and their interfaces at the population level, program science emphasizes “getting research out of practice” and formulating new hypotheses

# Program Science – FAQs

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- **How does PS differ from “operations research”?**
  - Operations research focuses on how to optimize the implementation of a particular intervention, not on strategic planning to achieve maximum population-level impact.
  - In addition to optimizing implementation, program science focuses on population impact, which depends on population focus, selection of interventions, interactions between interventions, etc.

# Program Science – FAQs

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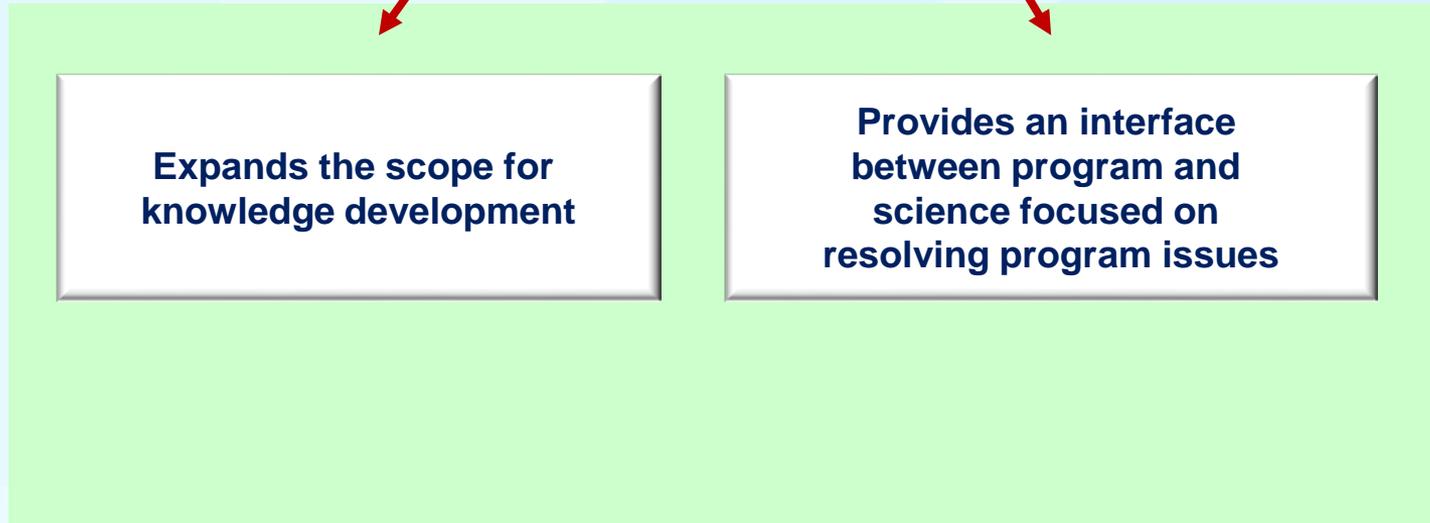
- **Isn't Program Science just the same as good program management?**
  - Program science should result in good program management, but also seeks to develop new insights and knowledge that can be translated to the design and implementation of future programs. New knowledge could emerge in areas such as:
    - Better approaches to appraising epidemics and transmission dynamics
    - Novel approaches to impact evaluation
    - Expanding public health sciences into new fields that address complexity, including new methods for understanding how epidemics emerge and the interfaces between individuals, pathogens, their environments and programs.

## Definition:

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- Program Science is the systematic application of theoretical and empirical scientific knowledge to improve the design, implementation and evaluation of public health programs.

## ➤ Program Science Framework

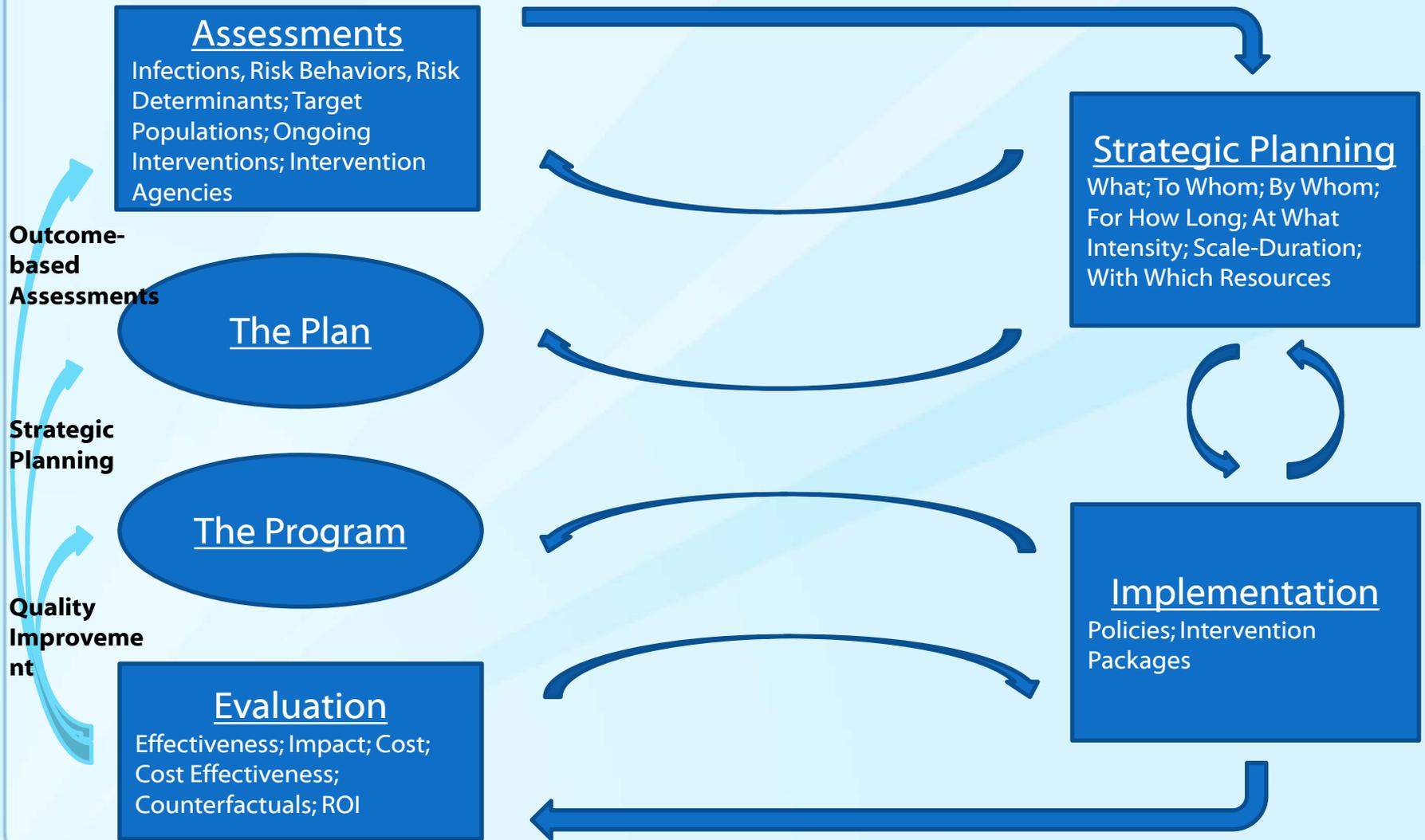


## Program Science Approach:

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- optimization of the choice of the right strategy for the right populations at the appropriate time;
- implementation of the right things the right way;
- achievement of appropriate scale and efficiency;
- prioritization of key populations (responsible for spread); and
- prioritization of optimal intervention packages

# The Program Science Cycle



## Program Science:

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- science base for the strategic planning, implementation, continuous quality improvement, monitoring and evaluation and re-positioning of STD/HIV prevention programs
- integrated science/program activity
- attention to big picture; the whole of the program
- attention to temporal dynamics
- attention to spatial dynamics
- use of non-linear analytic representations and methodologies

## Program Science:

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- Maximizing population level impact
- Maximizing efficiencies
- Maximizing return on Investment in STD/HIV Prevention

***The BIG Picture  
Totality of Epidemics  
Totality of the Program***

- **Variation across space**
- **Identification of Hot Spots**
- **Geographic targeting**

- **Epidemic Phases**
- **Epidemic Trajectories**
- **Tipping Points**
- **Phase Appropriate Intervention Packages**

***Temporal Dynamics***

- **Life course in context**
- **Path dependence**
- **Mutual determination**

***Spatial Dynamics***

## Current Challenges:

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- Defining combination intervention packages that incorporate complex interactions among interventions and context
  - Minimize antagonisms
  - Maximize synergies
- Implementing effective interventions at sufficient scale and intensity relative to the need

## Current Challenges:

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- Avoiding the scattering of interventions across geographic areas to realize synergies from multiple interventions in one location
- Targeting interventions sufficiently to key populations
  - ✓ especially in concentrated and mixed epidemics

## Prevention Science Questions for Which Program Science May Have Answers:

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- Scaled up interventions may have desired results among those reached/enrolled....but no impact on population incidence

[often public health intervention uptake is among those who need it least]

- Interventions shown to be efficacious may not be implemented by provider – not feasible

## Prevention Science Questions for Which Program Science May Have Answers:

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- Same (similar) interventions may have different results in different locales – heterogeneity of social/epidemiological context
- Interventions may have unintended consequences which increase infection spread

## Washington State Department of Agriculture Trip to China to Promote Trade



10 pretty stupid business moves: <http://listverse.com/2010/03/23/10-pretty-stupid-business-moves/>  
"BUSINESS TRAVEL; Beware of Green Hats in China and Other Cross-Cultural Faux Pas", New York Times, Craig Smith, April 20, 2002.



“Green hat” sounds like “cuckold”

Cuckold: A man whose wife is unfaithful

# Acknowledgements

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David Wilson



**Thank You**