

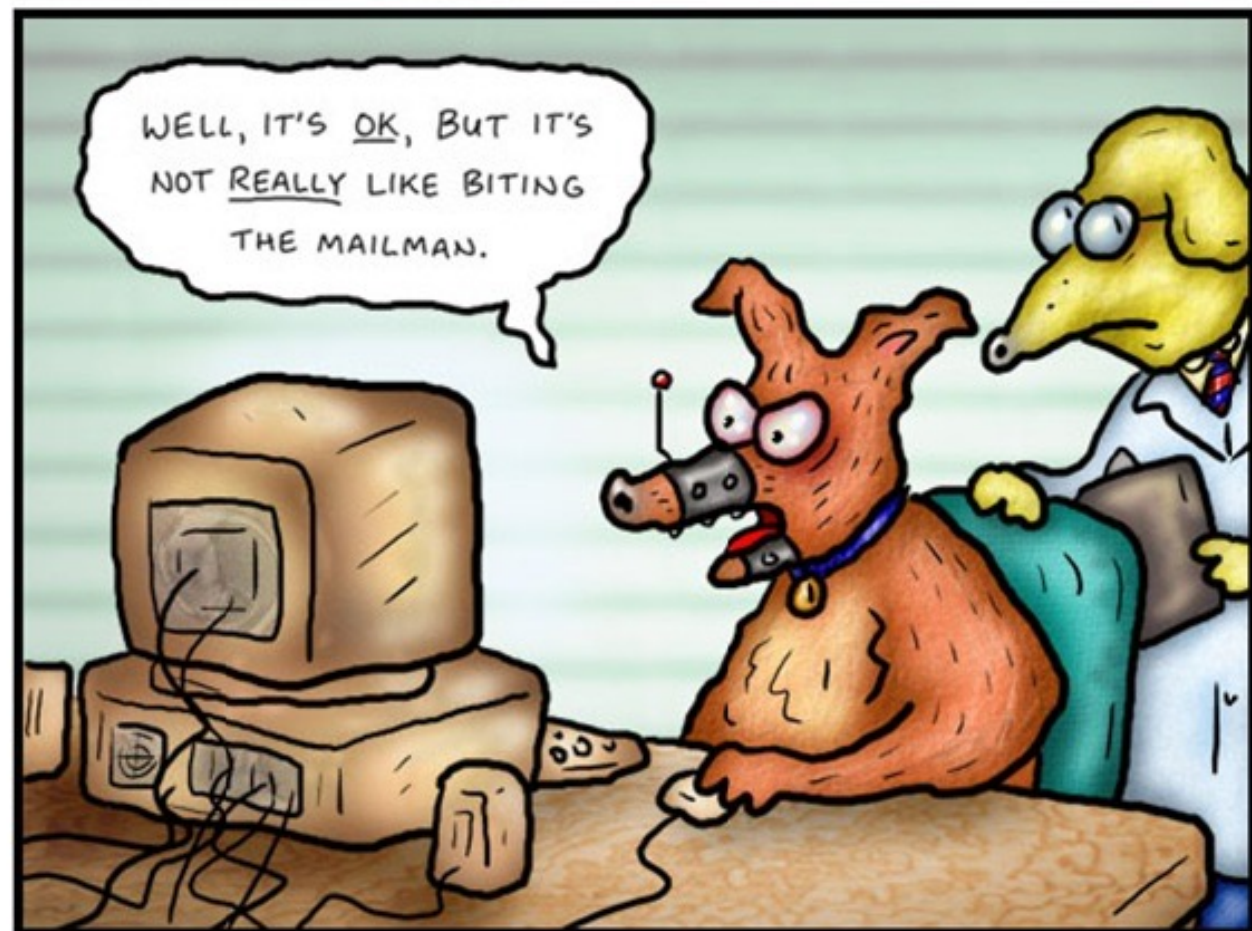
Agent-based modeling and simulation

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DOCTOR FUN

9 Apr 2002



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<http://ibiblio.org/Dave/drfun.html>

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Ceci n'est pas une pipe.

A COMPLEX MODEL



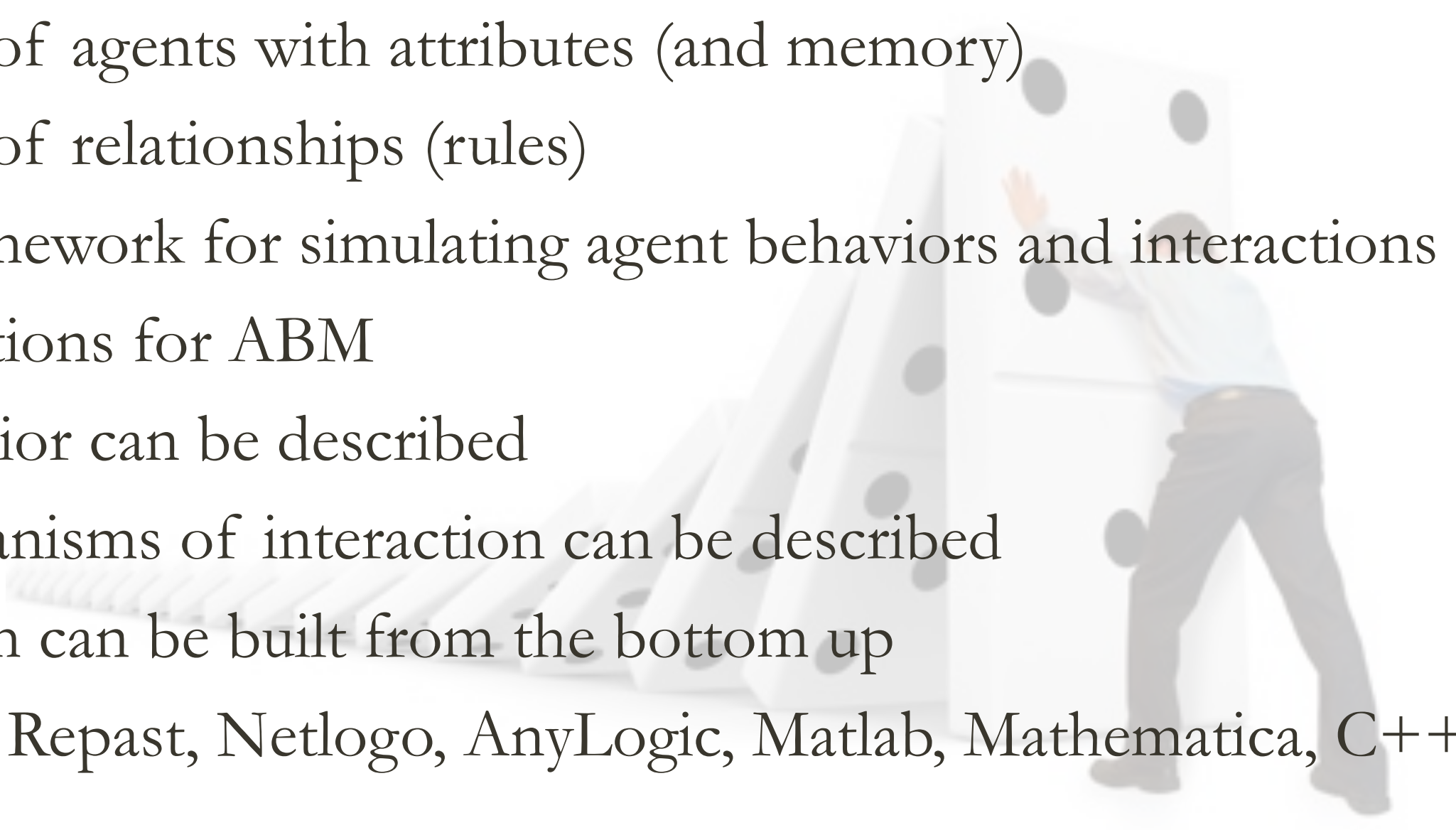
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SOME COMPLEX DATA



2012-3 MEASLES OUTBREAK

AGENT-BASED MODELING

- An agent is a discrete entity with its own goals and behaviors
 - An agent-based model (ABM) consists of
 - ◆ A set of agents with attributes (and memory)
 - ◆ A set of relationships (rules)
 - ◆ A framework for simulating agent behaviors and interactions
 - Assumptions for ABM
 - ◆ Behavior can be described
 - ◆ Mechanisms of interaction can be described
 - ◆ System can be built from the bottom up
 - Toolkits: Repast, Netlogo, AnyLogic, Matlab, Mathematica, C++
- 

START

Formulate the question

Assemble hypothesis

Initial data analysis

Choose model structure

Implement the model

Analyze the model

Communicate the model

The modeling cycle

Sensitivity analysis
Validation
Verification

Parameterization

SHELLING SEGREGATION MODEL

The screenshot shows the NetLogo interface for the Segregation model. The window title is "NetLogo — Segregation (/Users/guclu/Downloads/Segregation)". The interface includes a toolbar with "Edit", "Delete", and "Add" buttons, a "Button" dropdown menu, a "normal speed" slider, a "view updates" checkbox, and a "Settings..." button. The main area contains a 3D view of the model, a "number" slider set to 2500, "setup" and "go" buttons, and a "%-similar-wanted" slider set to 45%. Two line graphs are displayed: "Percent Similar" and "Percent Unhappy". The "Percent Similar" graph shows a curve rising from approximately 50% at time 0 to about 95% at time 22.5. The "Percent Unhappy" graph shows a curve falling from approximately 50% at time 0 to about 5% at time 22.5. A data box shows "% similar" at 86.4 and "% unhappy" at 0. The 3D view shows a grid of agents, with green and red triangles representing different types of agents. The "Command Center" at the bottom shows "observer>" and a "Clear" button.

NetLogo — Segregation (/Users/guclu/Downloads/Segregation)

Interface Info Code

Edit Delete Add abc Button

normal speed

view updates
on ticks

Settings...

number 2500

setup go

%-similar-wanted 45 %

ticks: 19 3D

Percent Similar

100
%
0

0 time 22.5

% similar
86.4

Percent Unhappy

100
%
0

0 time 22.5

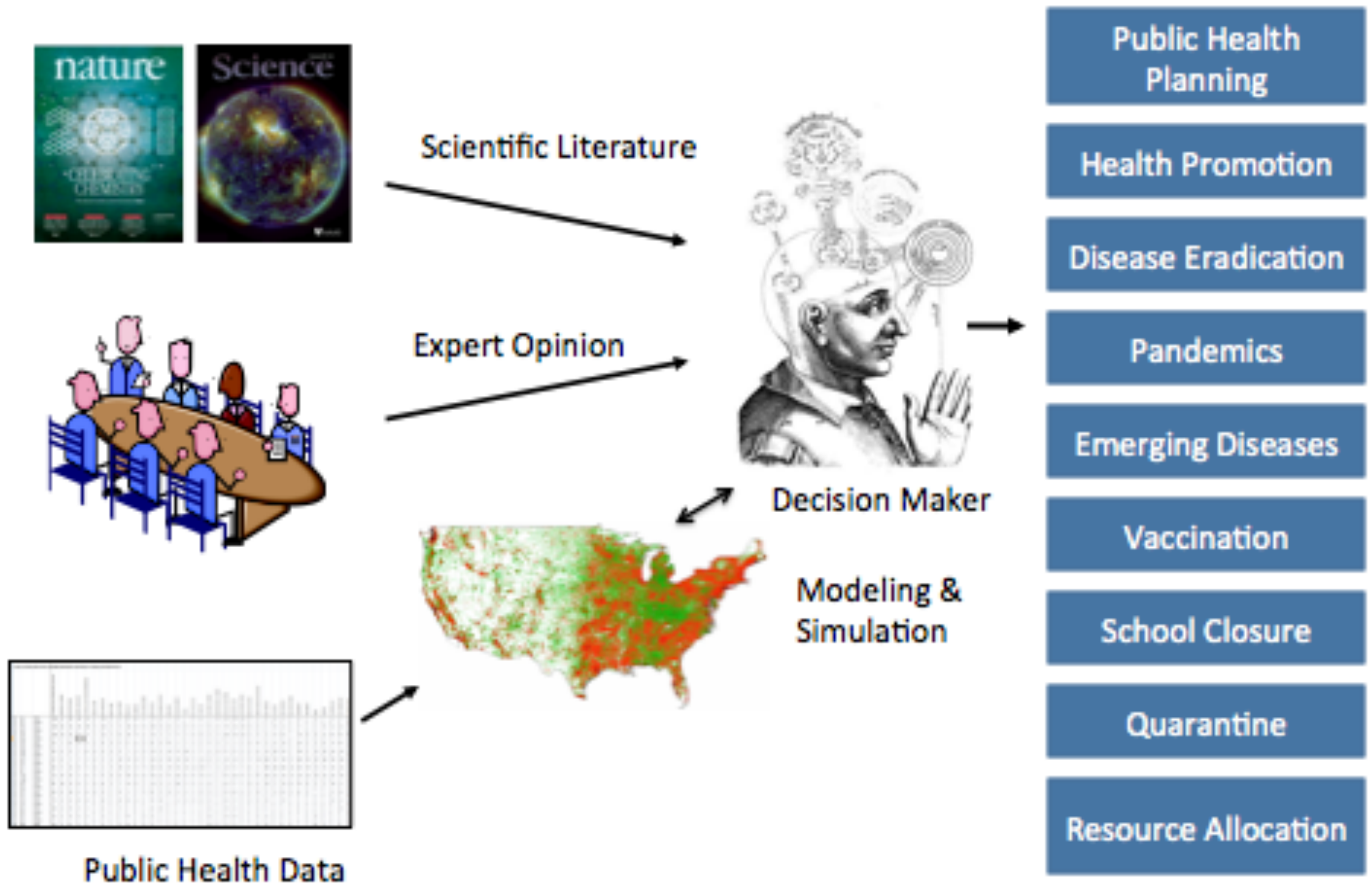
% unhappy
0

Command Center

Clear

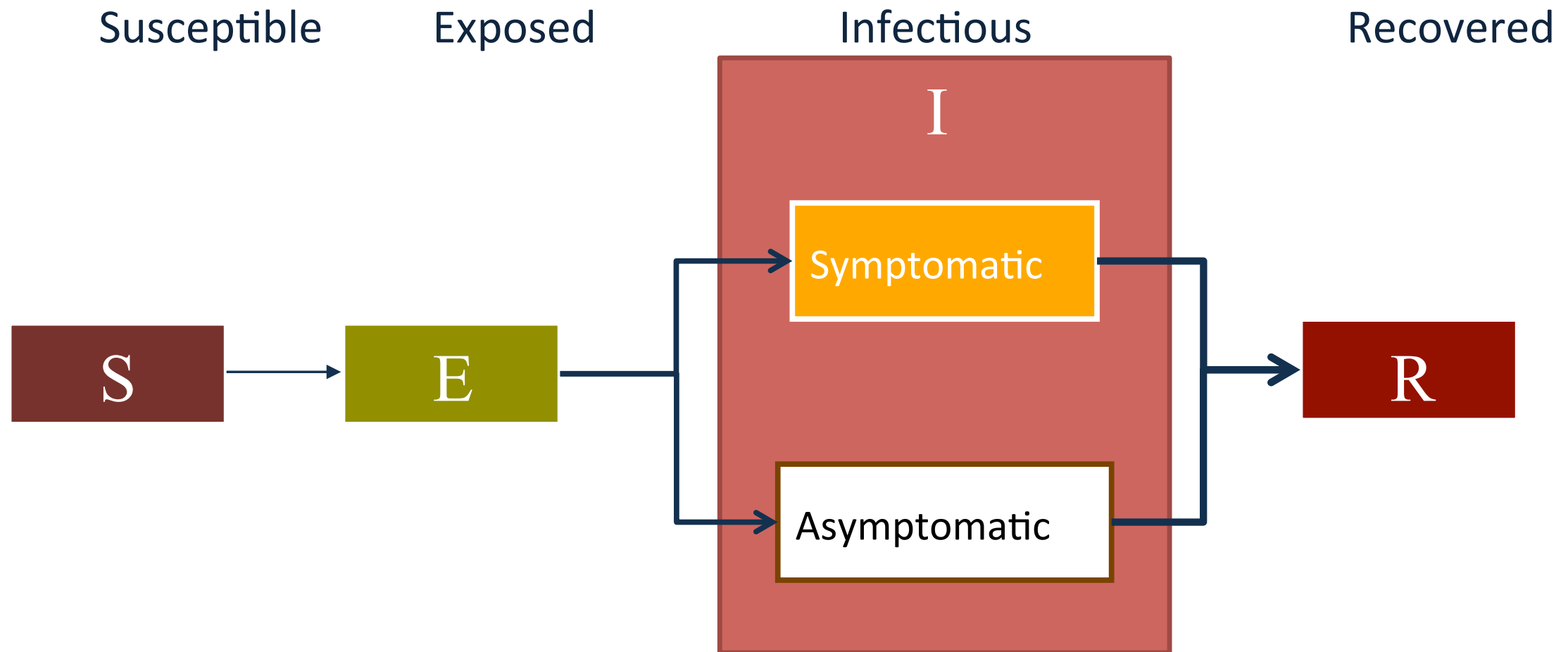
observer>

Models for Public Health Policy

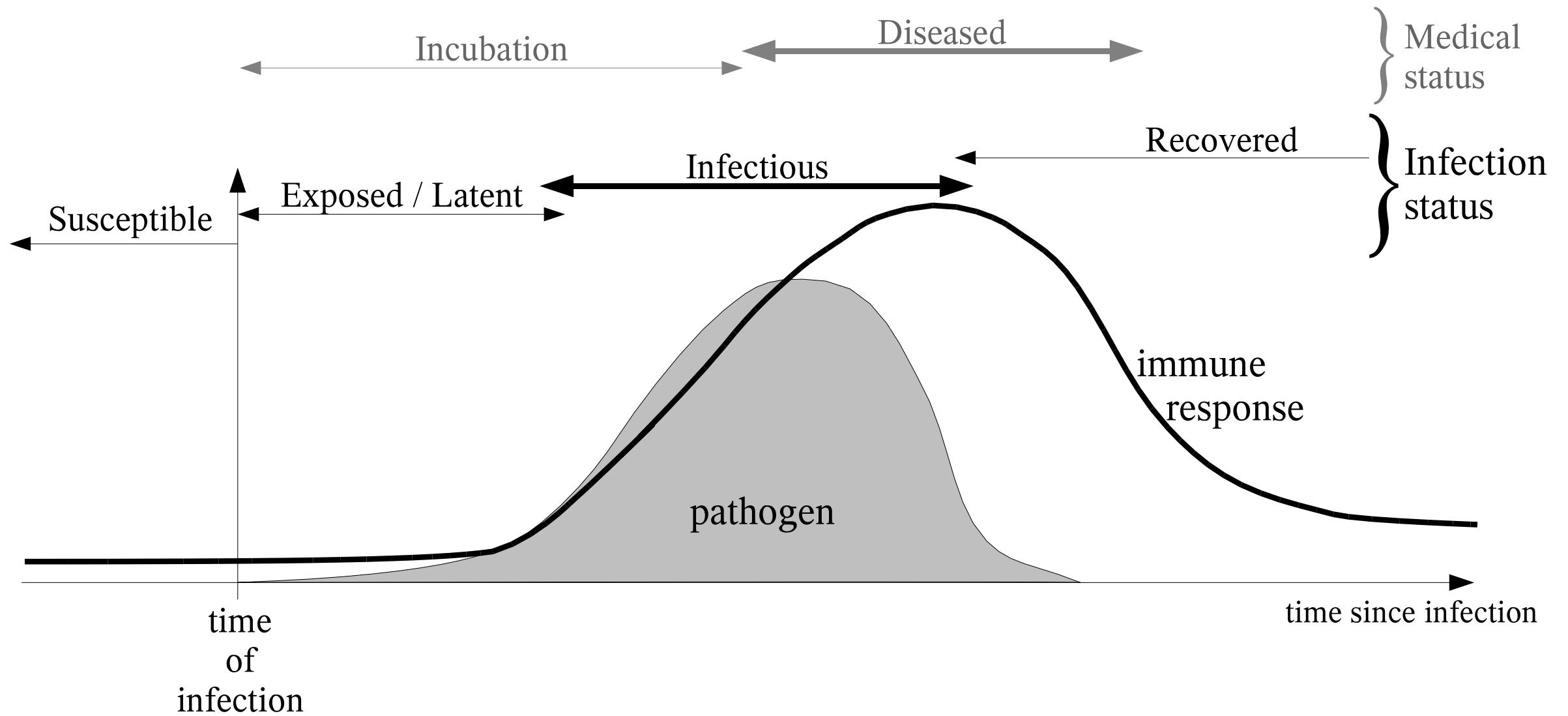


MODELING AND SIMULATION
OF INFECTIOUS DISEASES

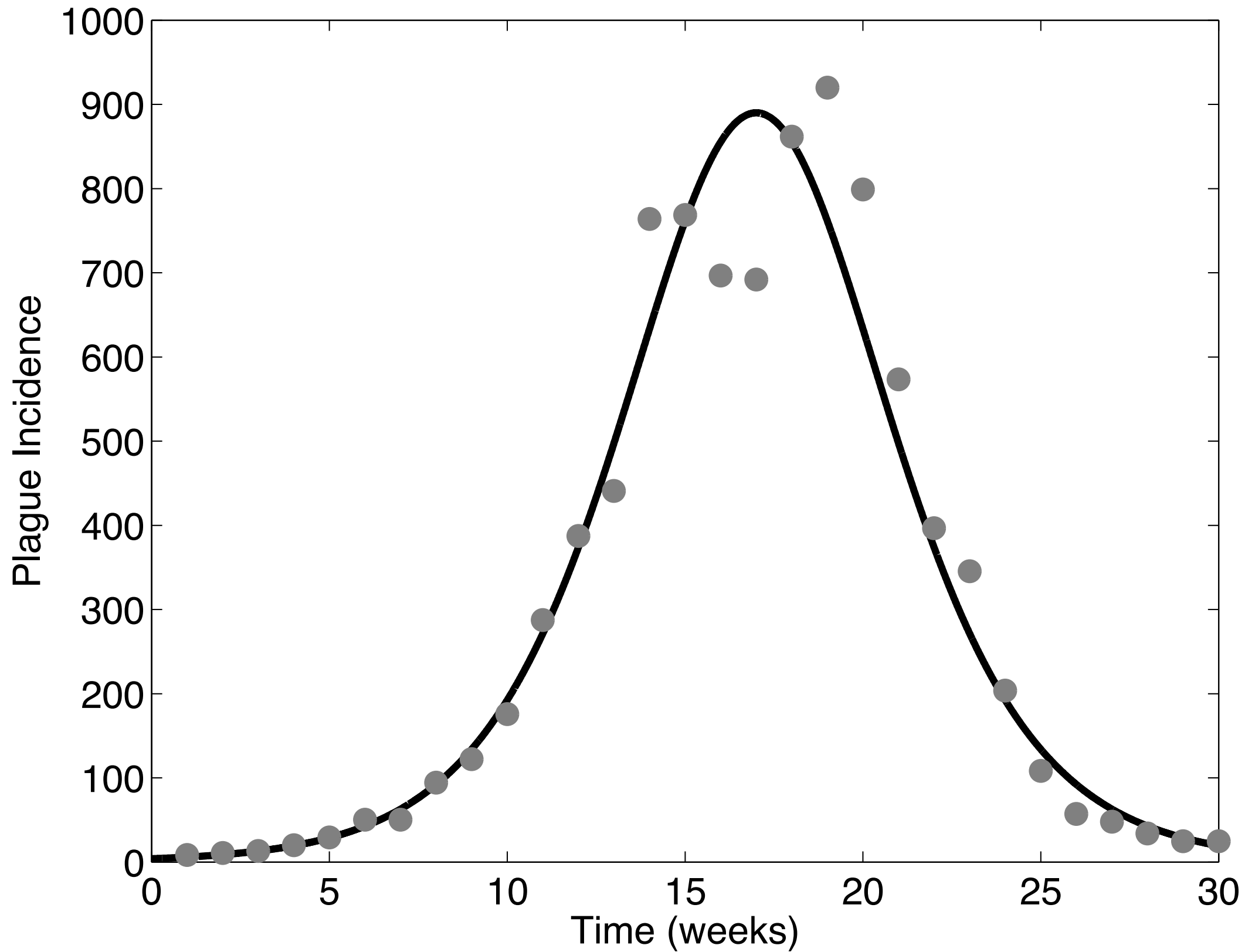
DISEASE MODEL IN FRED



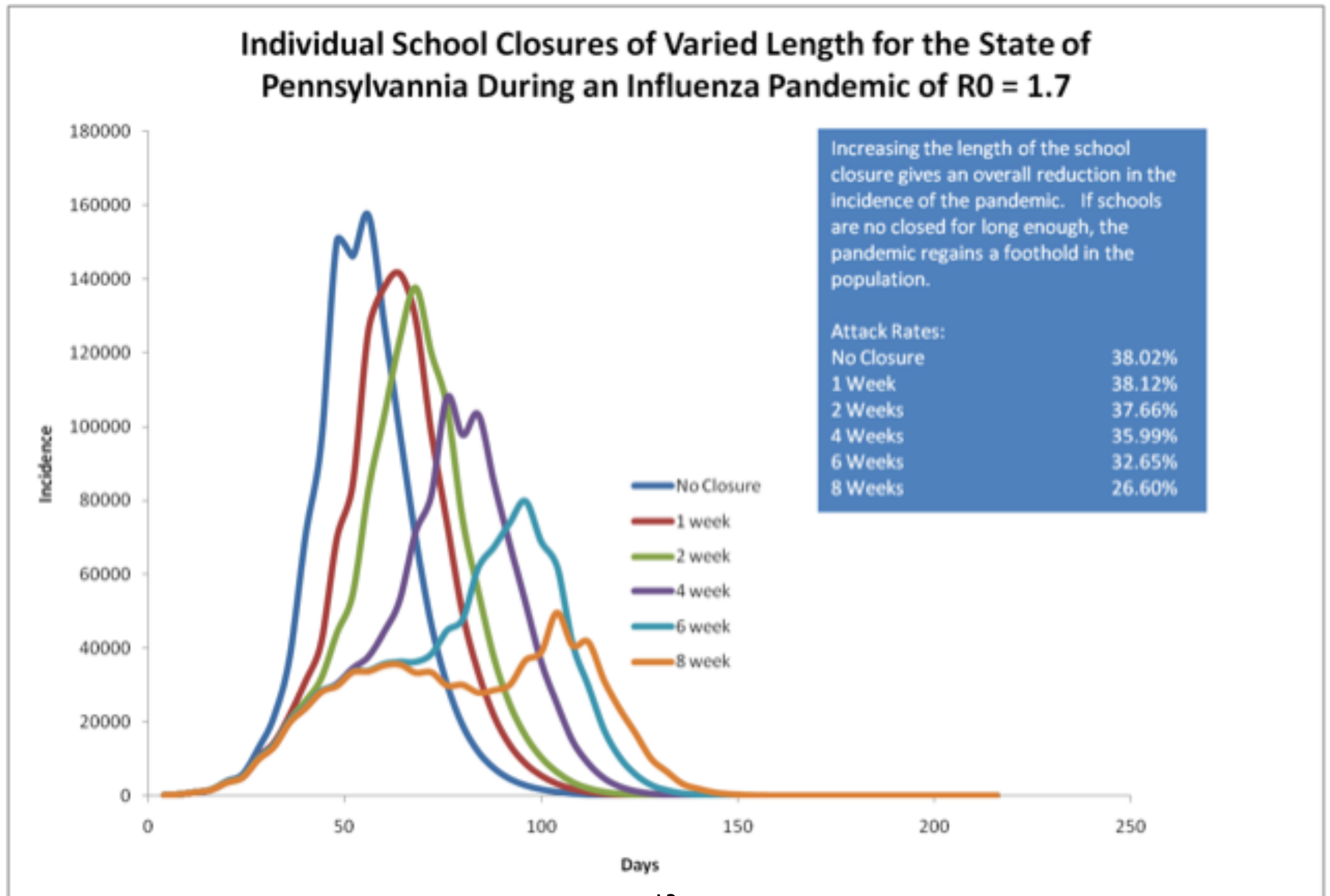
PATHOGEN-IMMUNE RESPONSE DYNAMICS



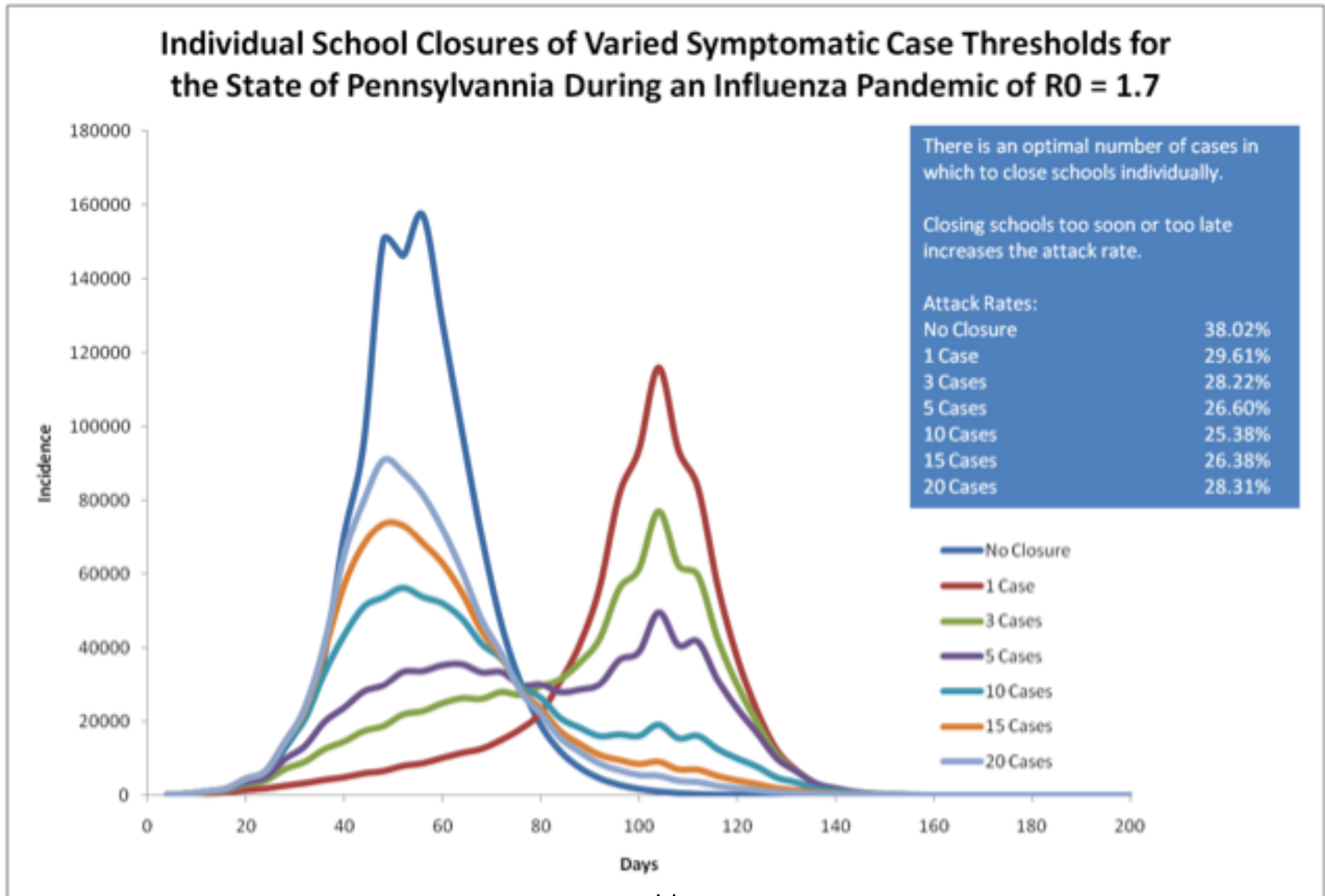
A TYPICAL EPIDEMIC CURVE



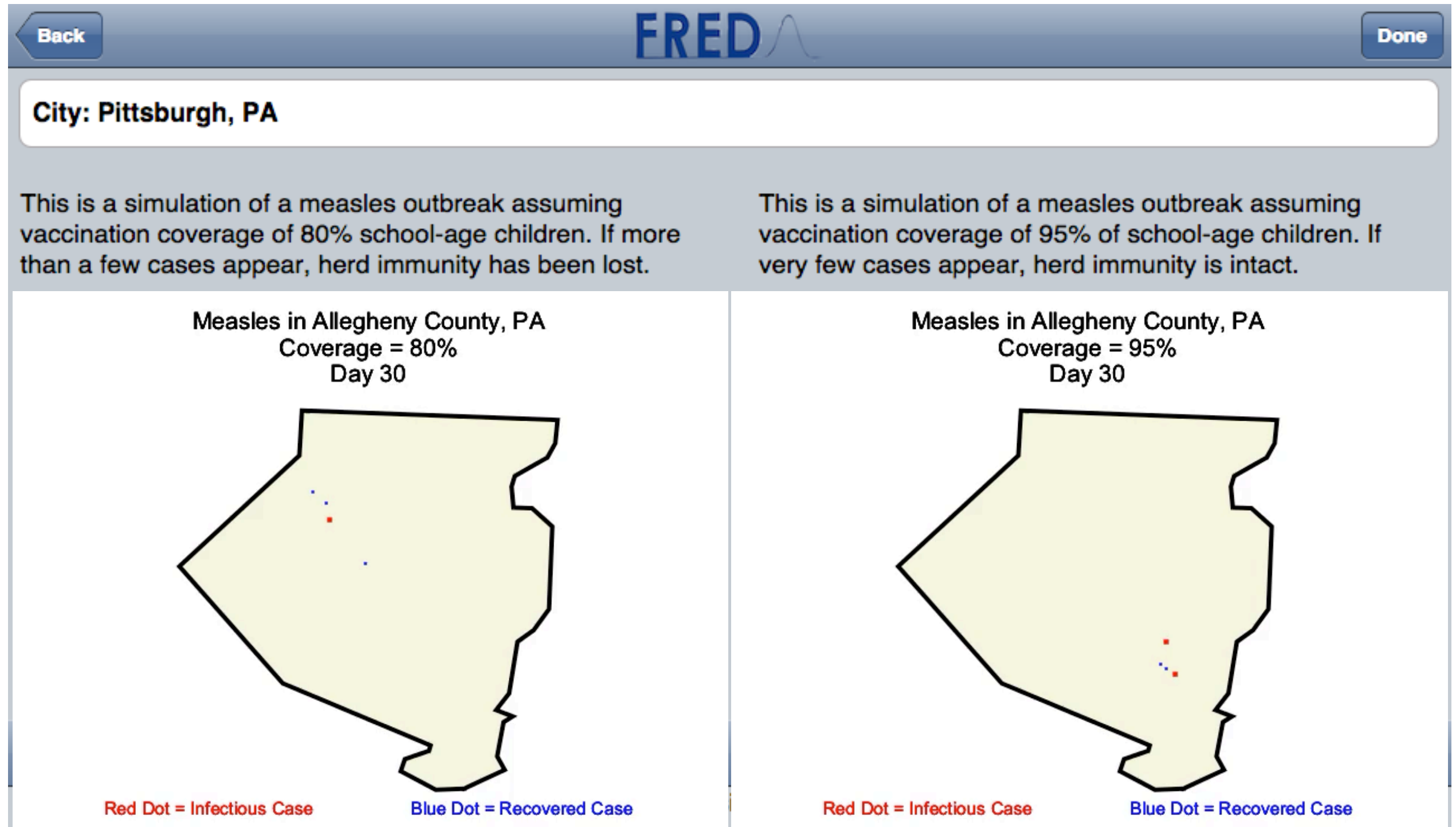
CLOSING THE SCHOOLS



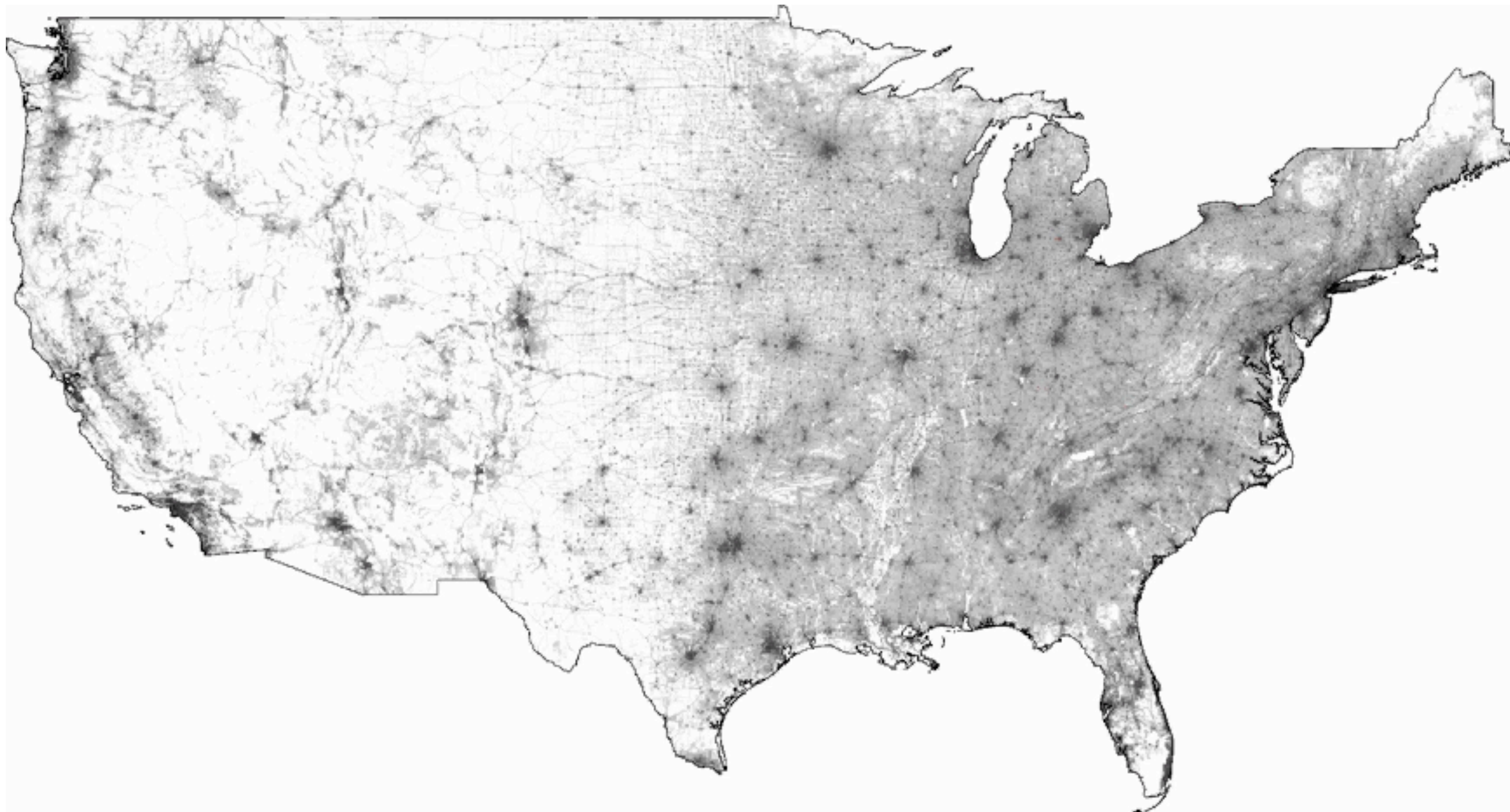
CONDITIONAL CLOSING



MEASLES OUTBREAK



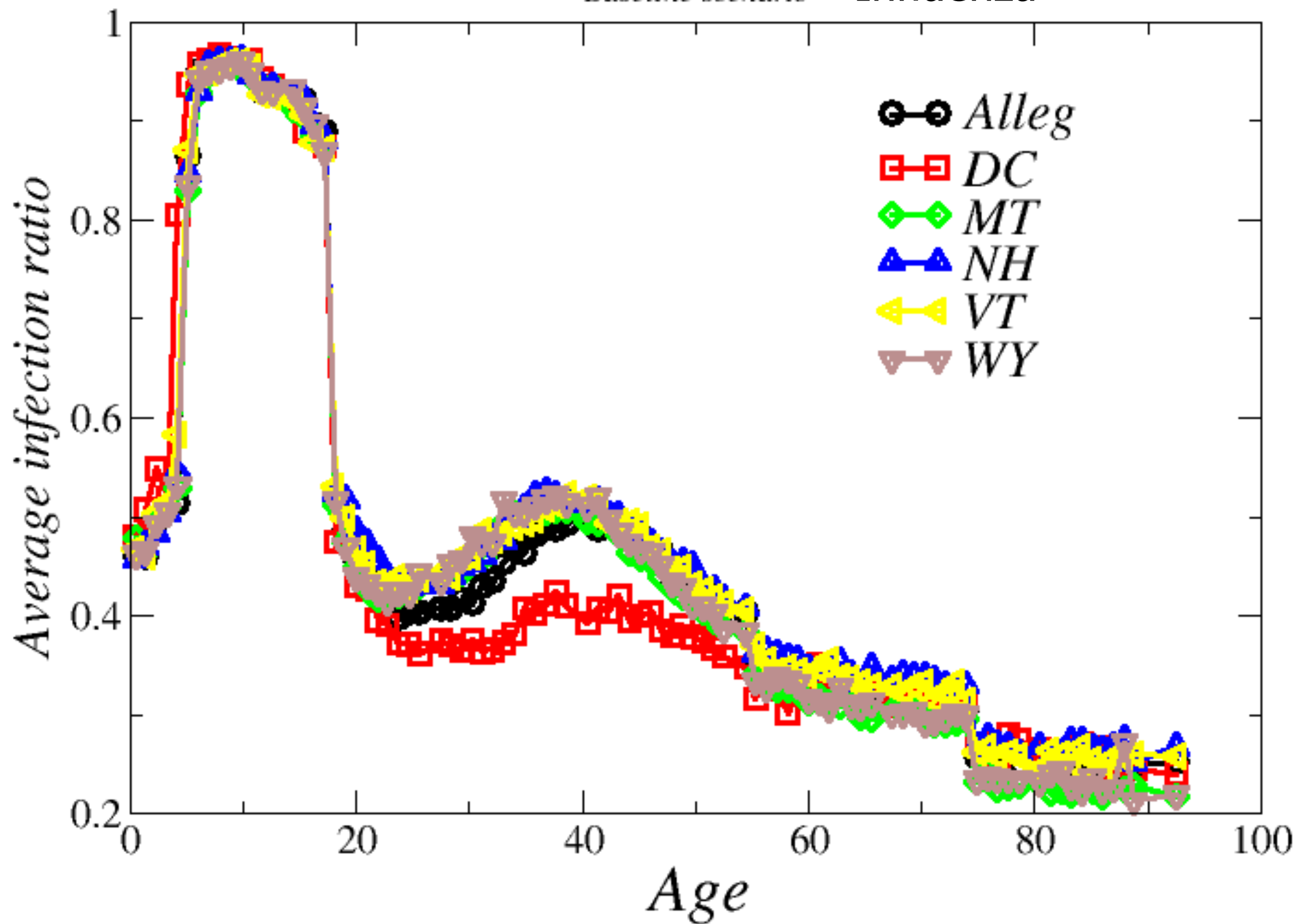
INFLUENZA IN THE USA



Average infection ratio vs age for 1000 independent runs

Baseline scenario

Influenza



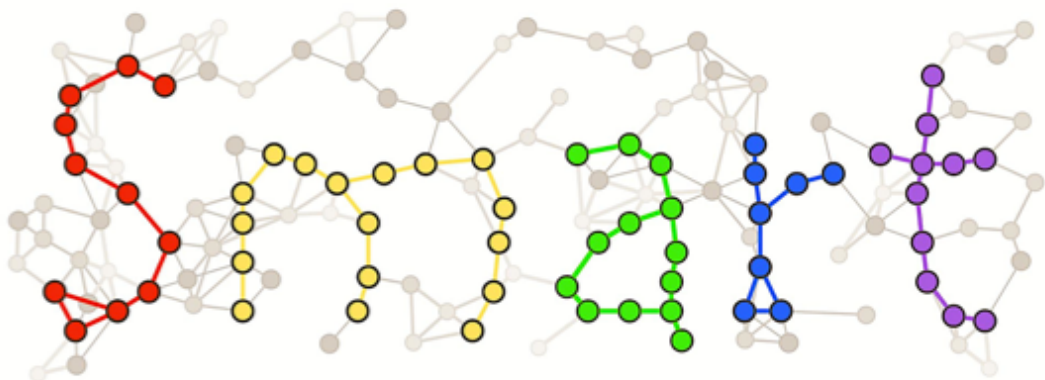
OUTBREAKS IN SCHOOLS

OUTBREAKS IN SCHOOLS

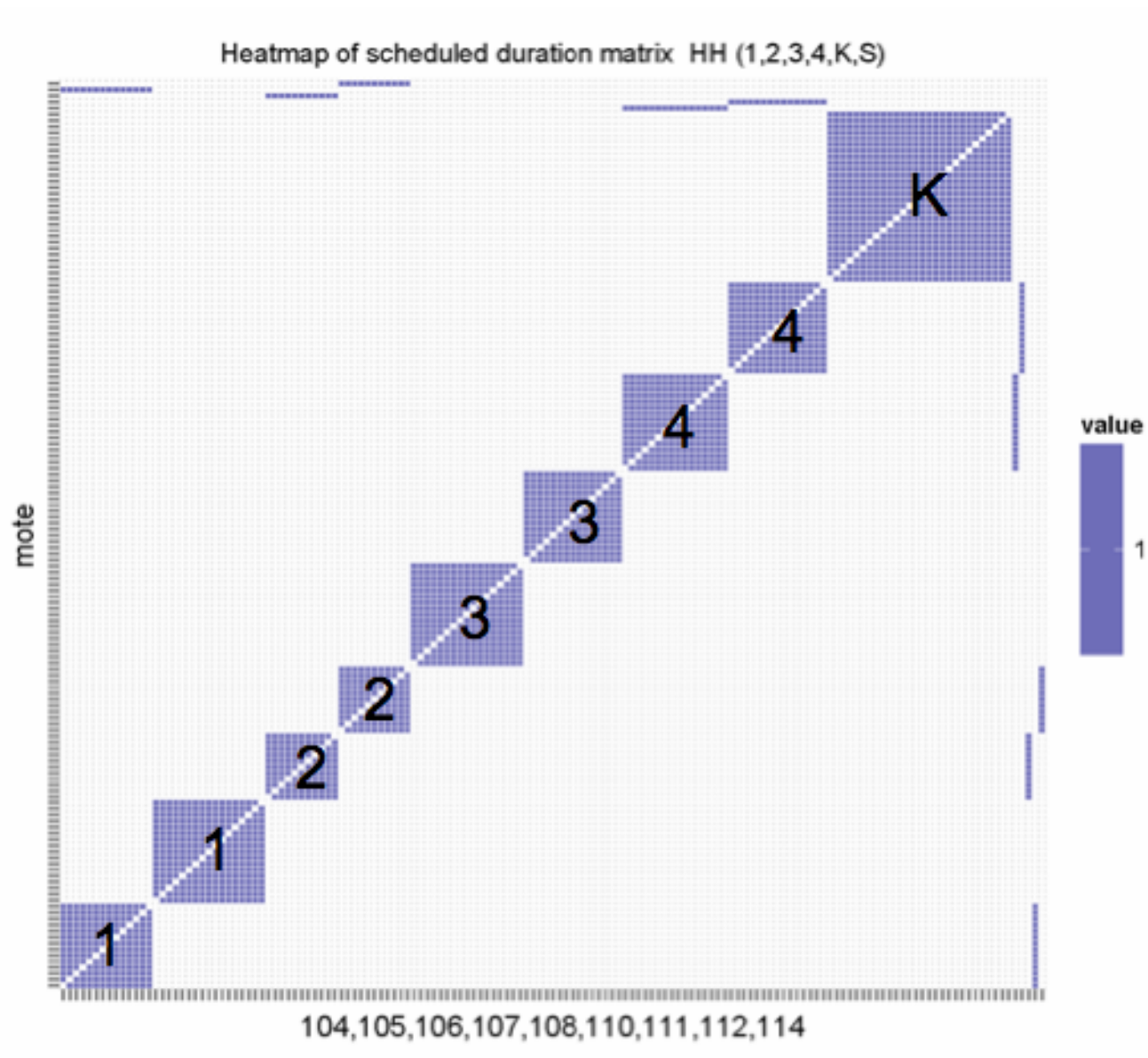


SCHOOL CONTACT NETWORKS

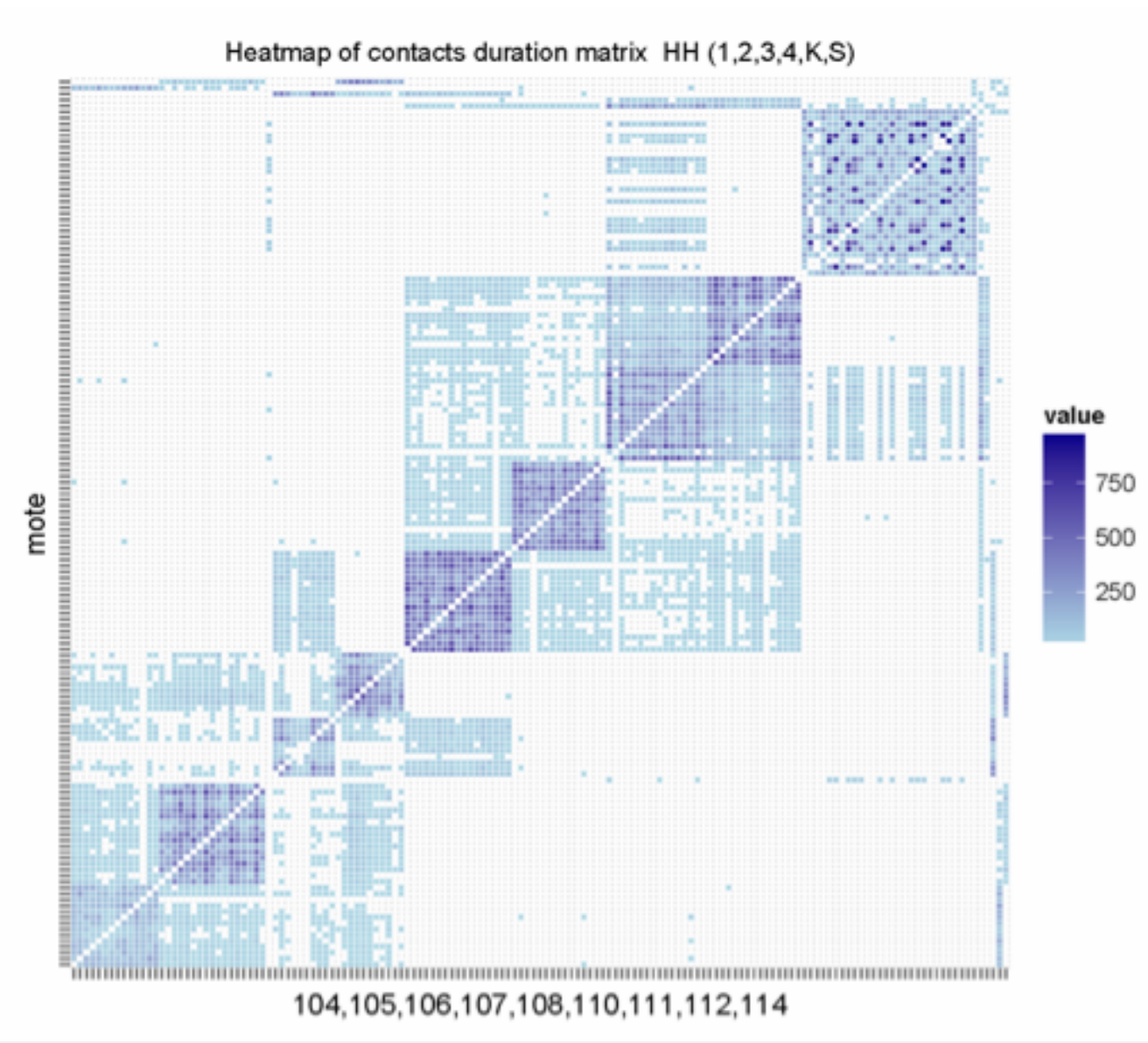
- Use of wireless sensors “motes” worn by students and staff members to measure contacts
- Daily deployments 10 schools in the Pittsburgh area (~1,800 students)
- Project is named SMART (Surveillance, Monitoring Absenteeism and Respiratory Transmission in Schools)



OUTBREAKS IN SCHOOLS



Schedule-based



Mote-based

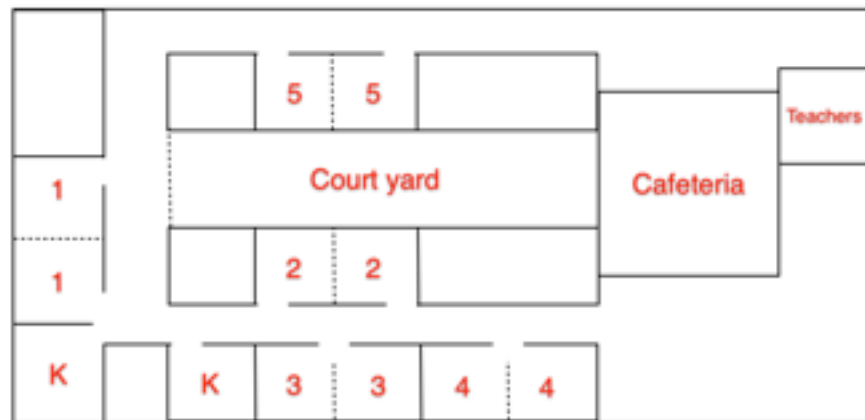
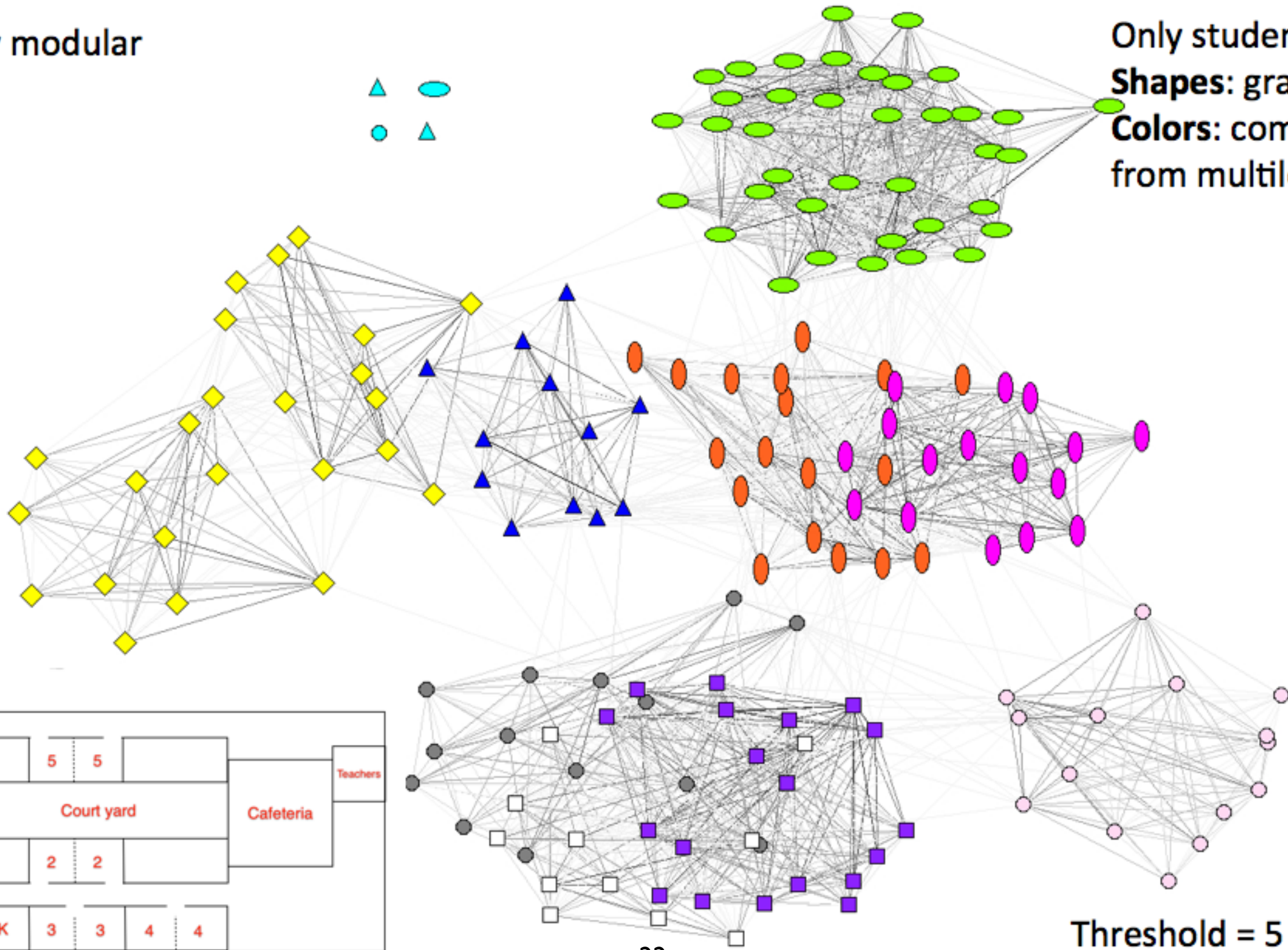
OUTBREAKS IN SCHOOLS

Very modular

- K
- 1
- ◇ 2
- △ 3
- 4
- 5

- ▲
-
-
- ▲

Only students
Shapes: grades
Colors: communities from multilevel alg.

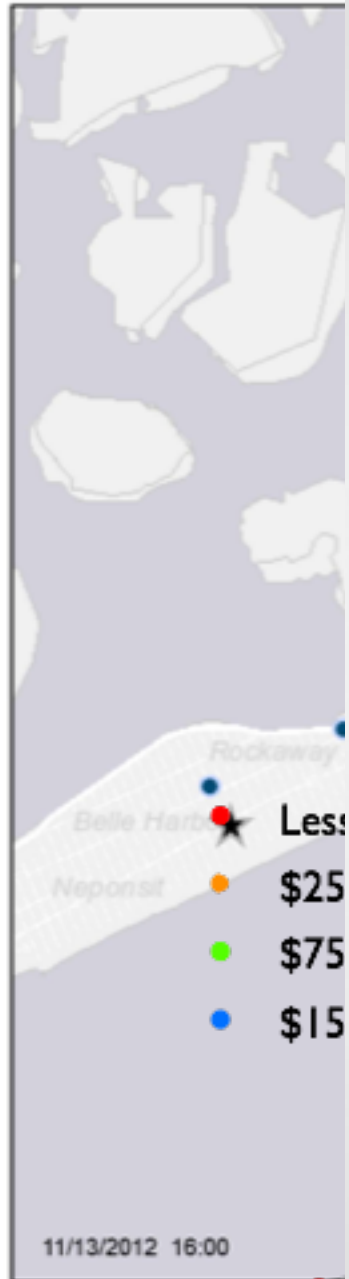


SIMULATION OF
EMERGENCIES

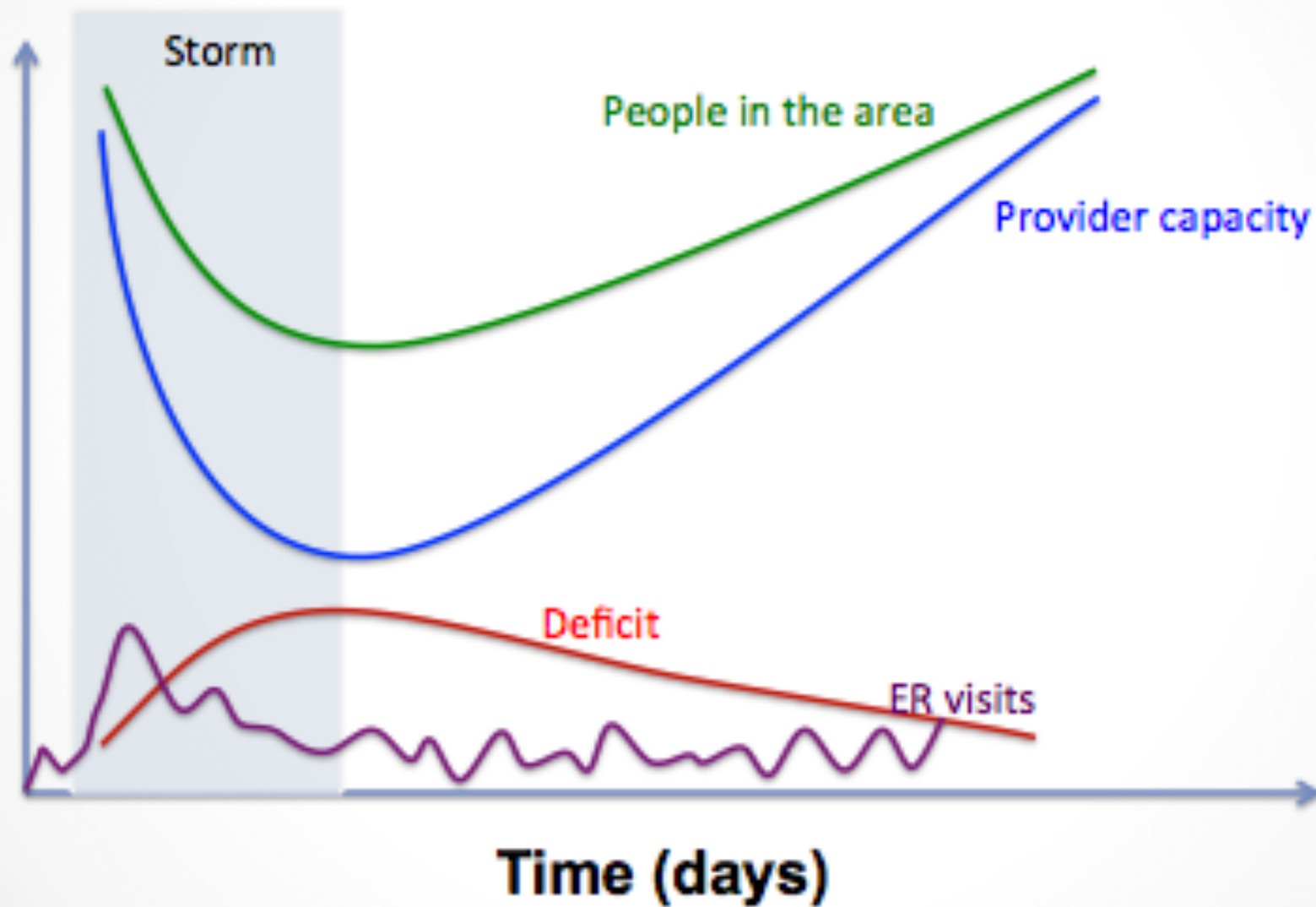
HURRICANE SANDY

SIMULATION OF EMERGENCIES

Rockaways



A sketch of results



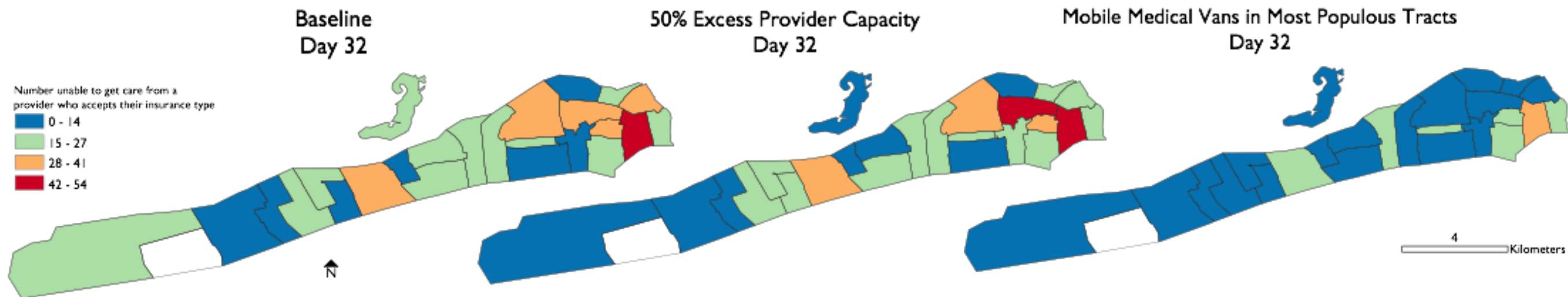
Kilometers

Guclu et al, *Disaster Medicine*, 2016

Sood et al, *Disaster Medicine*, 2016

SIMULATION OF EMERGENCIES

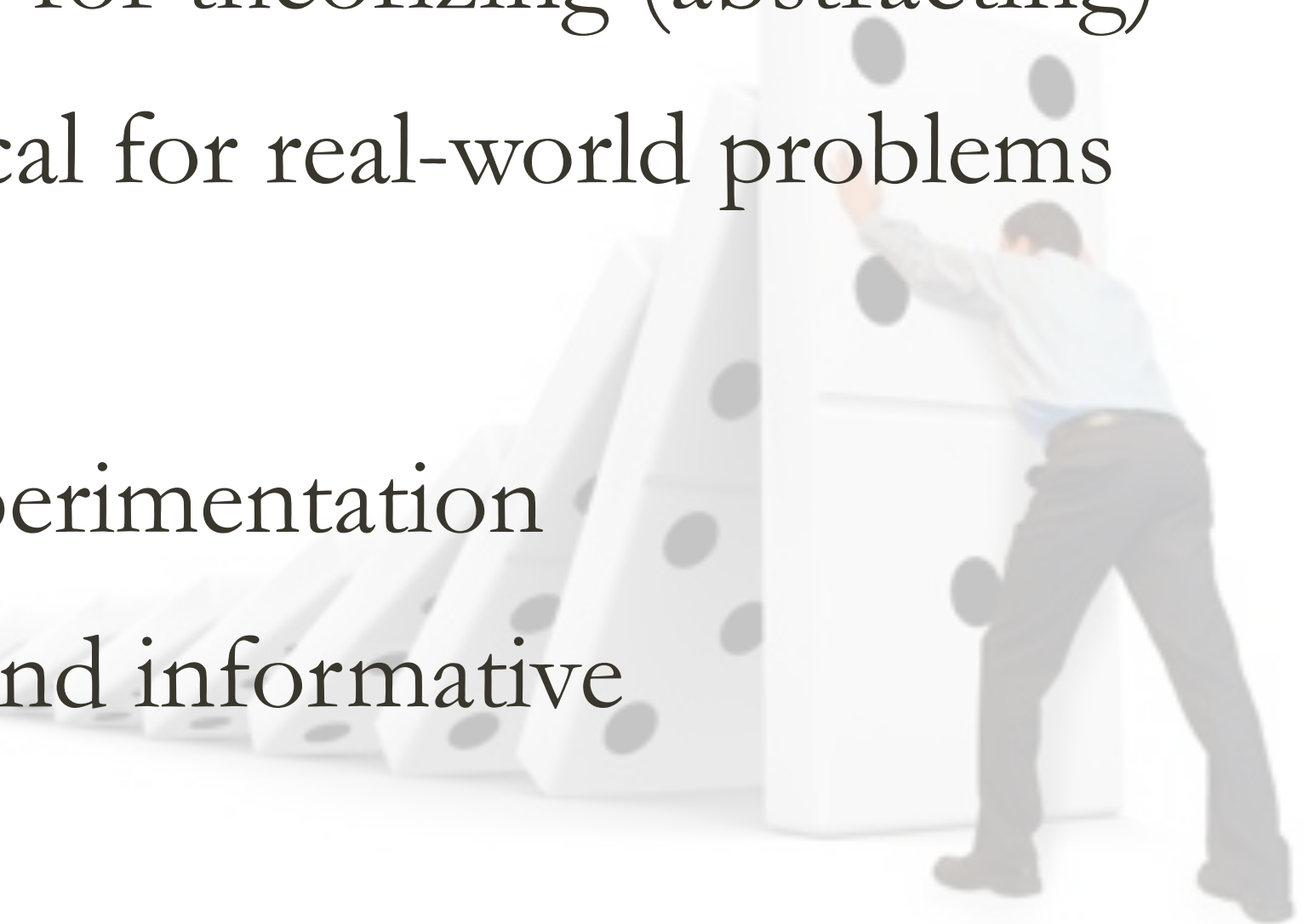
Issues in health services during and post emergencies



IN SUMMARY

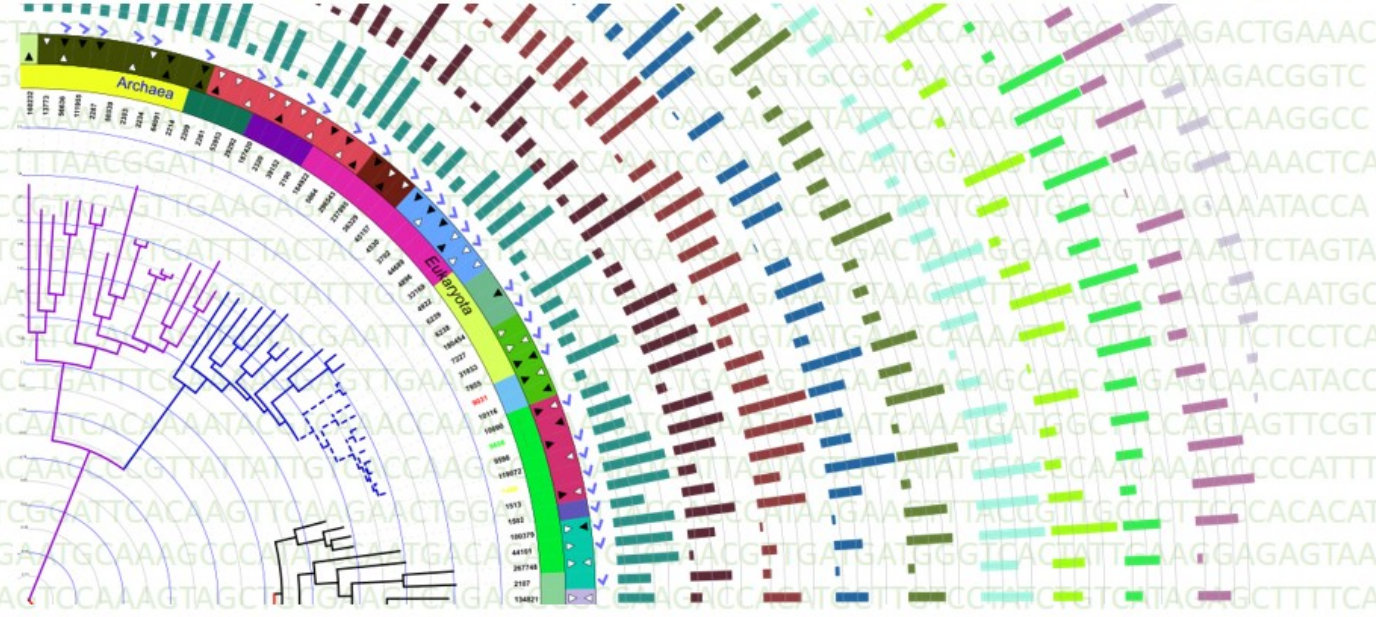
■ ABM

- is a technique for theorizing (abstracting)
- can be practical for real-world problems
- is fun
 - creative experimentation
 - surprising and informative



TAKE HOME MESSAGE

- Infectious disease outbreaks and their interventions can be modeled and simulated
- Models can be used to understand the problems as well as forecasting and prediction
- Stay home if you are sick



Son Başvuru Tarihi: 21 Haziran



Biyoenformatik



Sınav Tarihi: 25 Haziran



Biyolojik Ağlar



Kayıt Tarihleri: 2-6 Eylül



Makine Öğrenmesi



ALES (SAY) Koşulu: 75



Biyoistatistik



Dil Puanı Koşulu: 60



Biyolojik Veri Etiği

<https://enstitu.medeniyet.edu.tr/tr>

Akademik Kadro:

Prof.Dr. Handan Ankaralı (Biyoistatistik), Prof.Dr. Seyit Ankaralı (Fizyoloji), Prof.Dr. Hasan Güçlü (Biyoistatistik), Prof.Dr. Mahmut Gümüş (Onkoloji), Prof.Dr. Nihat Kabaoğlu (Elektrik-Elektronik Mühendisliği), Prof.Dr. Işıl Maral (Halk Sağlığı), Doç.Dr. Rahmet Savaş (Matematik), Dr.Öğr.Üyesi Arafat Salih Aydınar (Yönetim Bilişim Sistemleri), Dr.Öğr.Üyesi Alpertunga Kara (Tıp Tarihi ve Etik), Dr.Öğr.Üyesi Muhammed Erkan Karabekmez (Biyomühendislik), Dr.Öğr.Üyesi Filiz Kısaayak Çollak (Moleküler Biyoloji ve Genetik), Dr.Öğr.Üyesi Ayşe Betül Oktay (Bilgisayar Mühendisliği), Dr.Öğr.Üyesi Ulaş Vural (Bilgisayar Mühendisliği).

Thank you for listening

**It's now safe to turn off
your computer.**

