Modeling Pandemic Influenza in Los Angeles County

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Emergency Preparedness and Response Program

Outline

- Modeling in Los Angeles
  - Big County, Distinct Challeng
  - So Many Questions
  - Unique Project
- Community Mitigation Mode
  - History
  - Design Specifics
  - Results and application
- Surge Model
  - Brief Overview
  - Results and application

Modeling in Los Angeles

Big County

- 11 million citizens; 88 cities
- 11 primary languages
- 108 Hospitals;
  87 Emergency Depts.
- 3 Health Depts:
  - County (3,700 staff)
  - Long Beach
  - Pasadena

Distinct Challenges

- Population density & scarcity
- Urban v. rural
- 1/3 of <65 pop uninsured
- 100,000 homeless
- 36% foreign born
- Over 200+ languages

So Many Questions…

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Modeling in Los Angeles: So Many Questions

- How will the pandemic spread throughout the County?
- How can we slow it down?
- How effective are:
  - Vaccines?
  - Anti Virals?
  - School Closures?
  - Social Distancing Measures?
- How many people will get sick?
- How many will go to the hospital?
- Will all hospitals experience “surge” at the same time?
- What can hospitals do to maximize their resources?

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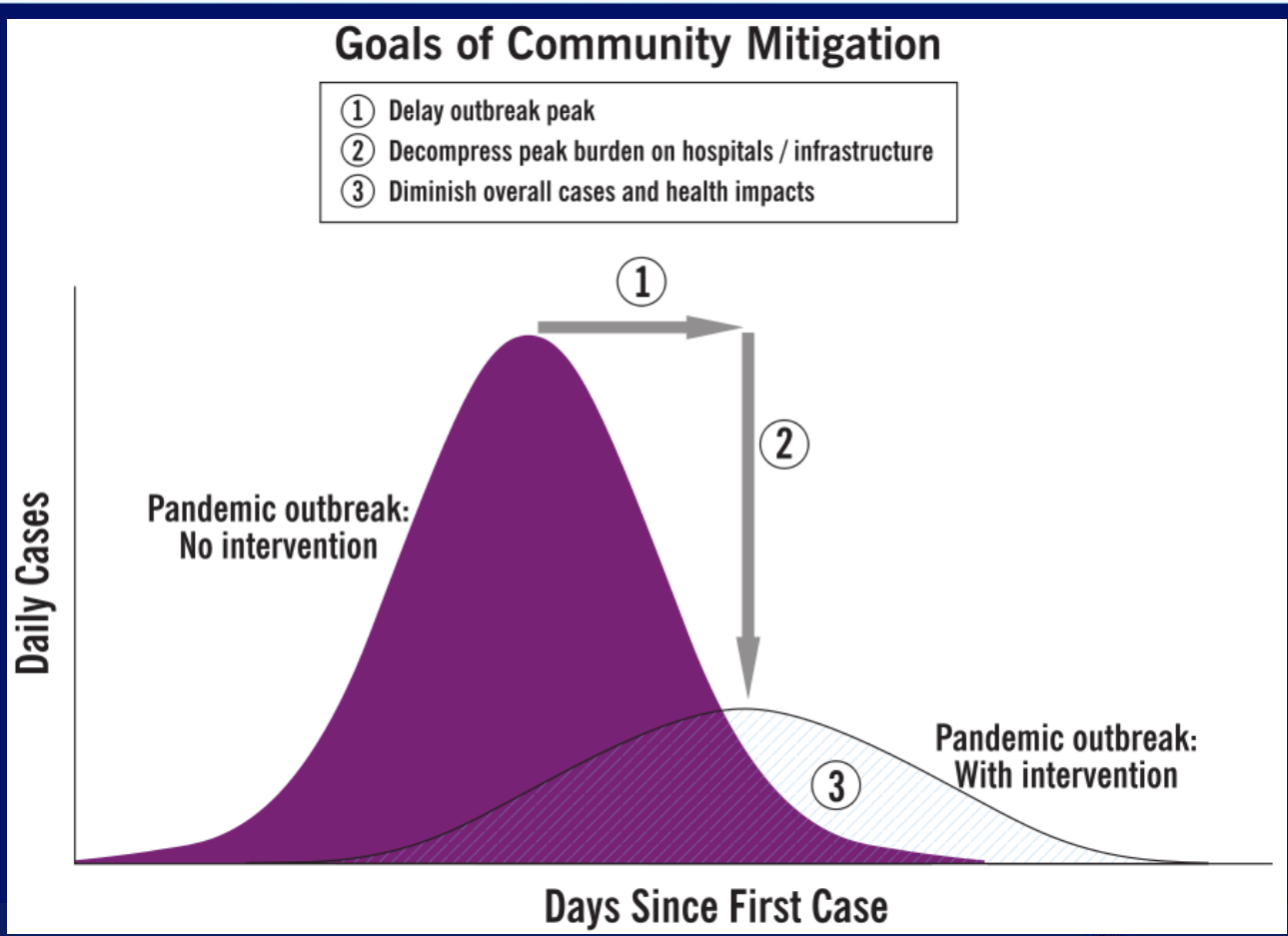
Community Mitigation: Goals



Centers for Disease Control. Interim Pre-Pandemic Planning Guidance: Community Strategy for Pandemic Influenza Mitigation in the United States Department of Health & Human Services, USA, 2007.

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Modeling in Los Angeles

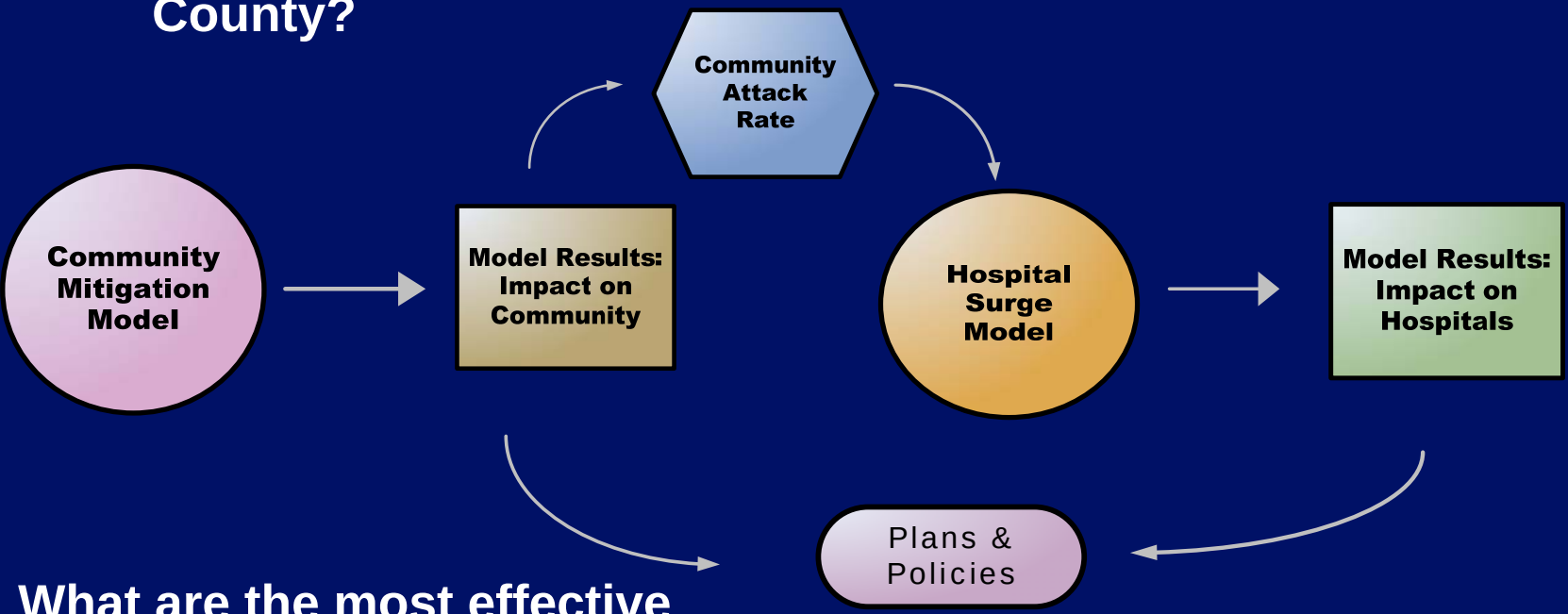
Unique Project

- Predictive mathematical disease models to:
  - Understand spread within community and hospital systems
  - Drive planning and policy development
- Explicitly designed for local health department;
  - Local data, objectives
- Incorporation of cutting edge methods and technology
- Output from Community Model drives Surge Model

Integration of Models

How will a pandemic affect LA County?

How will a pandemic affect LA County hospitals?



What are the most effective interventions and policies?

Community Mitigation Model: History

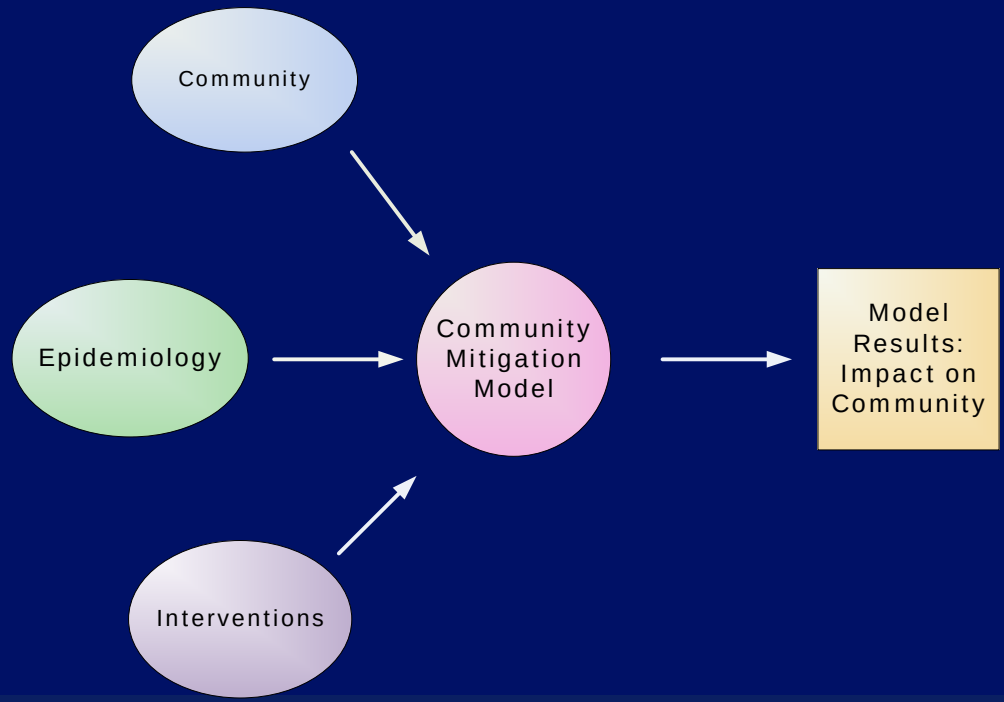
Models of Infectious Disease Agents Study (MIDAS)

- NIH Commissioned, 2004
  - 7 multi-institutional research groups
  - Ira Longini-U. Emory/Washington, Fred Hutchinson Cancer Research Center
- 2006 Contracted with Longini group
  - H5N1 Focus: Disease spread, specific vaccines
- April-June 2009: Retooled model to reflect Pandemic H1N1 Situation

Community Mitigation Model: Design Specifics

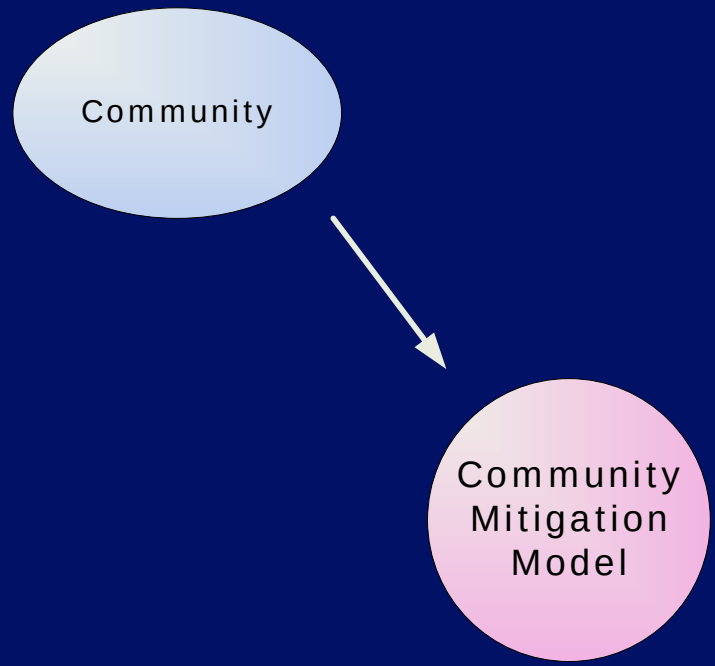
- "Model" is a composite of:
  - Computer codes
  - Statistical probabilities
  - Disease transmission parameters
  - Mathematical equations
- Parallelized-Stochastic Model
  - Concurrent elements
  - Elements of randomness
  - 180 days long
- 3 general components:
  - Community
  - Epidemiology
  - Interventions

Community Mitigation Model: General Design



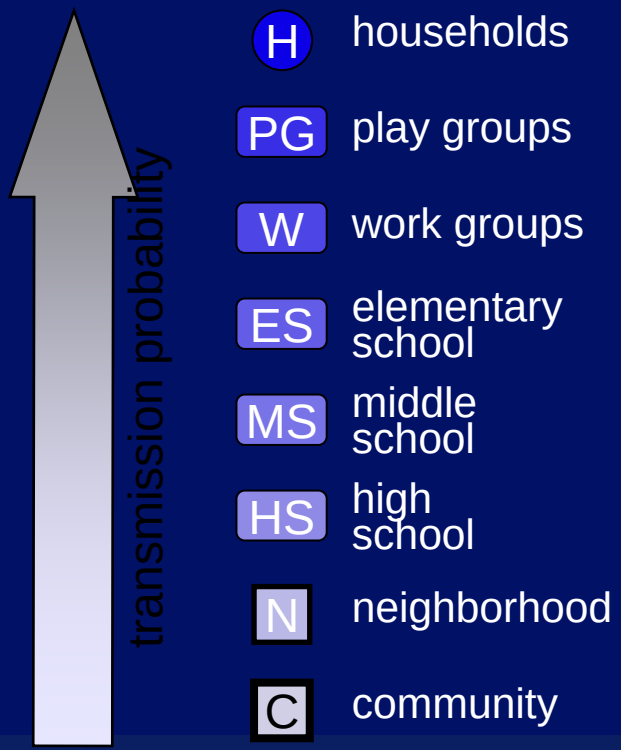
Design Specifics: Community

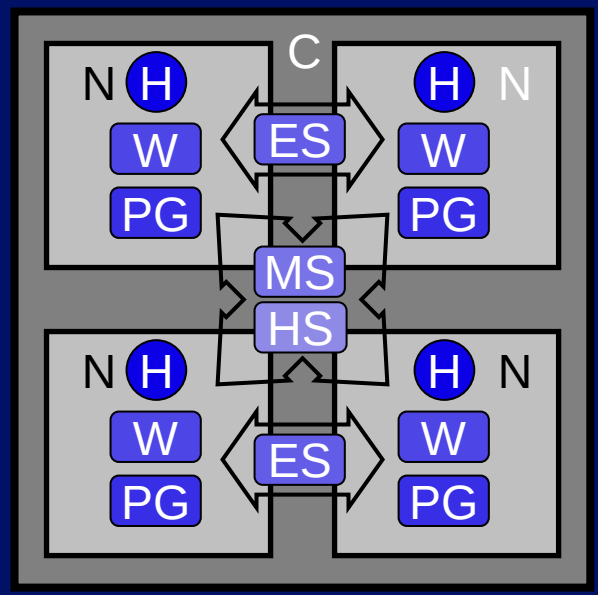
- Synthetic Population
- Population Demographics
  - Census Tracts (2007 est)
    - Gender, age, geog.
  - Commuter data and transportation patterns
    - 12 hour day/night cycles
  - Undocumented worker totals included
- Mixing groups drive population interaction



Design Specifics: Community

Halloran-Longini Community Mixing Model

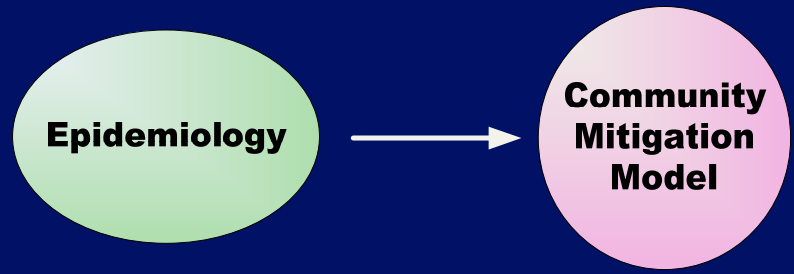




Design Specifics: Epidemiology

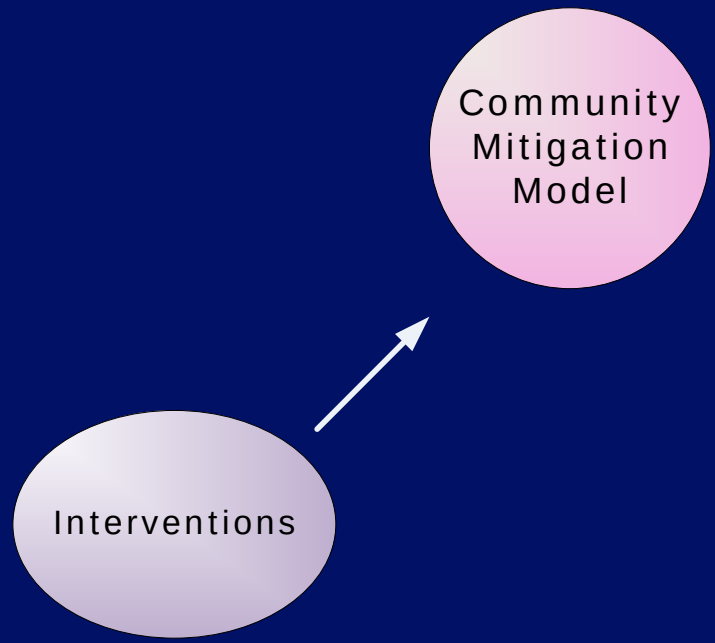
Spread of disease throughout community

- Infectious of disease (R_o)
  - Mild = R_o 1.6
  - Moderate = R_o 1.8
  - Severe = R_o 2.0 (H5N1)
- Time varying infectiousness
  - different viral loads
- Stochastic spread within multiple contact groups
- Age-dependent transmission probabilities
- Time-varying infectiousness (viral production rate)
- Behavioral modification of symptomatic individuals



Design Specifics: Interventions

- 3rd Component of Model
- Variety or “menu” of options
- Dynamic process
  - Latest research findings
- Two Intervention Types:
  1. **Pharmaceutical**
  2. **Non-Pharmaceutical (NPI)**



Design Specifics: Pharmaceuticals

Vaccine

- Different efficacies (well v. poor match)
- Coverage levels: 30%, 40%, 70%
- Time delay in intervention

Anti-Viral

- Treatment only v. Prophy (Household TA
- 2.527 million courses (84% Tamiflu 16% Relen
- HTAP:
  - Ascertained ill: 2 doses/day/5 days
  - Members of ill's household: 1 dose/day/10 days
  - Limited response, first 100 cases only

Design Specifics: Non-Pharmaceutical

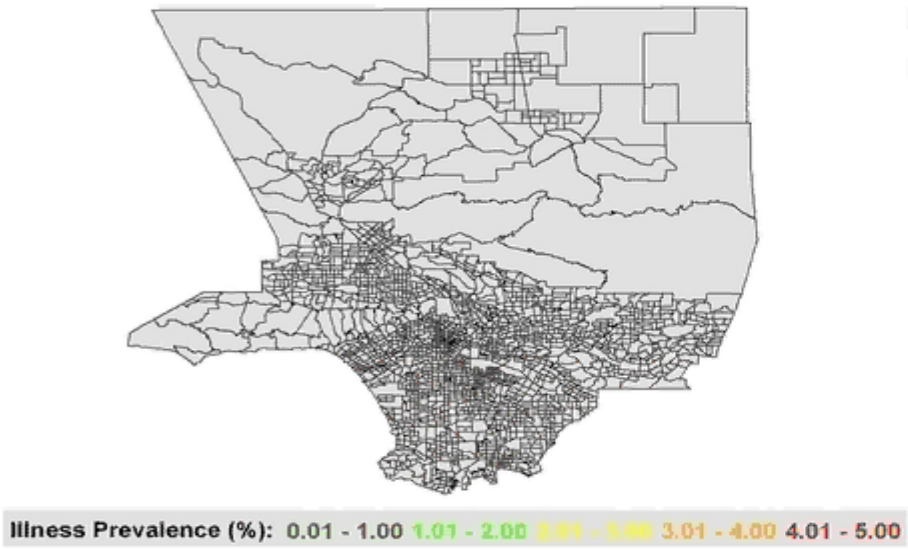
School Dismissal

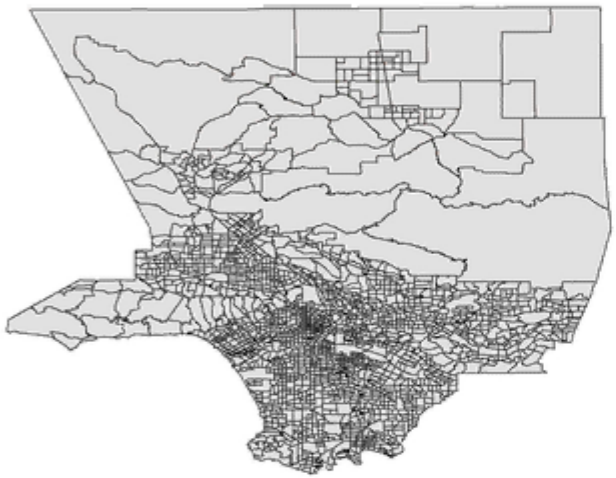
- Multiple variations tested: when closed, duration of closure, etc.

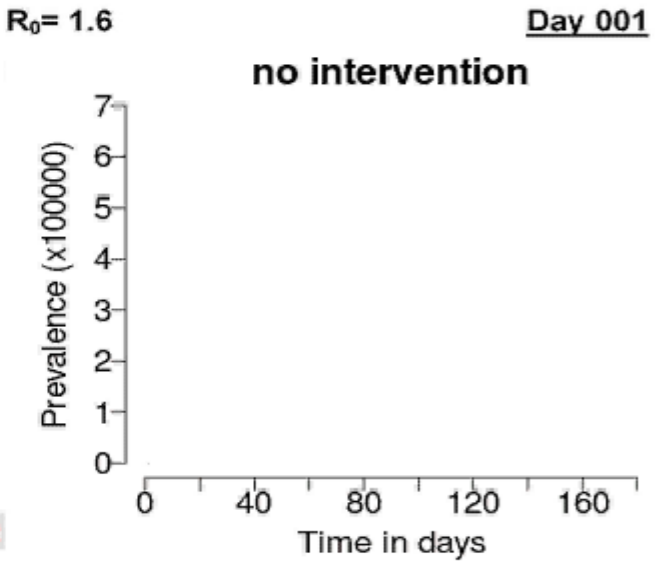
Social Distancing

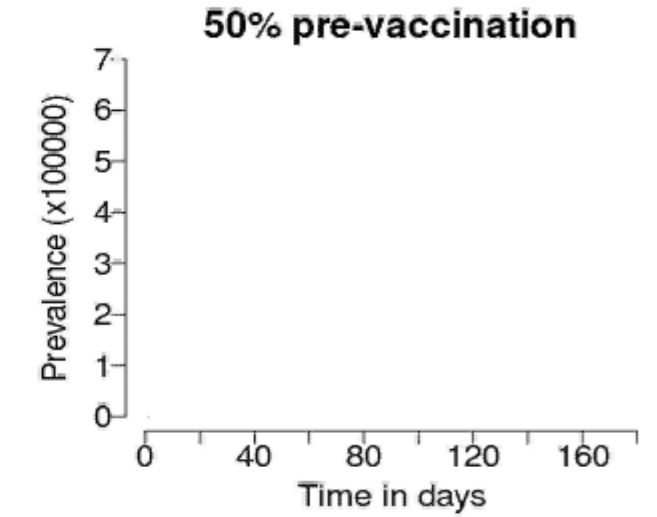
- Quarantine and Isolation
  - Compliance data: LA County Health Survey (2007)
- 60% of ill have contact with only household members
- “Liberal Leave” policy: symptomatics retire to home one day after becoming ill; 60% compliance

Sample Results









Results and Application

Results Influencing Planning and Response:
Anti Virals

R_o = 1.6

Strategy	Avg AR	0-4	5-18	19-29	30-34	65+	Cases (x10,000)
No intervention	36.0 %	40.8%	55.0%	29.1%	31.8%	25.8%	399.6
HTAP	30.8	34.2	49.6	24.3	26.4	21.5	342
Tx Only	33.0	37.6	52.8	25.9	28.4	22.9	366

Early, Aggressive, and Targeted prophylactic use of anti virals, if feasible can reduce overall spread, particular in younger age groups

Results and Application

Results Influencing Planning and Response: NPI

R_o = 1.6

Strategy	Avg AR	0-4	5-18	19-29	30-34	65+	Cases (x10,000)
No intervention	36.0%	40.8%	55.0%	29.1%	31.8%	25.8%	399.6
County Wide School Closure	2.1	1.9	1.9	2.1	2.3	1.9	23.1
Closure by Tract and Age	35.9	40.7	54.8	29.1	31.8	25.8	398.6
Combined NPI	0.2	0.2	0.2	0.2	0.2	0.1	1.8

Aggressive school closure, where feasible is effective.

Layered NPI extremely effective.

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Results and Application

Results Influencing Planning and Response: Vaccine

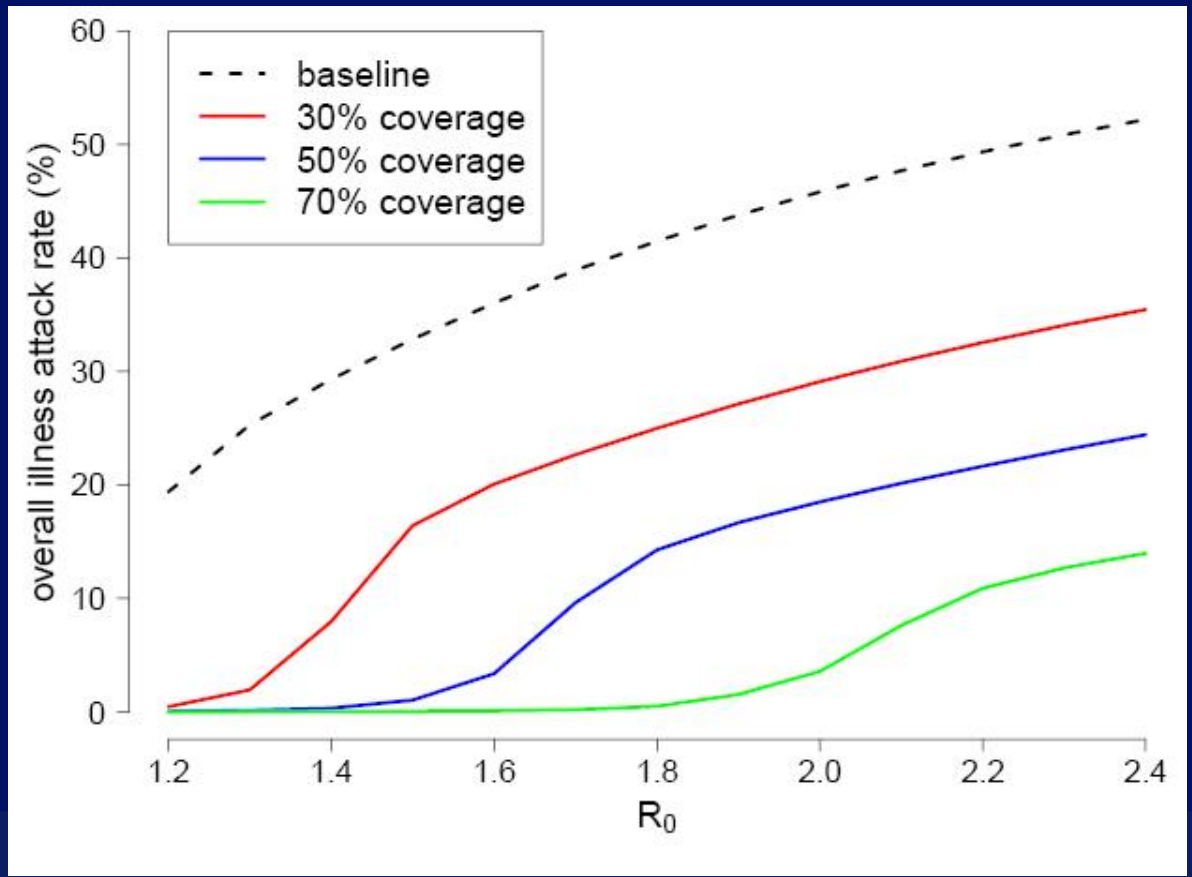
R_o = 1.6

Strategy	Avg AR	0-4	5-18	19-29	30-34	65+	Cases (x10,000)
No intervention	36.0 %	40.8 %	55.0 %	29.1 %	31.8 %	25.8 %	399.6
Pre Vac 30 %	18.7	21.0	34.4	13.2	14.9	11.4	207.4
Pre Vac 50 %	0.8	0.8	1.7	0.5	0.6	0.4	8.8
Pre Vac 70 %	0.0	0.0	0.1	0.0	0.0	0.0	0.4

Each subsequent level of vaccine coverage greatly reduces both Attack Rate and Total Cases

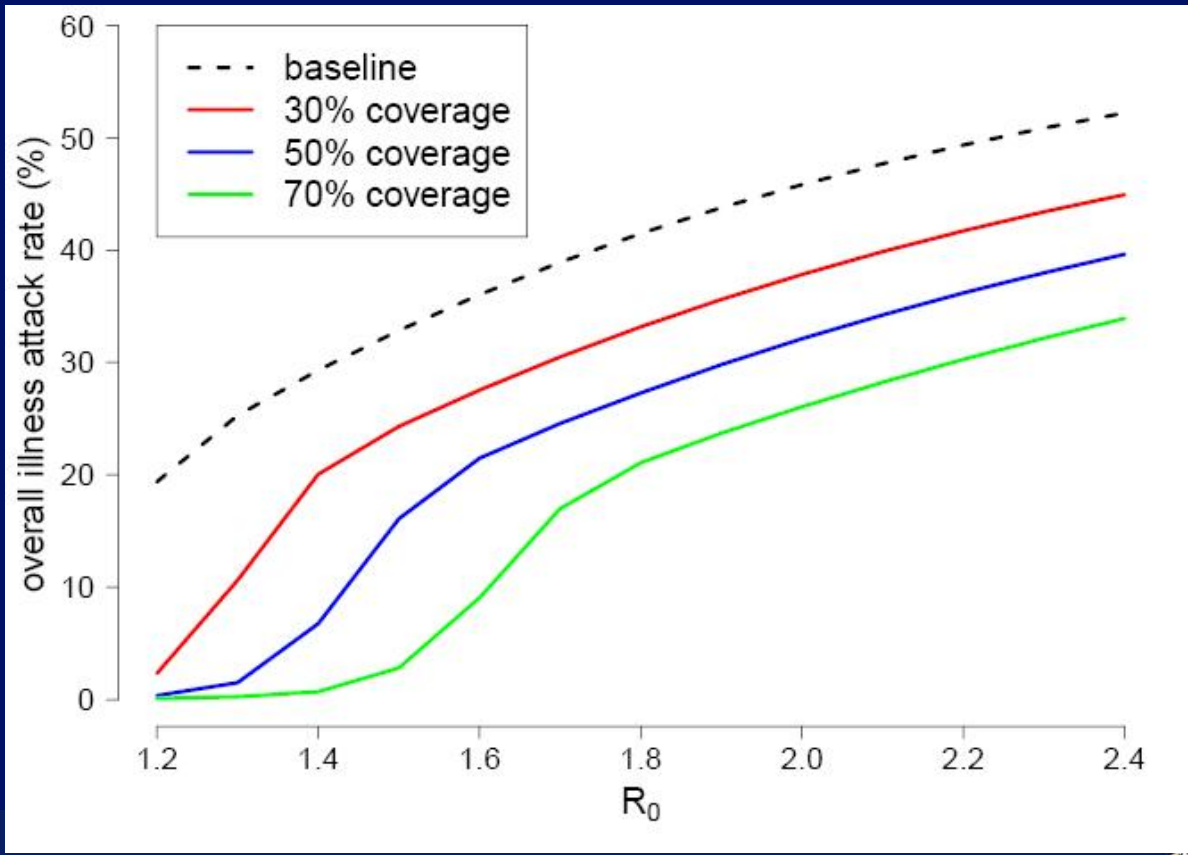
Results and Application: Vaccine Efficacy

Well Matched Vaccine



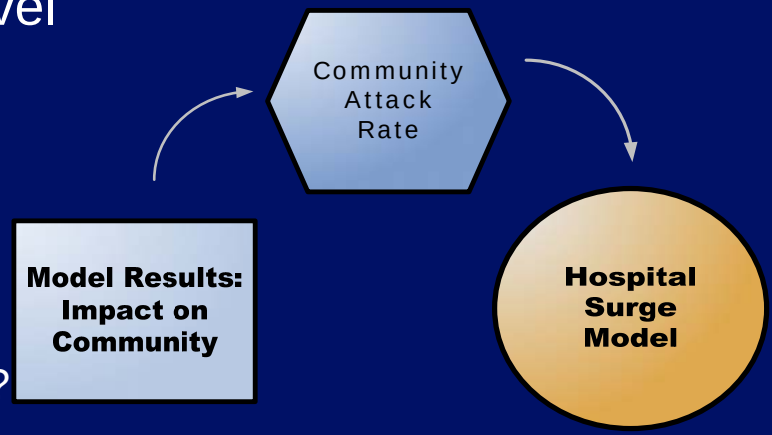
Results and Application: Vaccine Efficacy

Poorly Matched Vaccine



Surge Model: Overview

- Community Attack Rate a key factor in Surge Model
- OSHPD Data: Patient and Hospital Level
  - System level analysis
  - 25 week scenario
- Policy Questions:
  - Does demand for beds vary across the county?
  - How many patients need a bed but never find one? Where are they?
  - How many elective surgeries need to be cancelled to provide enough beds?
- Intervention Options:
  - Cancel Elective Surgeries
  - Add Beds
  - Ignore Payer Status



Surge Model: Initial Results and Application

- Finalizing results and report
- Both moderate (Ro 1.6) and severe (Ro 2.0) scenarios flooded system
- Unmet Need: Patients requiring admission, but unable to find a bed
  - Moderate: 42,000
  - Severe" 178,000
- Surge follows epidemic curve
  - Have 6 weeks to prepare policies and interventions
- Emphasizes value of community mitigation to alleviate burden on hospital system

Thank you

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