Modeling Social Networks and MRSA Spread – *a regional approach*

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Disclosures: None

MRSA US Burden Estimates

2000	2005
133,500 hospitalizations	278,200 hospitalizations
33,250 septic events	56,250 septic events
29,000 pneumonias	36,500 pneumonias
71,000 other infections	185,500 other infections

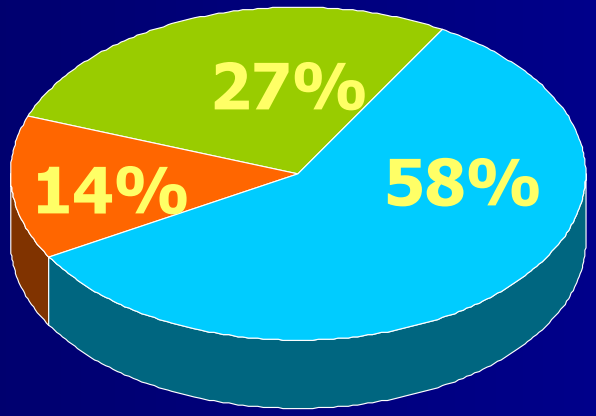
Klein et al. Emerg Infect Dis 2007;13(12):1840-6

S. aureus Carriage

- 30% of people carry *S. aureus*
- Antibiotic resistant form (MRSA)
  - Community 2% [1]
  - Prevalence in non-ICUs 5-7% [2-3]
  - Prevalence in ICUs 10-20% with screening [4]
  - Nursing homes (5-51%) [5]

[1] R Gorwitz et al, JID 2008; 197(9): 1226
[2] A Robicsek et al, Ann Intern Med 2008; 148: 409-418
[3] W Jarvis Am J Infect Control 2007;35:631-7
[4] SS Huang et al, JID 2007;195(3):330-8
[5] C Reynolds et al. Infect Control Hosp Epidemiol 2011; 32(1):91-3

Invasive MRSA Cases CDC ABCs 2004-2005



- Community-Associated
- Healthcare-Associated (community-onset)
- Healthcare-Associated (hospital-onset)

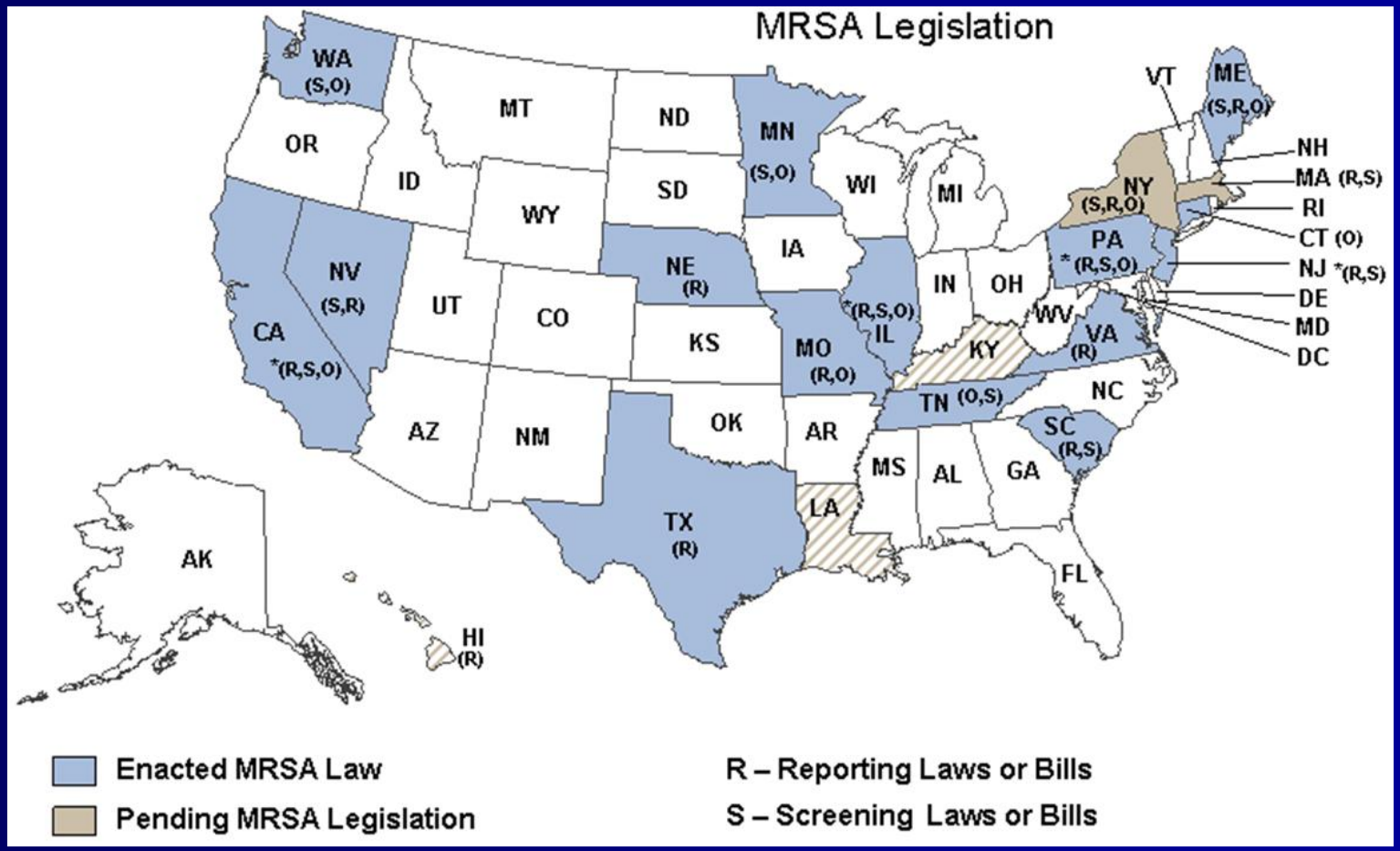
Klevens M et al. JAMA 2007;298(15):1763-71

MRSA Sequelae

- 33% of newly-identified chronically ill carriers experience invasive disease in 1y
- 25% at risk post discharge
- Increased cost, hospital stay, risk of death

[1] S Huang et al. Clin Infect Dis 2003;36(3):281-5
[2] S Huang, SHEA 2006

MRSA Legislation- 2010



http://www.apic.org/downloads/legislation/MRSA_map.gif

California MRSA Laws

- Report severe community *S aureus* infections
- Report all (nosocomial) MRSA bacteremias
- Admission screening
- Discharge screening
- Inform patients verbally and in writing

What is the best response?

Potential Interventions

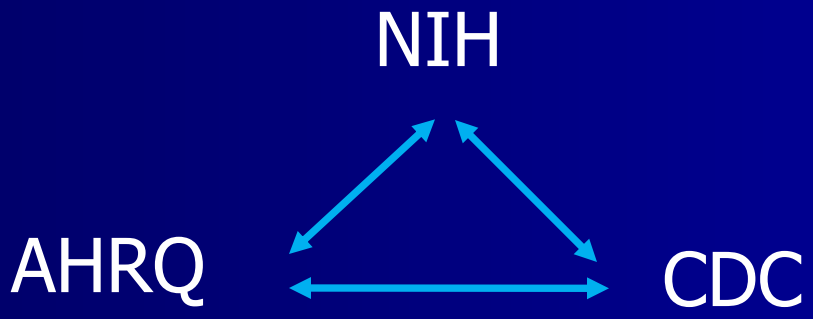
- Isolate
- Screen and isolate
- Enhance environmental cleaning
- Decolonize
- Antibiotic restriction
- Vaccinate?

Unknown Directions

- Who
  - Hospitals, nursing homes, community
- What
  - Which intervention?
- When
  - At what prevalence?
- Where
  - High-impact hospitals?

Multi-Project Goal

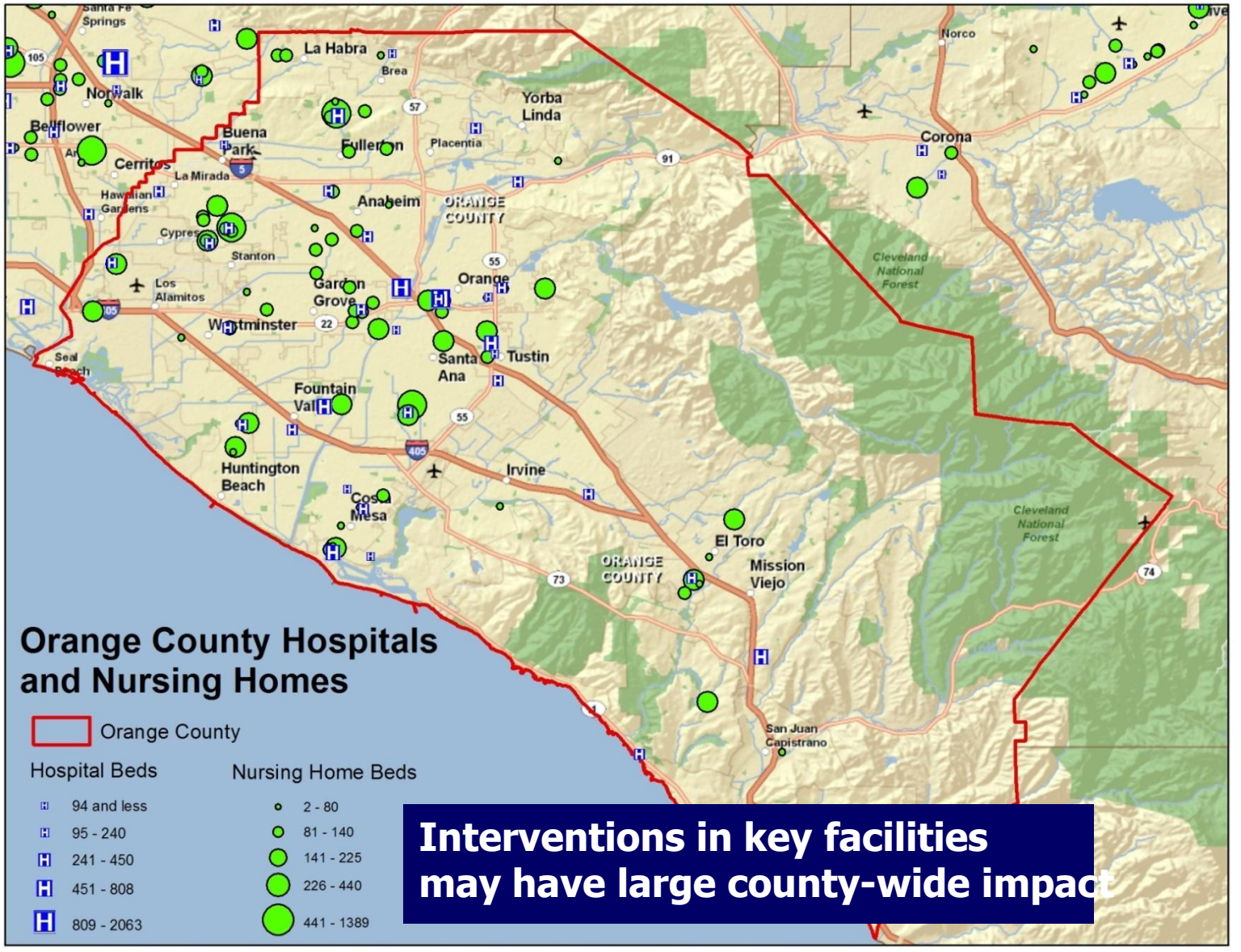
- Collect detailed epidemiologic data on a network of acute, subacute, and chronic care facilities in order to model strategies for MRSA eradication in a large county.



NIH, Models of Infectious Disease Agents Study (MIDAS)
AHRQ, HHSA29020050033I-TO9
CDC Prevention Epicenters

Orange County, CA

- Large metropolitan county (5th largest)
- 3 million people
  - 32 Hospitals
  - 71 Nursing Homes
- Relatively enclosed
  - Ocean to West
  - Forest to East
  - Undeveloped land to South
  - Traffic to North


Orange County Hospitals and Nursing Homes
Orange County
Hospital Beds
94 and less
95 - 240
241 - 450
451 - 808
809 - 2063
Nursing Home Beds
2 - 80
81 - 140
141 - 225
226 - 440
441 - 1389
Interventions in key facilities may have large county-wide impact
Norwalk
La Habra
Brea
Yorba Linda
Bellflower
Buena Park
Fullerton
Placentia
Corona
Norco
Cerritos
La Mirada
Anaheim
ORANGE COUNTY
Cypress
Stanton
Orange
Garden Grove
Los Alamitos
Westminster
Santa Ana
Tustin
Seal Beach
Fountain Valley
Huntington Beach
Irvine
Costa Mesa
El Toro
Mission Viejo
San Juan Capistrano
Cleveland National Forest

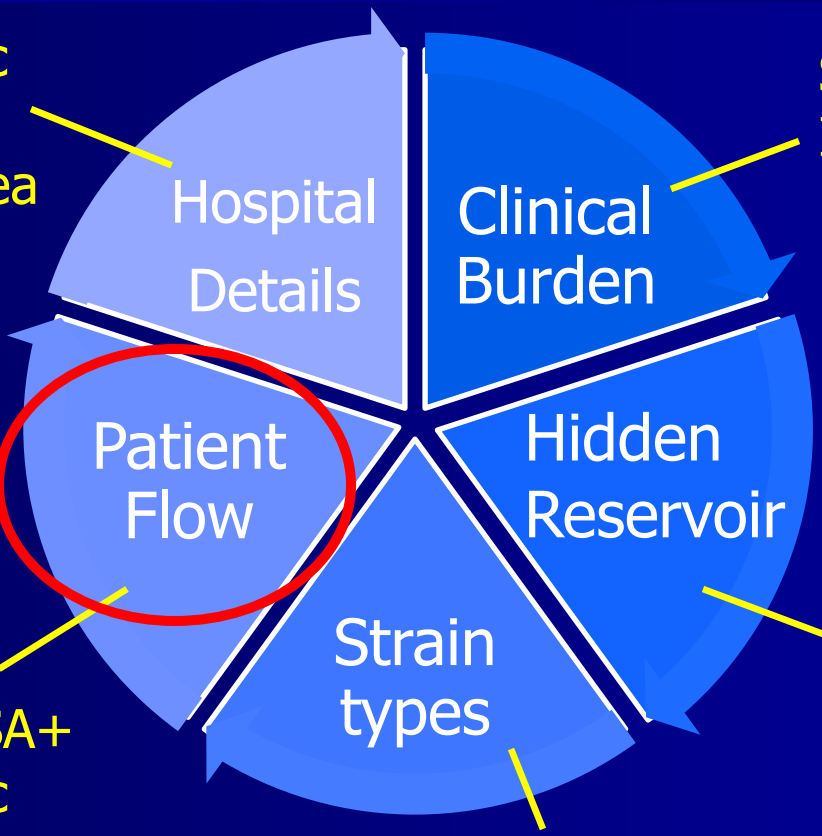
Orange County, CA
Project MAPP
Mapping and Analyzing Patient Pathways

UC Irvine

OCHCA

Graphic used with permission, OrangeCountyShopping.com

5 Arms of Project MAPP



Adult/Pediatric
ICU/non-ICU
Catchment area

Survey
Infection Control
Microbiology Labs

Swab patients in participating hospitals and nursing homes

Genotypic and Phenotypic Assessment

Total and MRSA+
Adult/Pediatric

Inter-facility Connections – Patient Sharing

Impact of Shared Patients

- Spread of contagious diseases
  - Outbreaks
  - Endemic MDROs
- Containment
  - Pandemic preparedness
- Responsibility
  - Healthcare-associated infections
  - Working together

Hospitals: Orange County, CA

- 32 Acute Care Hospitals
  - 6 Long-term Acute Care (LTAC)
  - 2 Dedicated Children's Hospitals
- Average annual volume 7,500
- 173,259 patients had 320,869 admissions
- 22% readmissions in 2005

CA Hospital Discharge Dataset

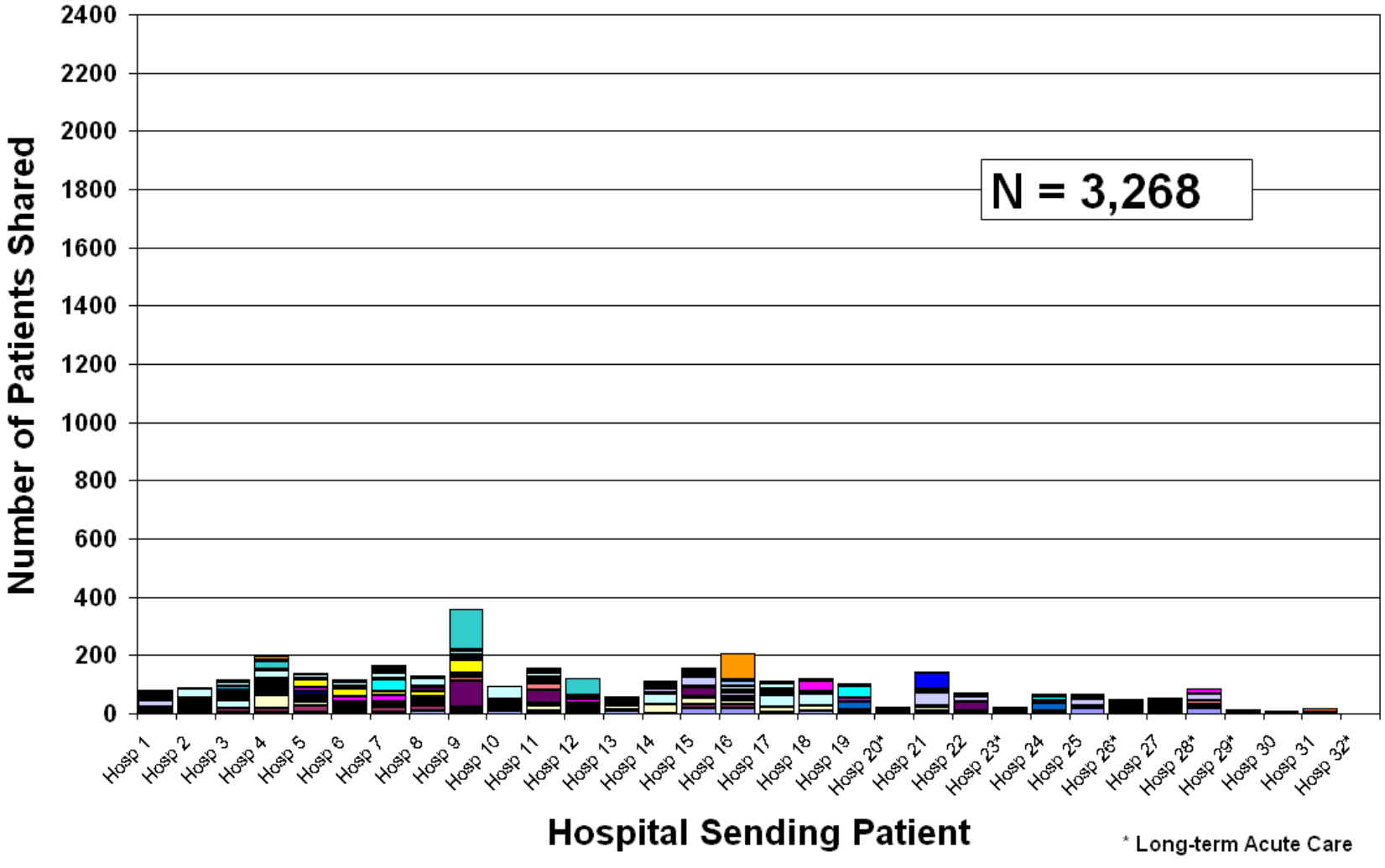
- 2005 mandatory hospital discharge dataset
- All patients (adults, pediatric)
- Line item inpatient data
  - Hospital
  - Admission dates
  - Diagnoses and procedure codes
  - Encrypted identifier (75%)
    - Of those without identifier, 58% newborns

Patient Sharing Definitions

- Direct Transfer
  - Patient transferred from one hospital to another
  - Hospitals are aware of this type of patient sharing
- Indirect Transfer
  - Patient admitted to one hospital is later admitted to another hospital after an intervening stay at home or rehab or a nursing home…
  - Hospital is unaware of this type of patient sharing

Volume of Patients Shared Knowingly & Unknowingly

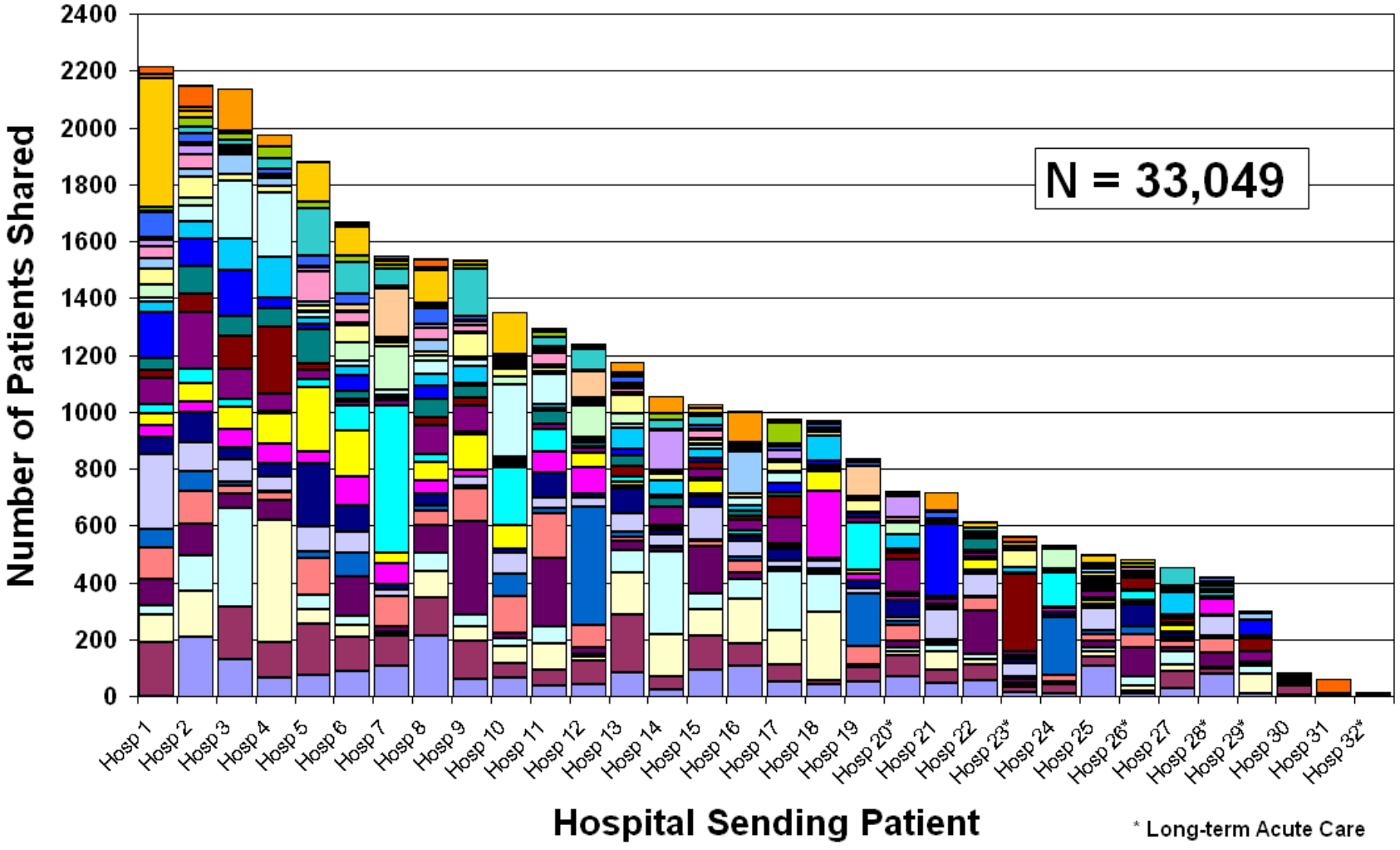
2005 Direct Transfers to Hospitals



Huang SS et al. Infect Control Hosp Epidemiol 2010. 31(11):1160-9

2005 Indirect and Direct Transfers

(Not including re-admission to self)



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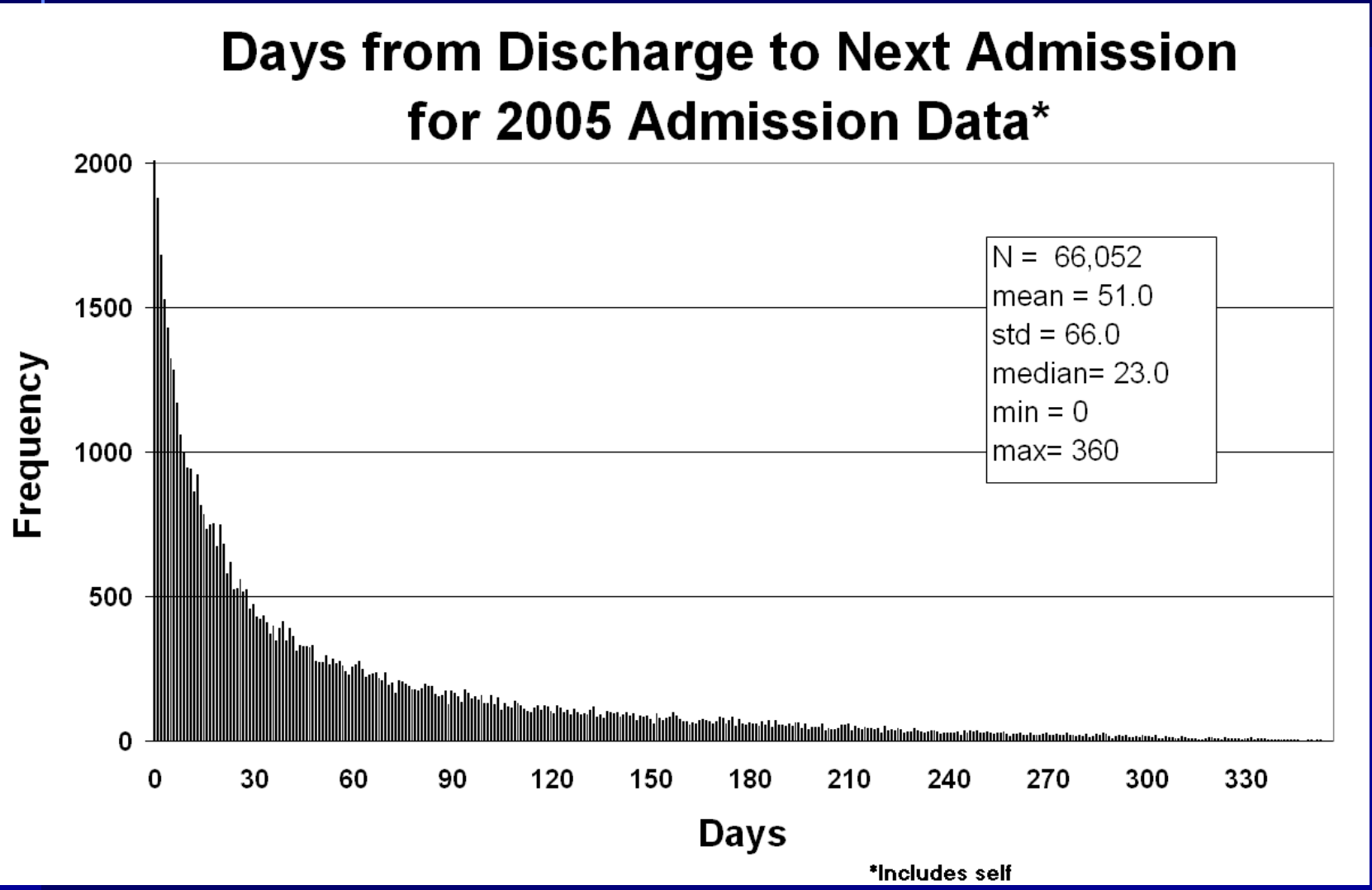
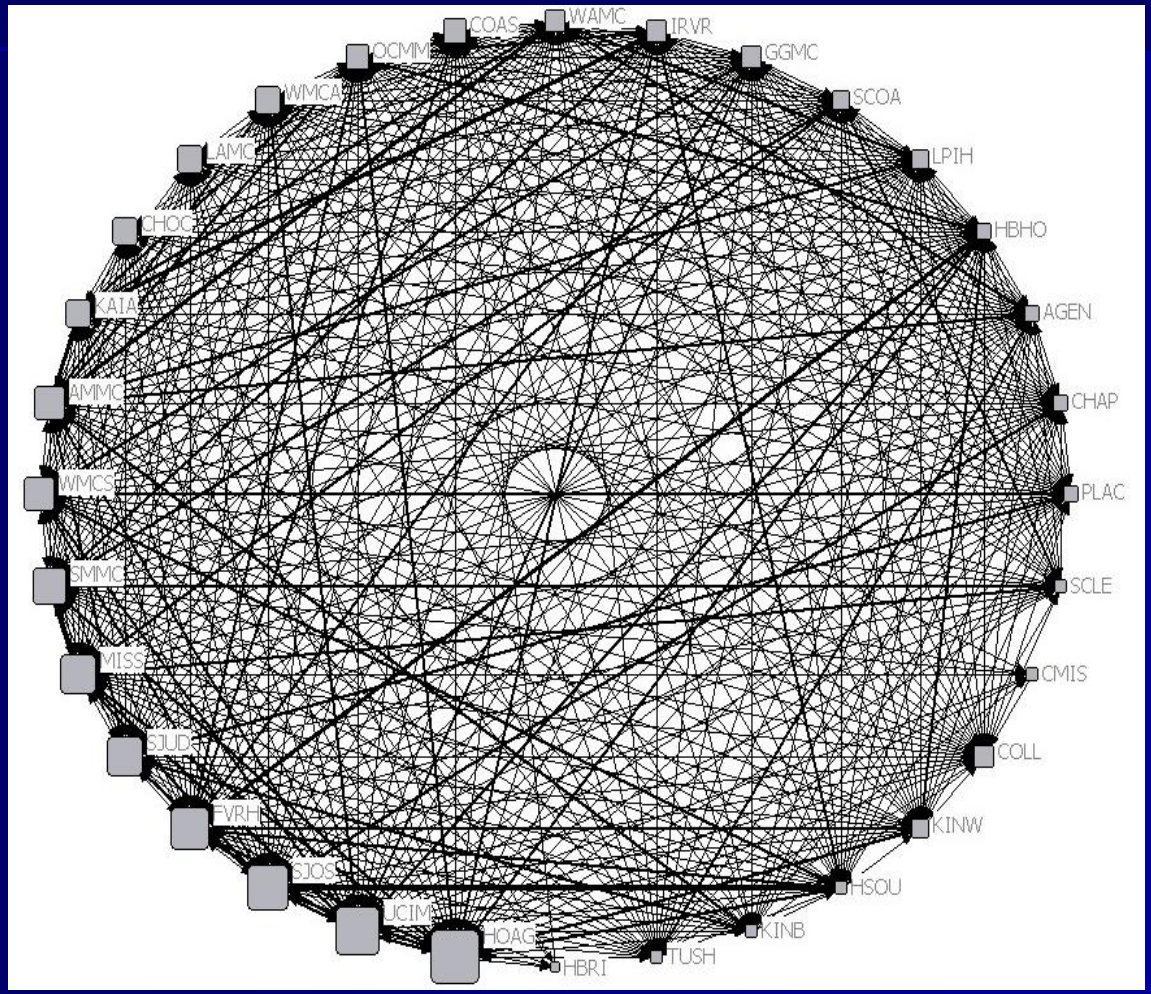
Days to Readmission



Patient Sharing

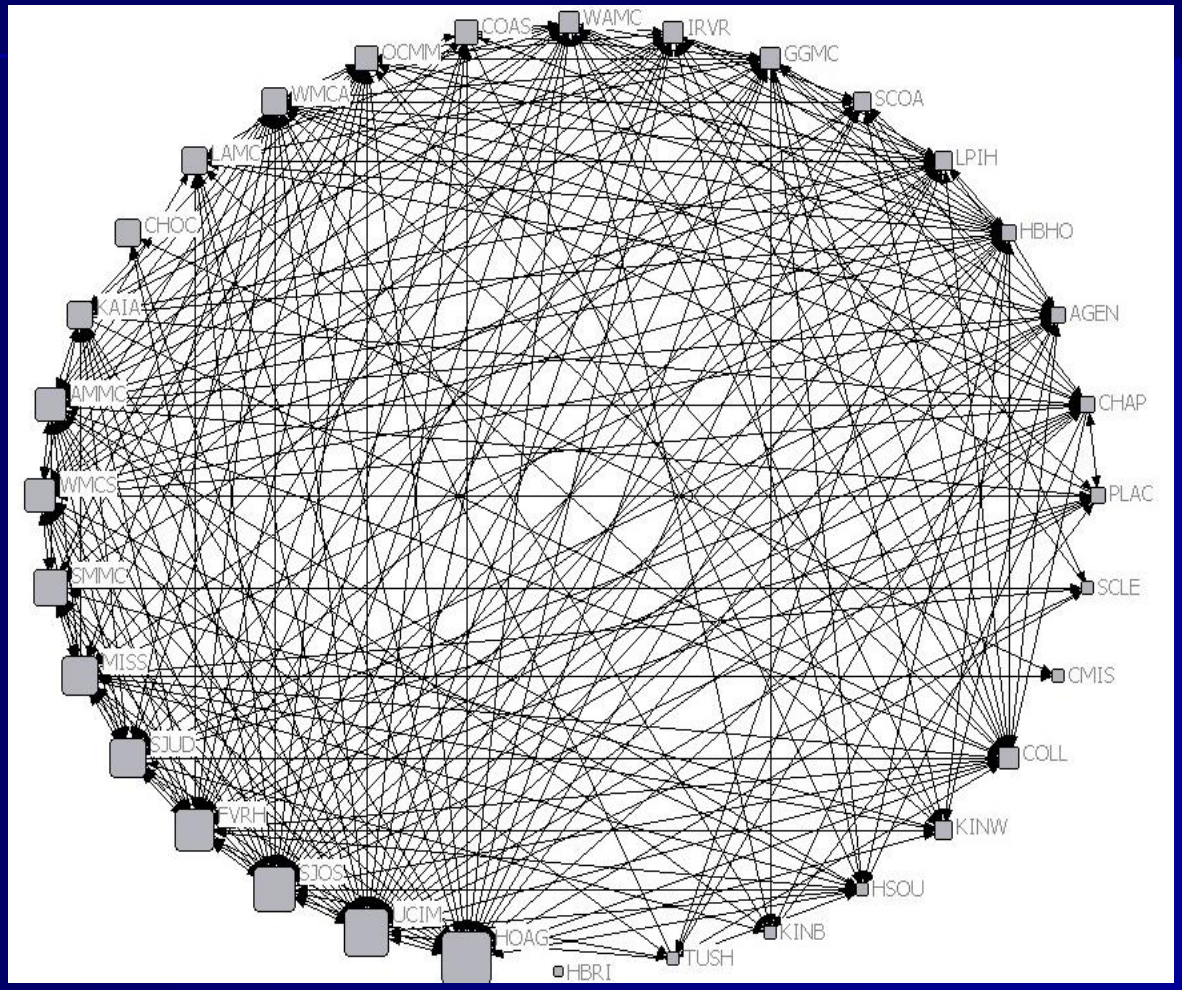
- 22% of patients are readmitted in a year
- Half are to different hospitals
- Among those admitted to different hospitals, only 1 in 11 were directly transferred
- Communication on transfer unlikely to be sufficient to halt exposures between hospitals

OC Hospital Linkages
1 patient shared



Lee BY et al. Am J Pub Health. In Press

OC Hospital Linkages
10 patients shared



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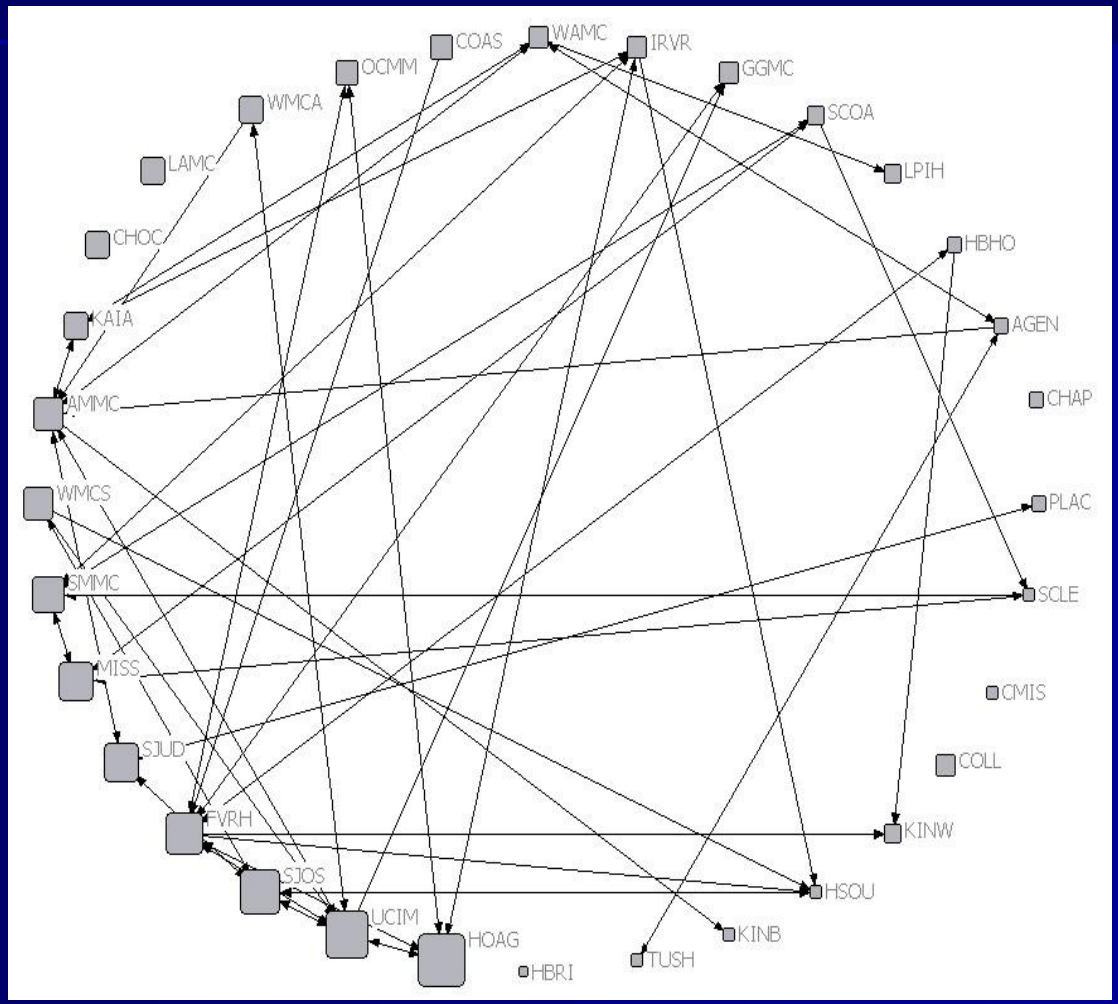
OC Hospital Linkages
100 patients shared



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Density

Number of Patients	Density	# Ties
> 10 Patients	0.54	538.0000
> 50 Patients	0.23	231.0000
> 100 Patients	0.11	114.0000

Lee BY et al. Am J Pub Health. In Press

Hospital and Nursing Home Patient Sharing

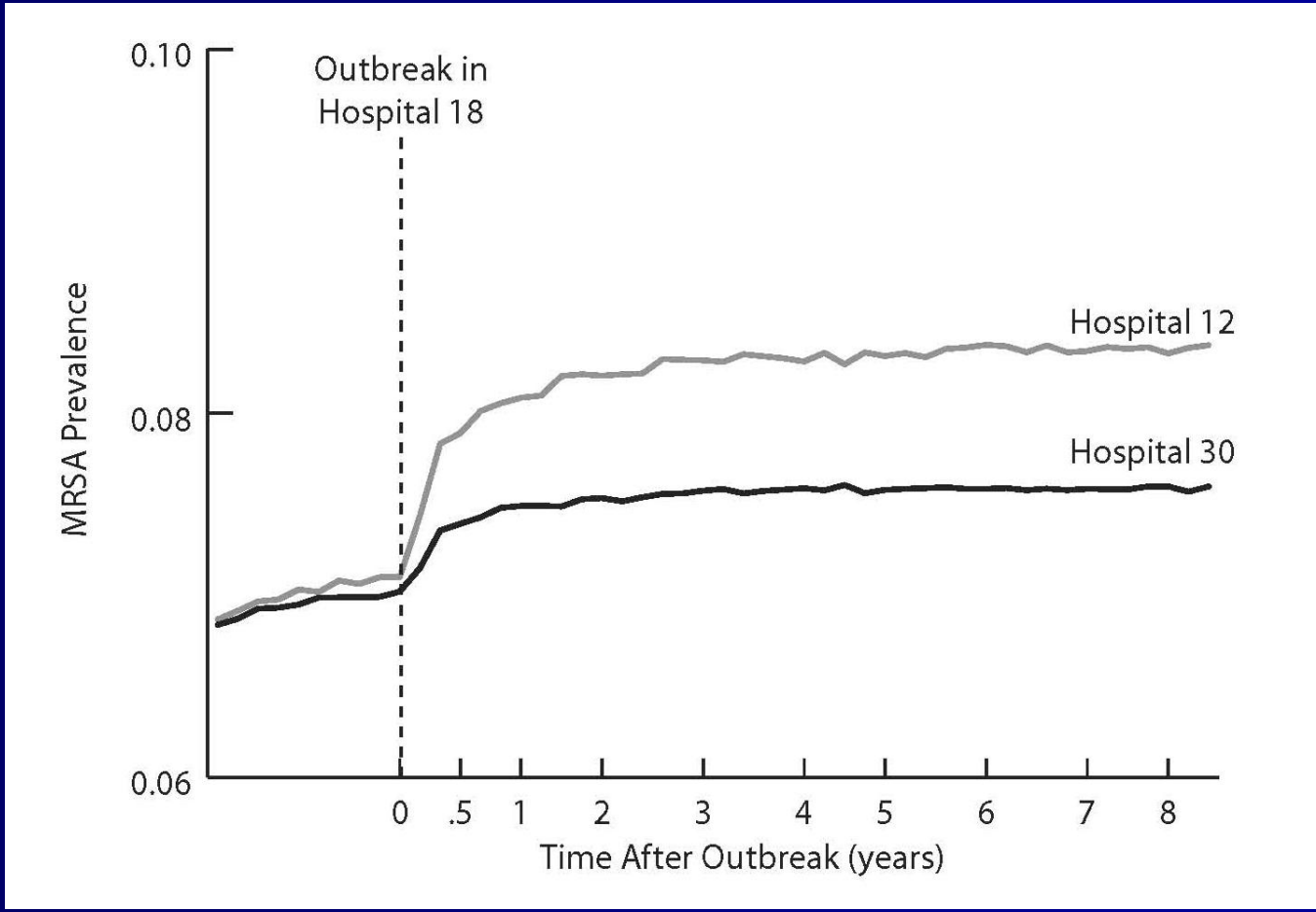
Hospital & NH Sharing

- Among all patients admitted in OC hospitals
  - 7% come from NH (22,500, underestimate)
  - 12% go to NH at discharge (38,500)
- Among patients admitted ≥2x / year
  - 12% come from NH (8,500, underestimate)
  - 19% go to NH at discharge (13,500)

Working Together

- Patient sharing is extensive and largely occurs unbeknownst to individual hospitals
- Inter-facility patient sharing can enable spread of contagious diseases
- Future Directions
  - Hospitals & NH: partnerships in intervention
  - Public health: strategies for outbreak control

Effect of Single Hospital Outbreak (5% to 15% MRSA Prevalence)



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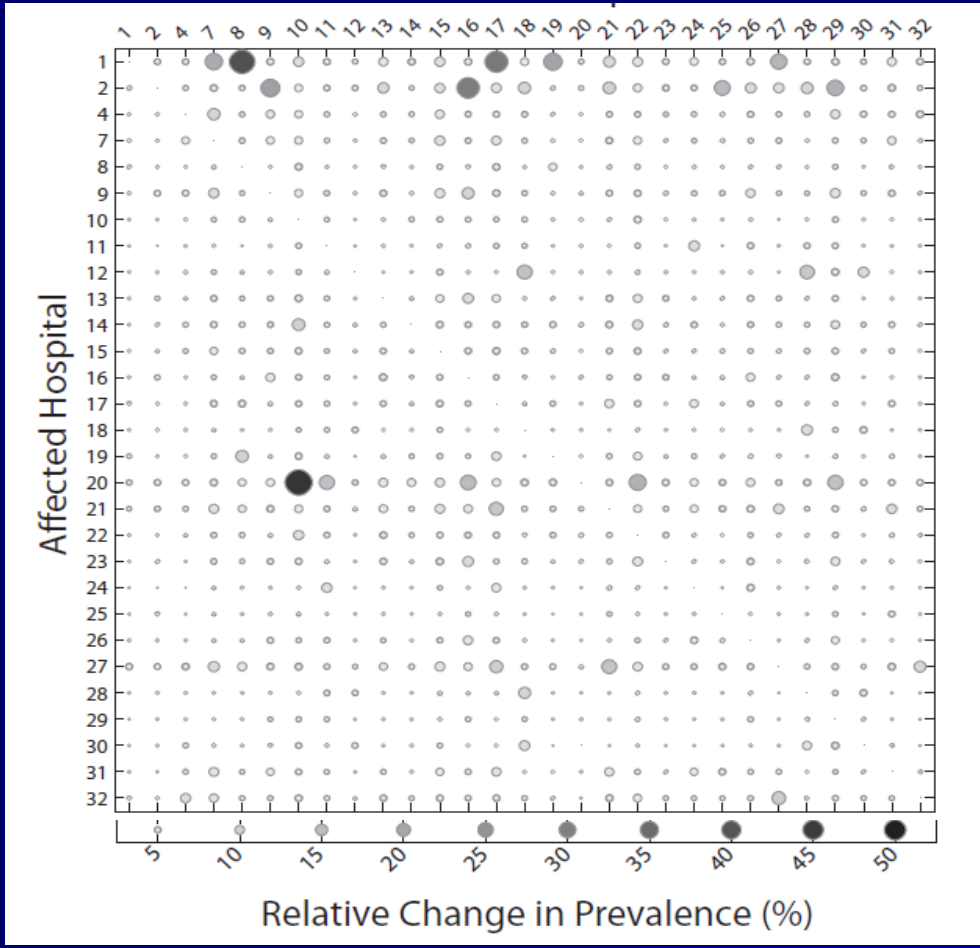
Simulating Outbreaks
(5% to 15% MRSA Prevalence)



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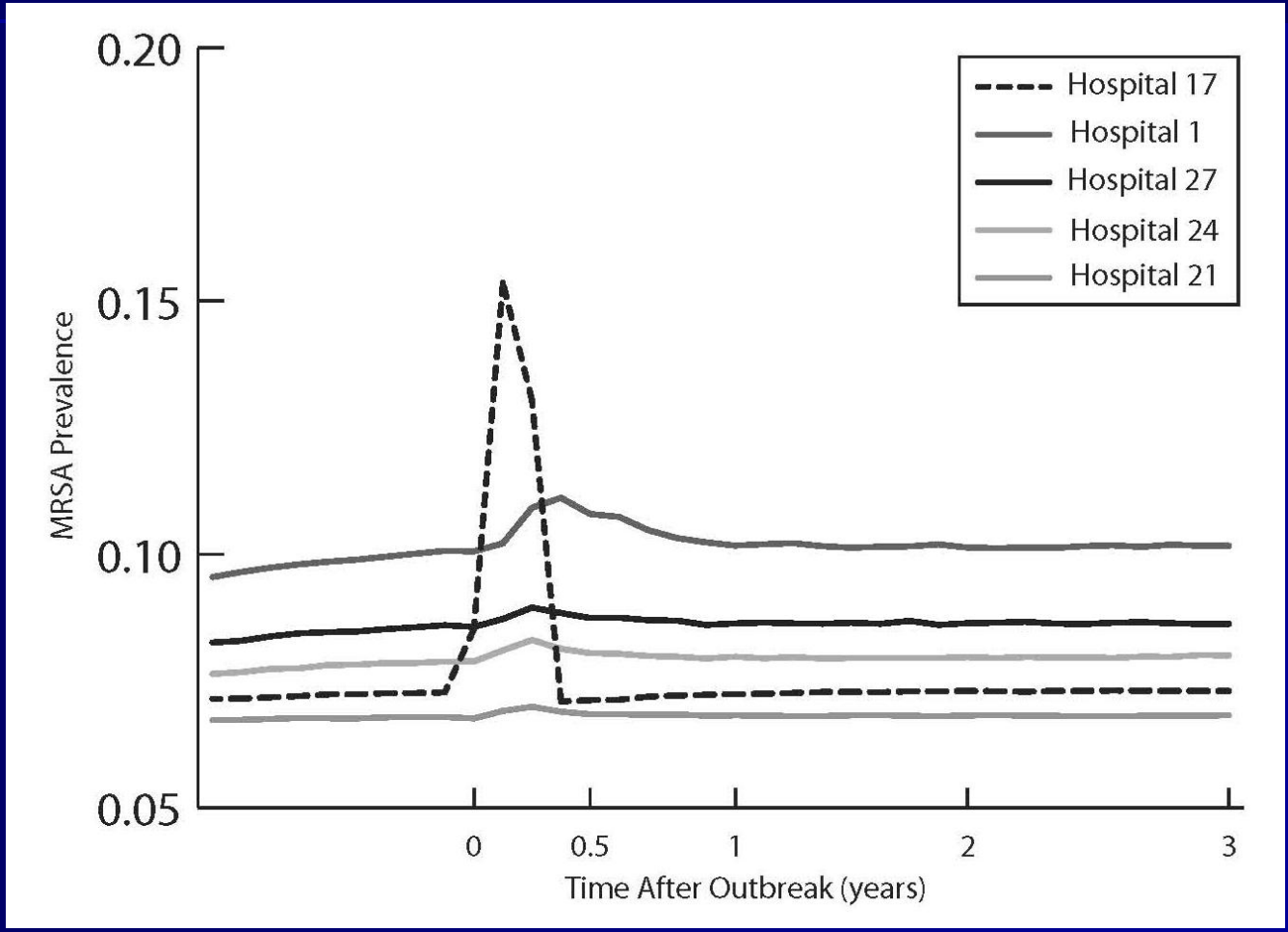
3 Month Outbreaks
(5% to 15% MRSA Prevalence)



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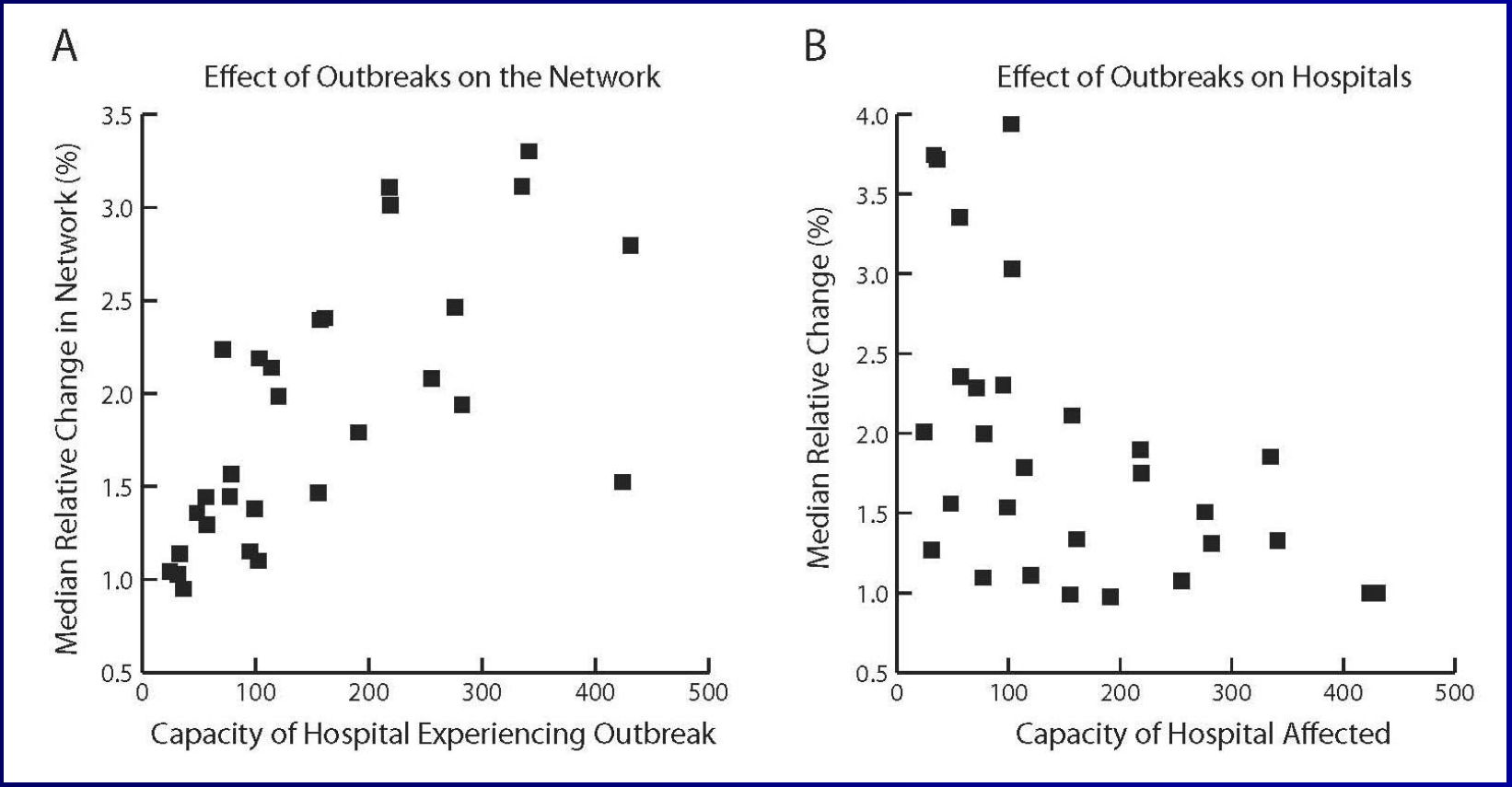
Size and Outbreak Effect



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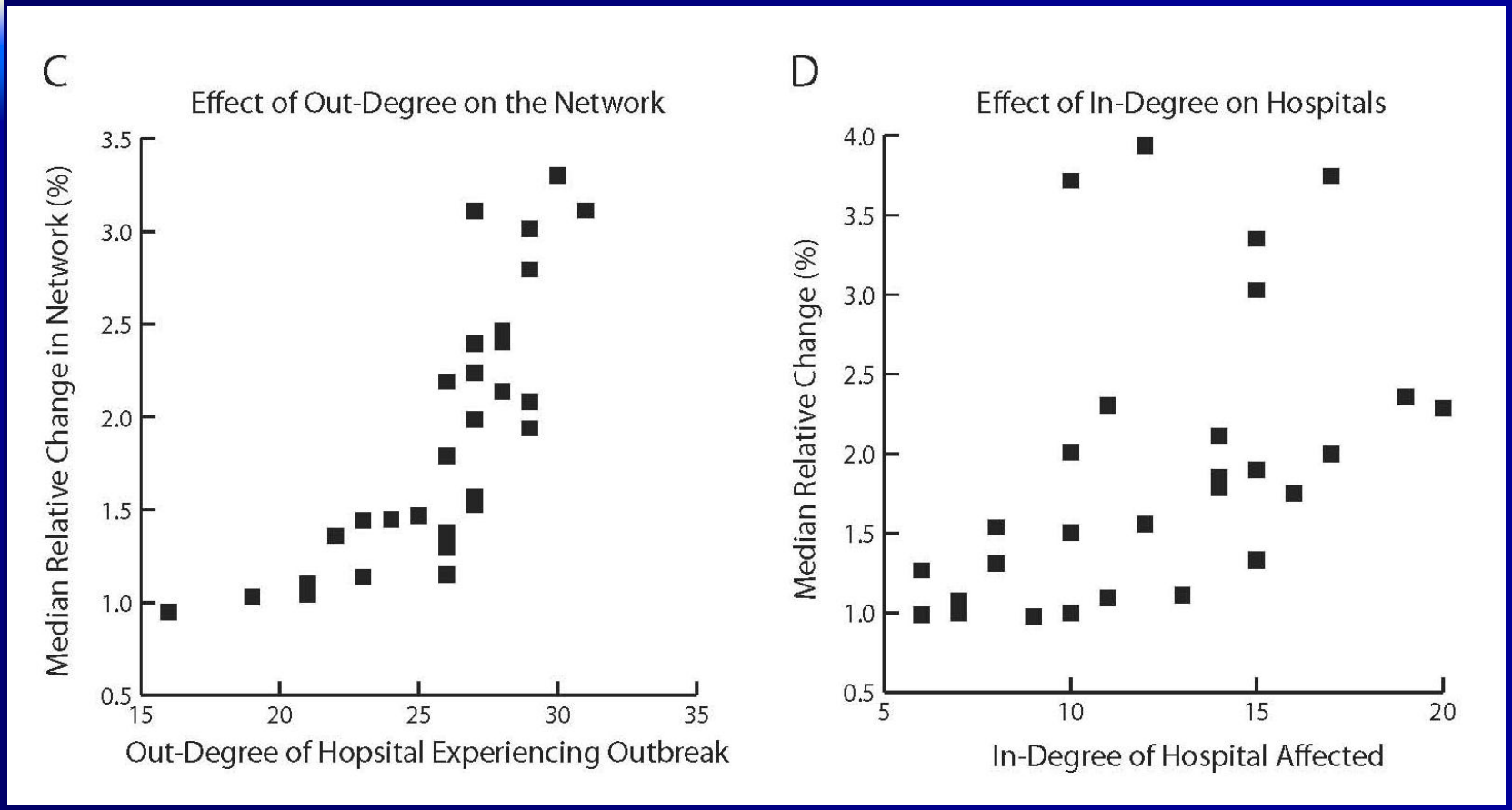
Degree and Outbreak Effect



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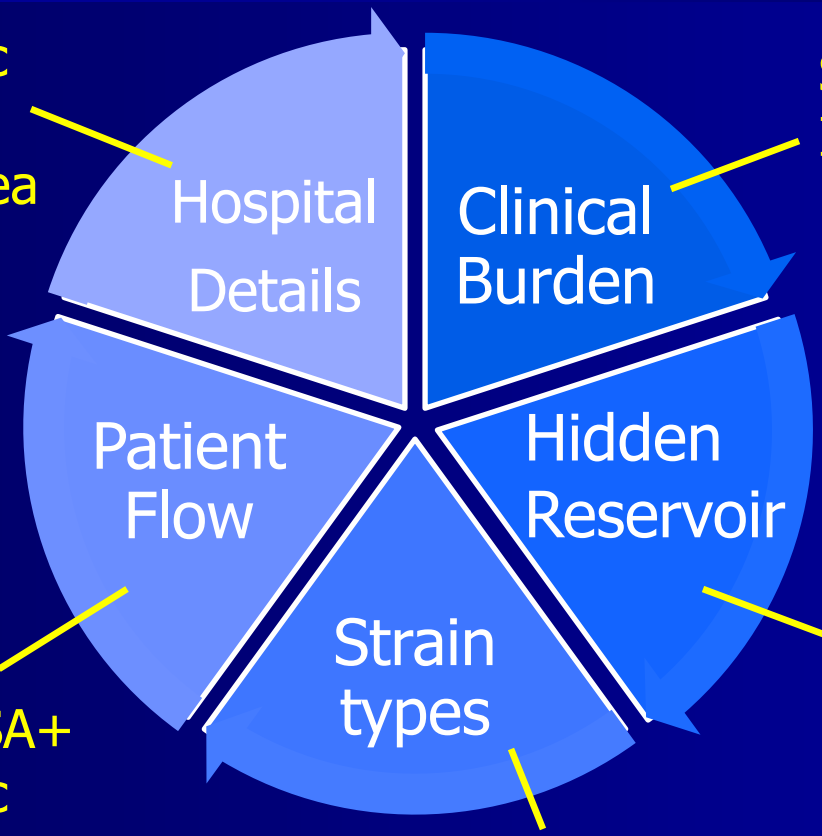
5 Arms of Project MAPP



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Project MAPP Model Goals

- Develop a county-wide fully population-based, facility-based model to assess MRSA
- Evaluate drivers of MRSA transmission
- Identify targeted interventions
  - Quantify individual facility impact
  - Quantify various group effort impact
  - Identify facilities and subgroups with max impact
  - Do different facilities need different interventions

Summary

- Growing MRSA prevalence in healthcare
  - 5-10% prevalence in hospitals
  - Average 26% prevalence in OC NH
  - Carriers at high risk for later infection
- Interaction between hospitals and NH
  - OC facilities highly interconnected
  - Containing MRSA and other contagious pathogens may require concerted efforts

Special Thanks

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Questions?


La Habra
Brea
Buena Park
Fullerton
Placentia
La Palma
Garden Grove
Yorba Linda
Los Alamitos
Anaheim
Anaheim Hills
Seal Beach
Stanton
Orange
Westminster
Santa Ana
Villa Park
Huntington Beach
Foothill Ranch
Tustin
Fountain Valley
Lake Forest
Rancho Santa Margarita
Irvine
Costa Mesa
Laguna Hills
Newport Beach
Mission Viejo
Aliso Viejo
Ladera Ranch
Laguna Beach
Laguna Niguel
Dana Point
San Juan Capistrano
San Clemente