

# Combining whole genome sequencing, data linkage and mathematical modelling: improving infection control

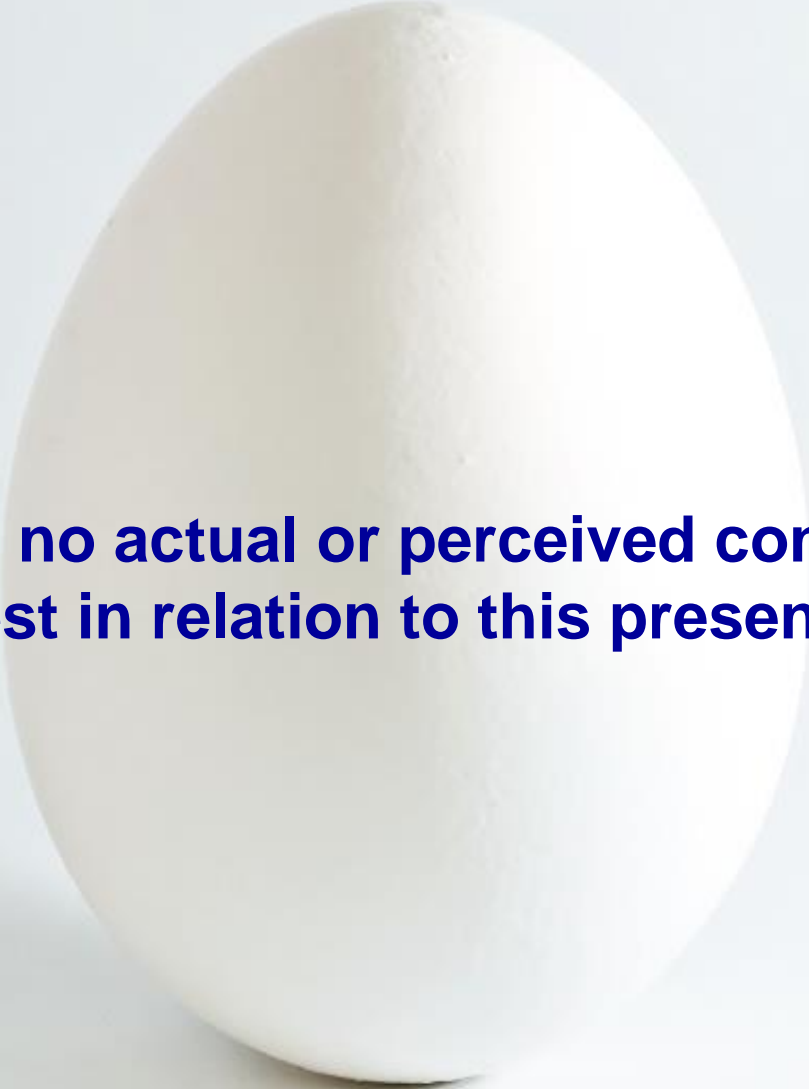
Associate Professor Martyn Kirk  
Convenor MAE Program  
The Australian National University, Australia

[martyn.kirk@anu.edu.au](mailto:martyn.kirk@anu.edu.au)



@KirkMartyn



A single white egg is centered on a white surface, casting a soft shadow to its left. The background is a plain, light-colored wall.

**I have no actual or perceived conflict of interest in relation to this presentation.**

# Outline

- Introduction
- Epidemiology
- Microbiology
- Modelling
- Bringing it all together...

# Introduction

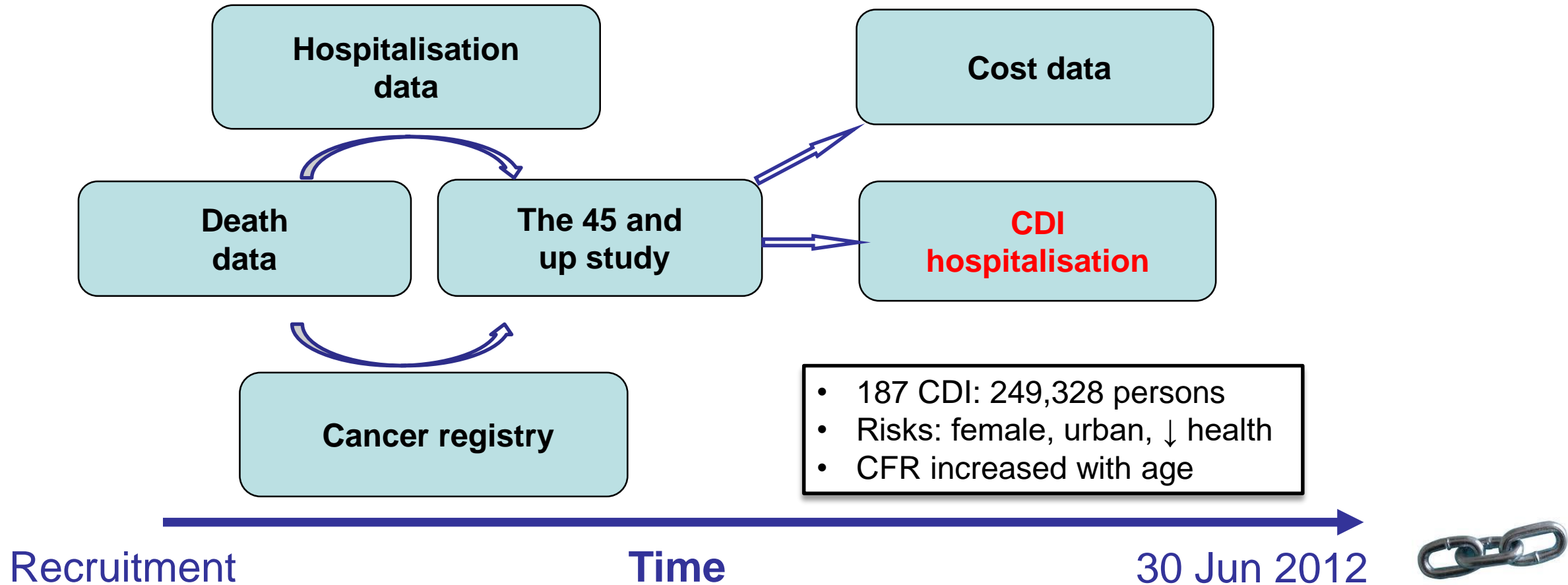
- HAI becoming more complex
- Infection control aims to minimize spread
- Understand how pathogens move
- Traditional tools helpful
  - Microbiology
  - Epidemiology
- Sometimes too blunt or blurry...

# Epidemiology

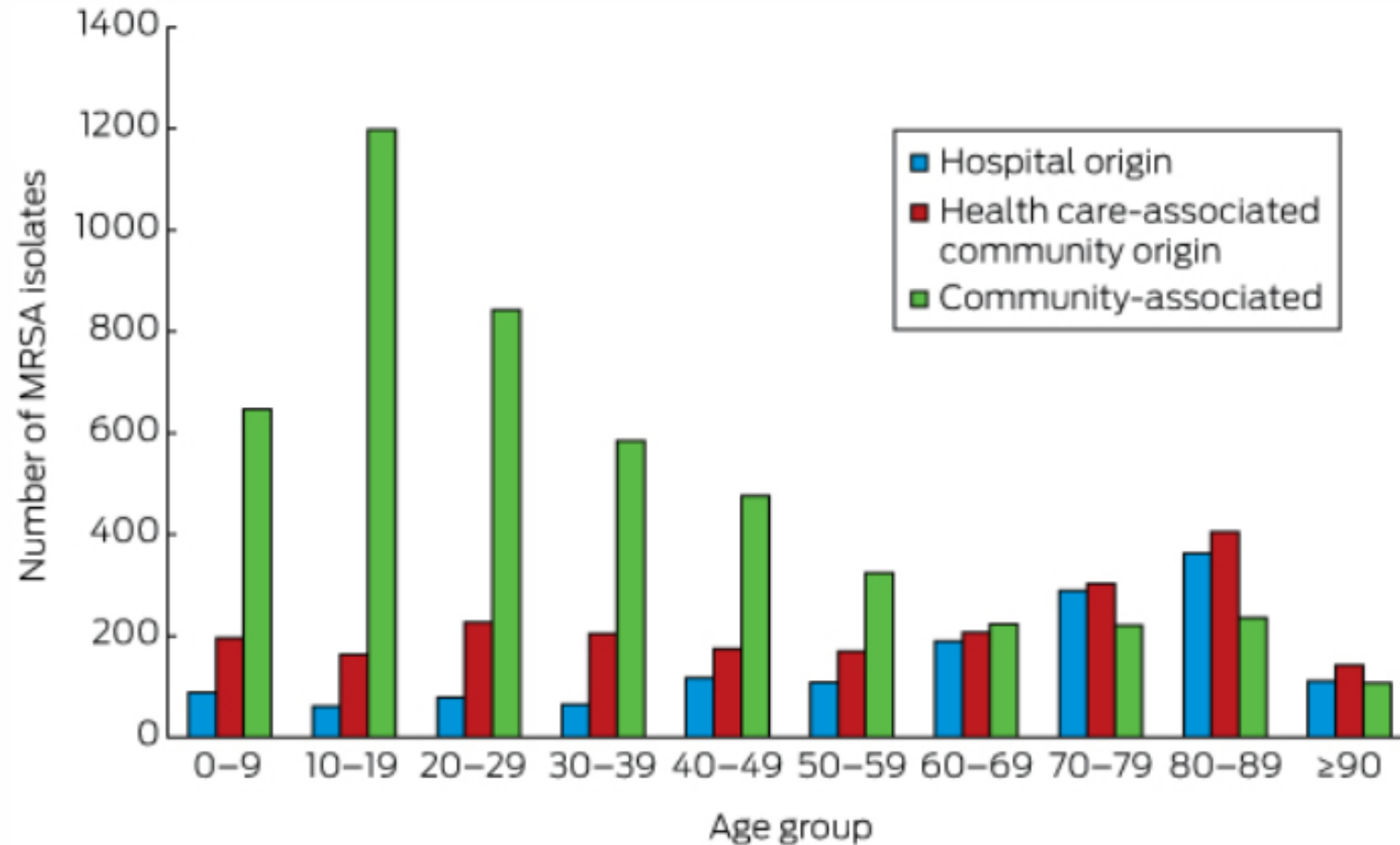
- Distribution & determinants of health-related states/events
- Basis of infection control surveillance
  - Outbreak investigation
- Move past descriptive epidemiology
  - Risk factors
- Electronic data improvements
  - Ease of data linkage



# Hospital-identified CDI, 45 and Up Study, 2006-12



# MRSA Hunter New England, 2008-14

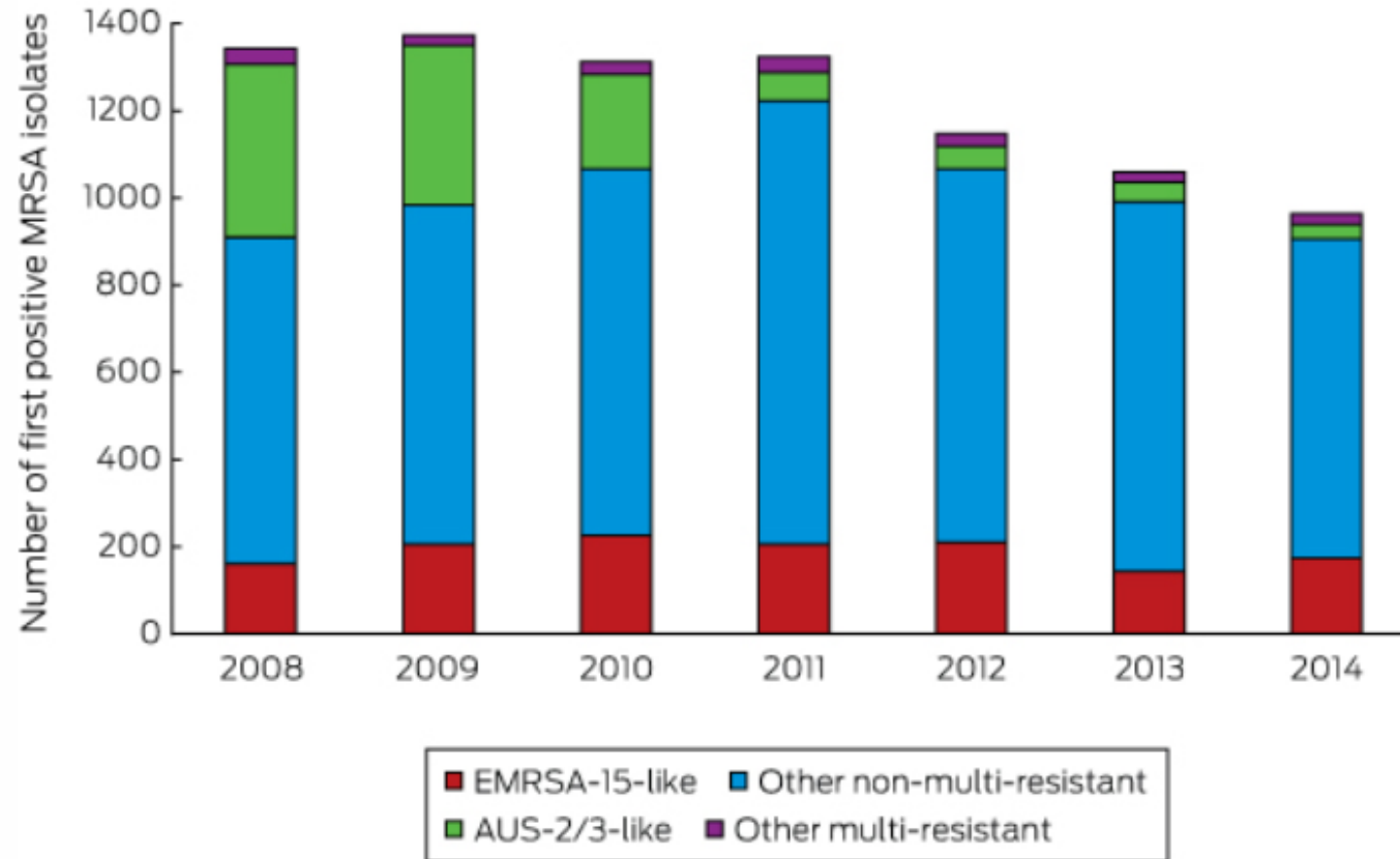


# Microbiology

- Understanding microbes and behaviour
- Mainstay of infectious disease control
  - Monitor > Prevent > Control
- Diagnosis Vs. Typing
- Undergoing a revolution
  - Rapid tests
  - Whole genome sequencing

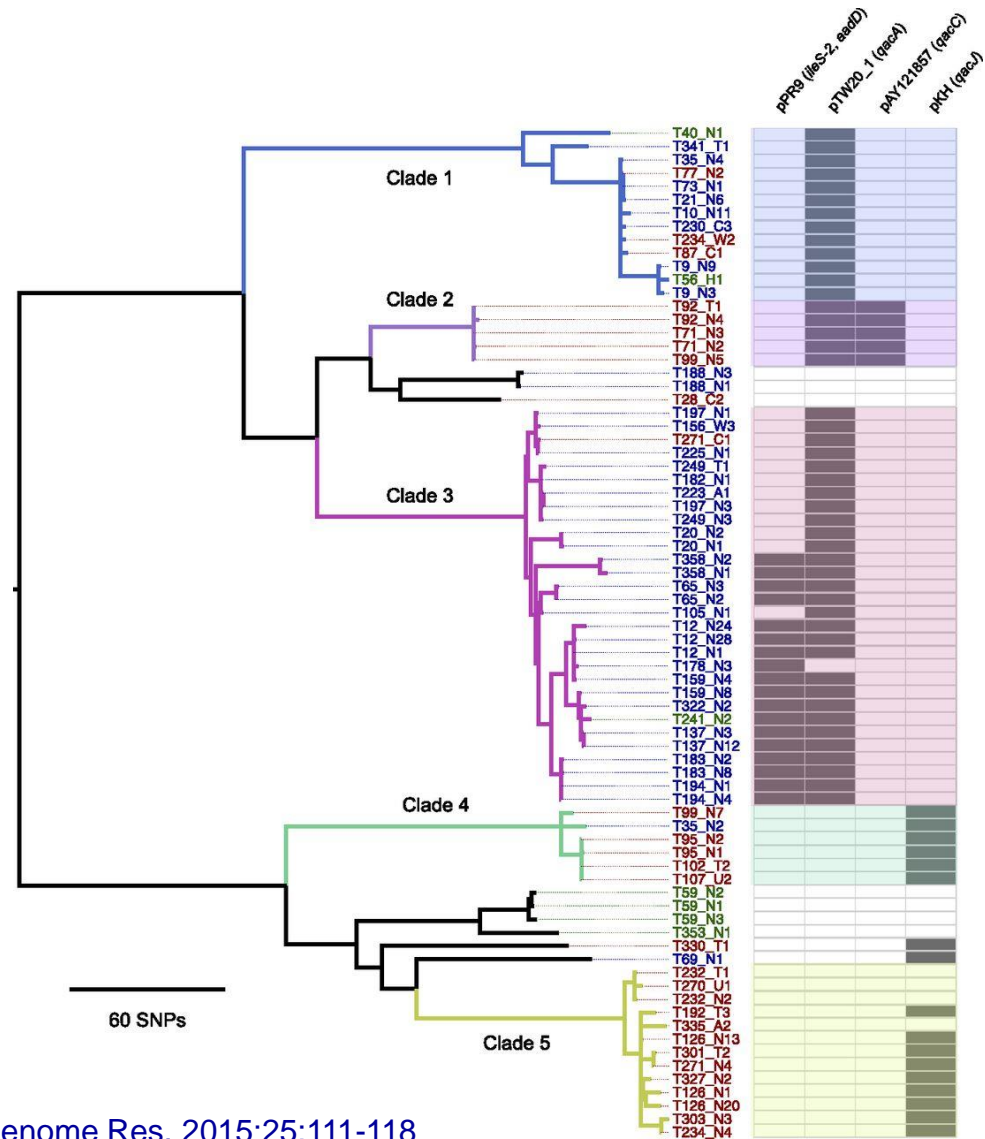


# MRSA Hunter New England, 2008-14



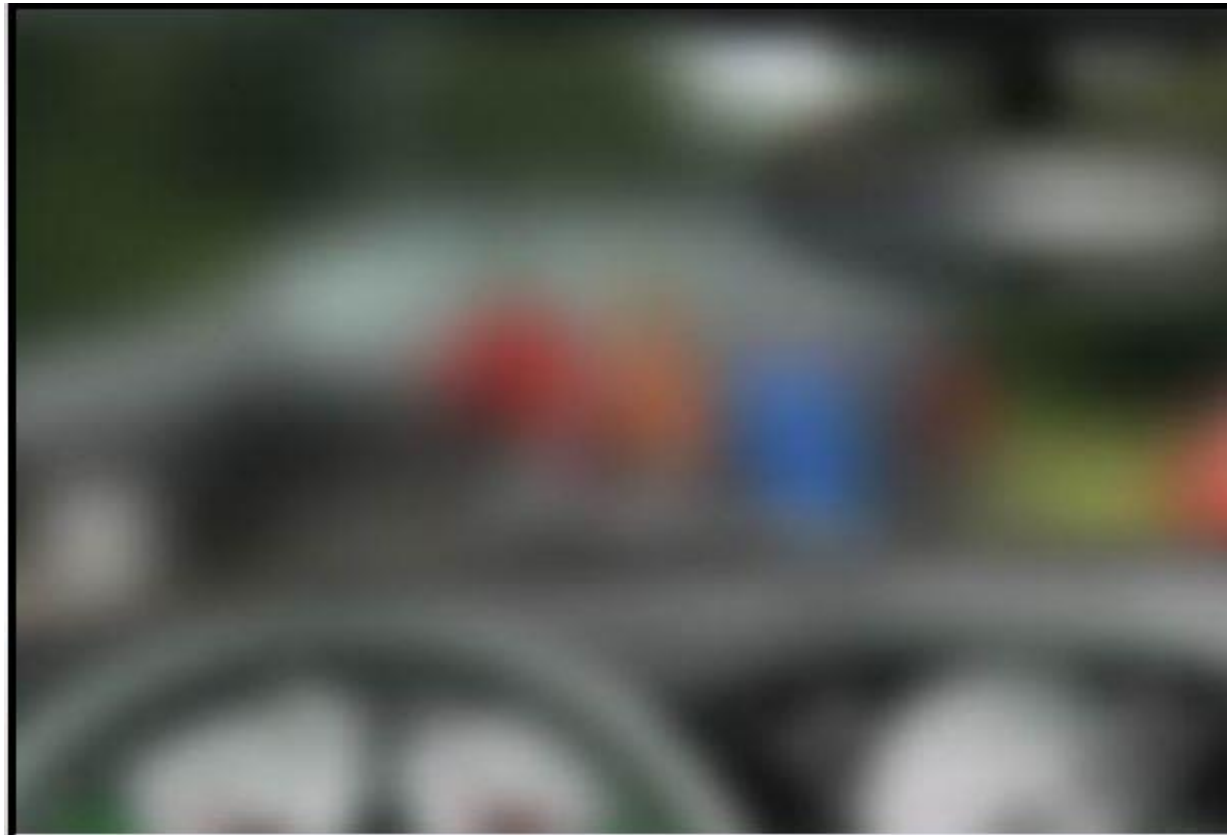
Agostino JW, Ferguson JK, Eastwood K, Kirk MD. Med J Aust. 2017 Nov 6;207(9):388-393.

# MRSA ST239





# Severe Myopia...





# Moderate Myopia...





# Mild Myopia...





# No Myopia!



# Mathematical Modelling

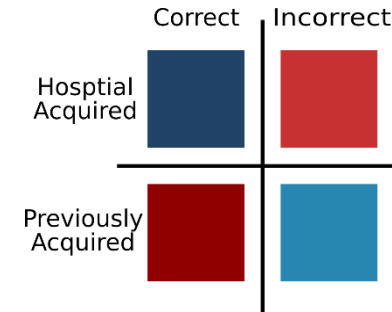
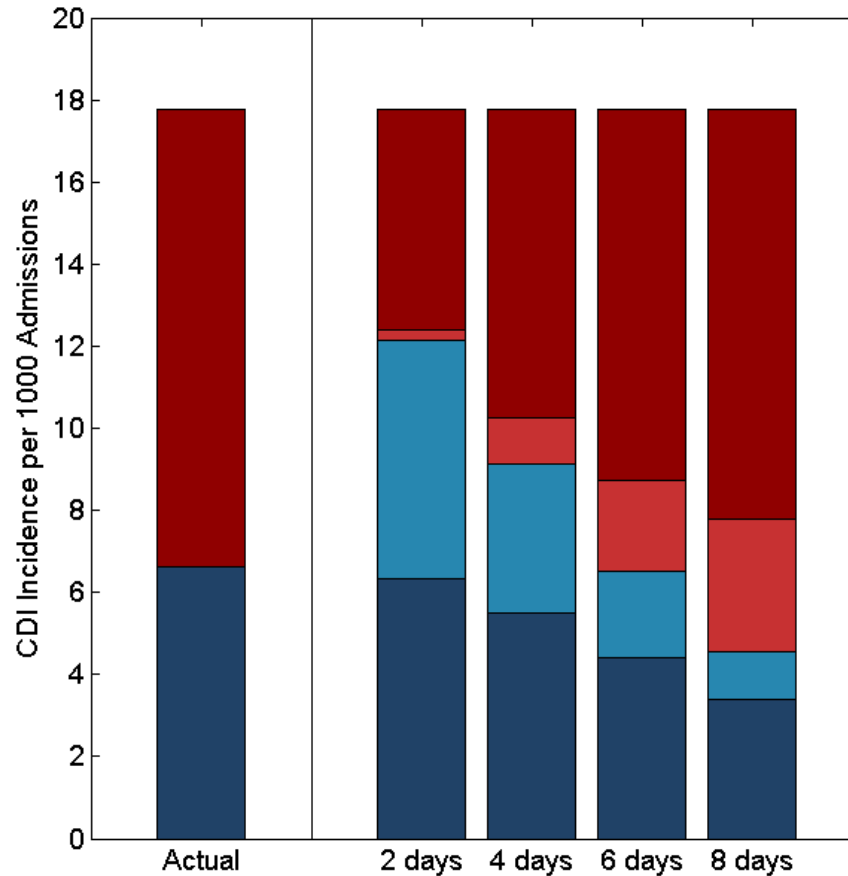
- Describe system using maths
  - Immunity
  - Natural history of disease
  - Outcomes of infection
- Test infection control scenarios
- Useful to explain how things work
- Powerful with real system data

# HA or CA *C. difficile* Cut-off

Too short:  
Over-estimates  
hospital acquired

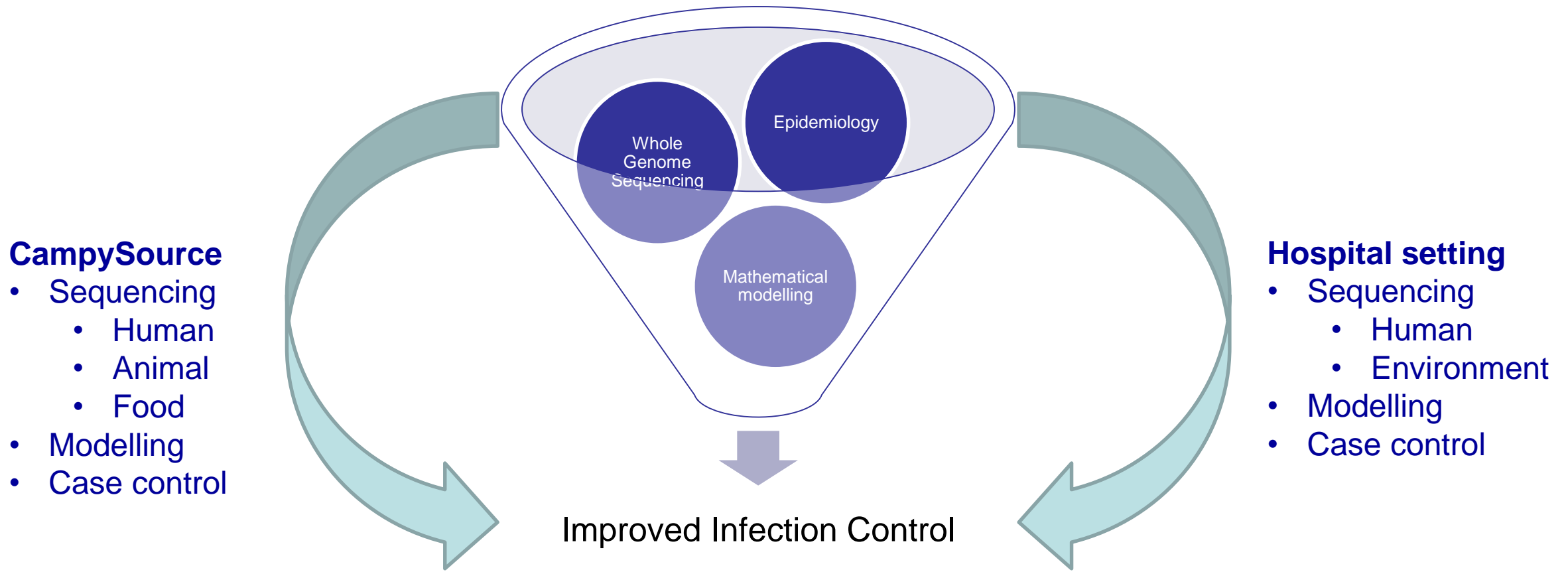
Too long:  
Over-estimates  
previously acquired

5 or 6 days  
Balanced





# Combining Methodologies...



# Summary

- Epidemiology more than describing
  - Linkage of data is a powerful tool
- Revolution in microbiology
  - Rapid diagnostics & WGS
- Mathematical modelling
  - Helps test systems
- Need to integrate multiple data streams

*“In public health, we can’t do anything without surveillance.  
That’s where public health begins.”*

Dr David Satcher, MD, PhD,  
U.S. Surgeon General, 1998–2002