

# Outbreak investigation & root cause analysis (RCA)

Glenys Harrington  
Infection Control Consultancy (ICC)  
Melbourne  
[infexion@ozemail.com.au](mailto:infexion@ozemail.com.au)

*Advanced Training for Infection Control Nurses (ICNs)  
Hospital Authority Centre for Health Protection, Kowloon, Hong Kong Special Administrative Region  
1 - 3 November 2017.  
(Organizers: Infectious Disease Control Training Centre, Hospital Authority/Infection Control Branch,  
Centre for Health Protection and Chief Infection Control Officer's Office).*

# Aims

- ▶ **Aims of an outbreak investigation**

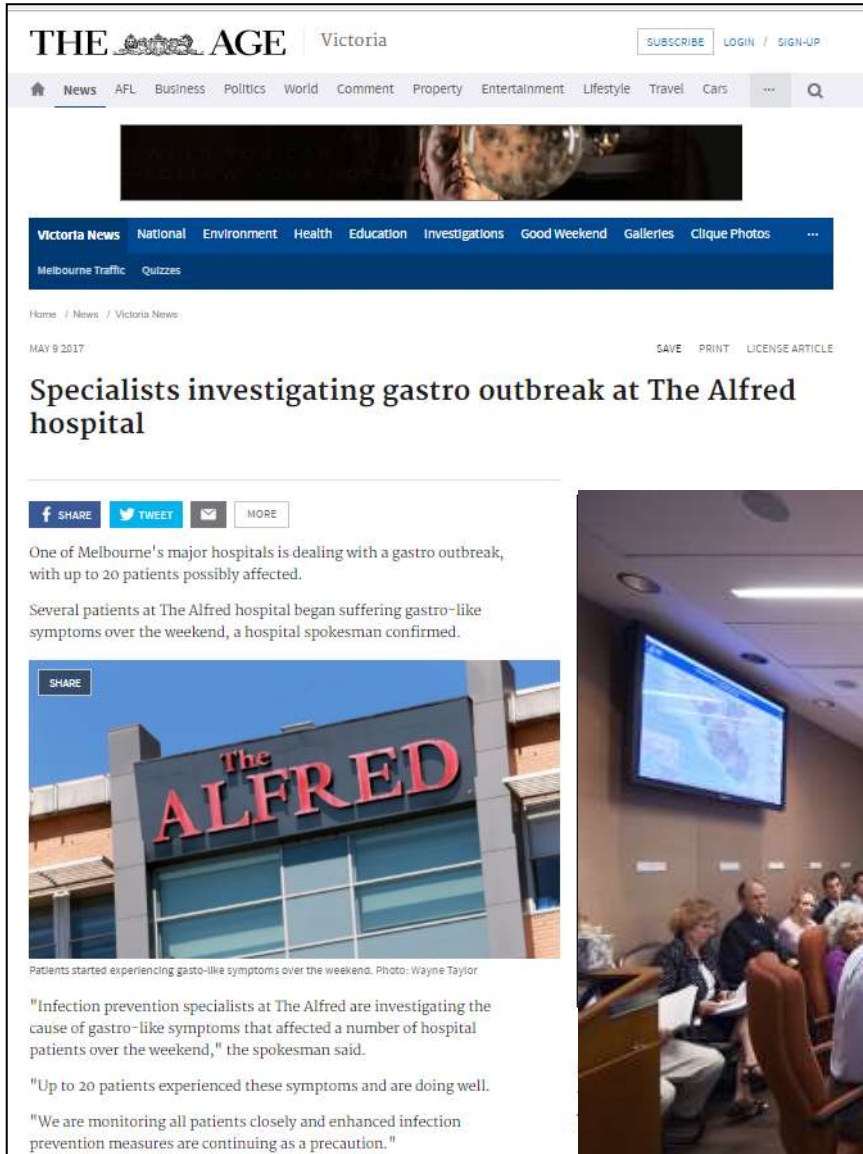
- ▶ To identify the source of the outbreak
- ▶ To identify the reservoir(s)
- ▶ To identify the mode of spread
- ▶ Eliminate the reservoir(s) and stop ongoing transmission
- ▶ Prevent future infection/s

- ▶ **Aims of a root cause analysis**

- ▶ Seeks to identify the origin of a problem using a specific set of steps
  - ▶ Determine what happened
  - ▶ Determine why it happened
  - ▶ Figure out what to do to reduce the likelihood that it will happen again

# Reasons for investigation outbreaks

- ▶ Prevent additional cases
- ▶ Prevent future outbreaks
- ▶ Assess prevention interventions
- ▶ Learn about new diseases
- ▶ Learn something new about an old disease
  - ▶ New route of transmission
  - ▶ Complication of new procedures
  - ▶ New sources
- ▶ Reassure the patients/staff/public



**THE AGE** Victoria

News AFL Business Politics World Comment Property Entertainment Lifestyle Travel Cars ...

Victoria News National Environment Health Education Investigations Good Weekend Galleries Clique Photos ...

Melbourne Traffic Quizzes

Home / News / Victoria News


MAY 9 2017 SAVE PRINT LICENSE ARTICLE

## Specialists investigating gastro outbreak at The Alfred hospital

SHARE TWEET MORE

One of Melbourne's major hospitals is dealing with a gastro outbreak, with up to 20 patients possibly affected.

Several patients at The Alfred hospital began suffering gastro-like symptoms over the weekend, a hospital spokesman confirmed.



SHARE

Patients started experiencing gastro-like symptoms over the weekend. Photo: Wayne Taylor

"Infection prevention specialists at The Alfred are investigating the cause of gastro-like symptoms that affected a number of hospital patients over the weekend," the spokesman said.

"Up to 20 patients experienced these symptoms and are doing well.

"We are monitoring all patients closely and enhanced infection prevention measures are continuing as a precaution."



# Descriptive epidemiology

- ▶ The 5W's of descriptive epidemiology:
  - ▶ **What** = health issue of concern
  - ▶ **Who** = person
  - ▶ **Where** = place
  - ▶ **When** = time
  - ▶ **Why/how** = causes, risk factors, modes of transmission

# Decision to investigate an outbreak

- ▶ **Further investigations vs implementing interventions**
  - ▶ Number of patients affected
  - ▶ Associated morbidity
  - ▶ Presence of unusual or severe symptoms of disease
  - ▶ Possibility of common source
  - ▶ Resource requirements
  - ▶ Level of public health importance
- ▶ **Some outbreaks**
  - ▶ Resources may be best utilised reinforcing basic infection control practices
    - ▶ May terminate the outbreak
    - ▶ Minimise the cost and resource utilisation associated with an extensive investigation

# Definitions

- ▶ **Epidemic**
  - ▶ Is the occurrence of more cases of disease than would normally be expected in a specific place or group of people over a given period of time
- ▶ **Outbreak**
  - ▶ The same as an epidemic
  - ▶ The term outbreak is often used rather than epidemic to avoid sensationalism
- ▶ **Cluster**
  - ▶ Is a group of cases in a specific time and place that may or may not be greater than the expected rate
- ▶ **Endemic**
  - ▶ A higher background rate of disease
- ▶ **Pandemic**
  - ▶ Very widespread, often global, disease



Official guidance states that infections are usually minor / PA

Candida auris infections that target the immune system have been diagnosed across 20 separate NHS trusts and independent hospitals and are proving 'difficult to control'

RYAN WILKINSON  
Tuesday 15 August 2017 10:30 BST



92 SHARES



CLICK TO FOLLOW  
INDY/LIFE

UK Independent Tuesday 15 August 2017



# Outbreaks in healthcare facilities

## ▶ Wenzel RP

- ▶ 1978 -1982 University of Virginia
  - ▶ 9.8 outbreaks per 100,000 admissions
  - ▶ 10/11 outbreaks occurred in ICU
  - ▶ 8/11 outbreaks involved bloodstream infections

## ▶ Baltimore, Maryland

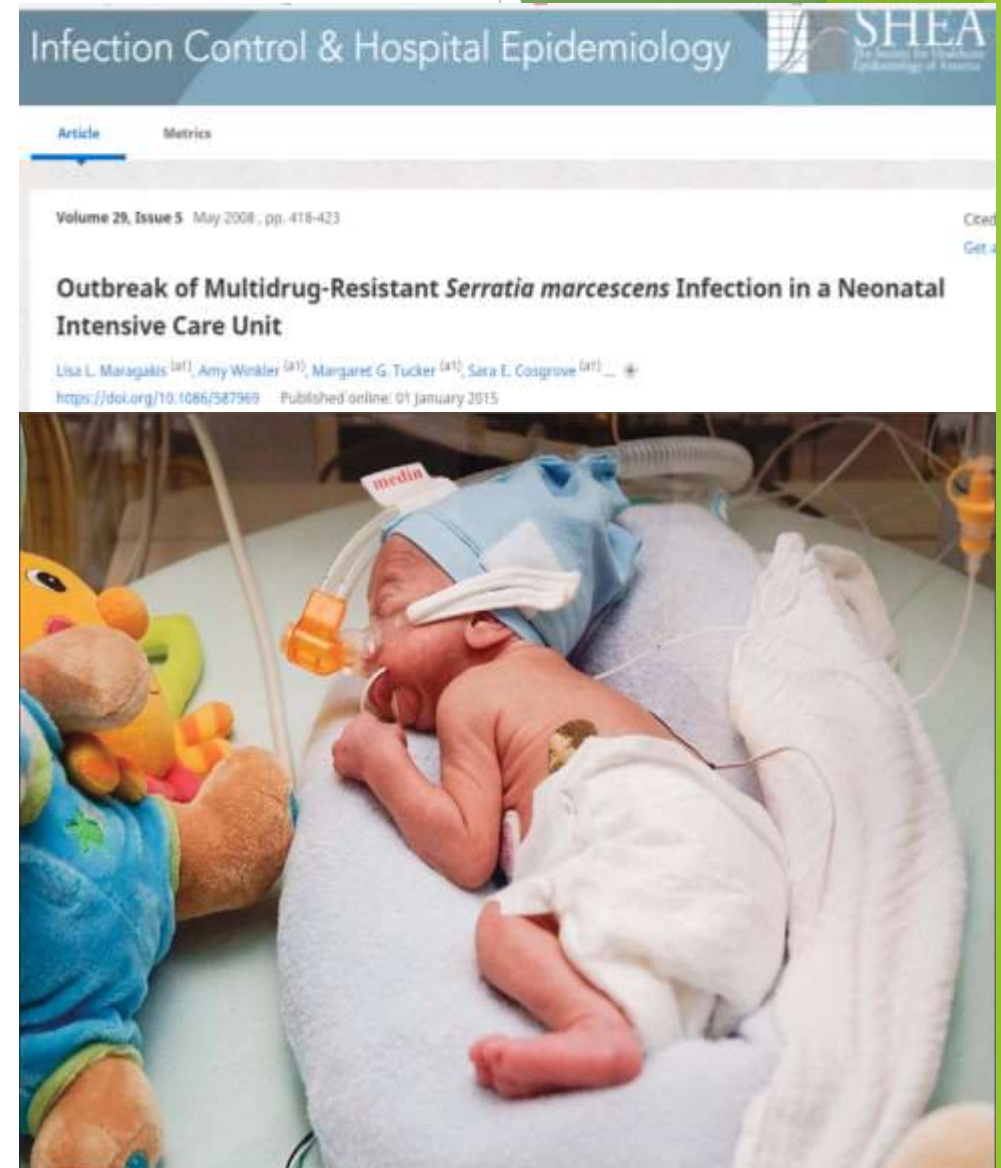
- ▶ 36-bed NICU
- ▶ Oct 2004 - Feb 2005
- ▶ Investigation included:
  - ▶ Case identification
  - ▶ Review of medical records
  - ▶ Environmental cultures
  - ▶ Patient surveillance cultures
  - ▶ Personnel hand cultures
  - ▶ Pulsed-field gel electrophoresis (PFGE)
- ▶ The case-control study included case identification and review of medical records
- ▶ Infection control measures were implemented



Wenzel RP. *Prevention and Control of Nosocomial infections. 4<sup>th</sup> Edition, Lippincott, Williams and Wilkins.*  
Maragakis L. *Outbreak of Multidrug-Resistant Serratia marcescens Infection in a Neonatal Intensive Care Unit.*  
ICHE Vol 28, Issue 5 May 2008 , pp. 418-423

# Outbreaks in healthcare facilities

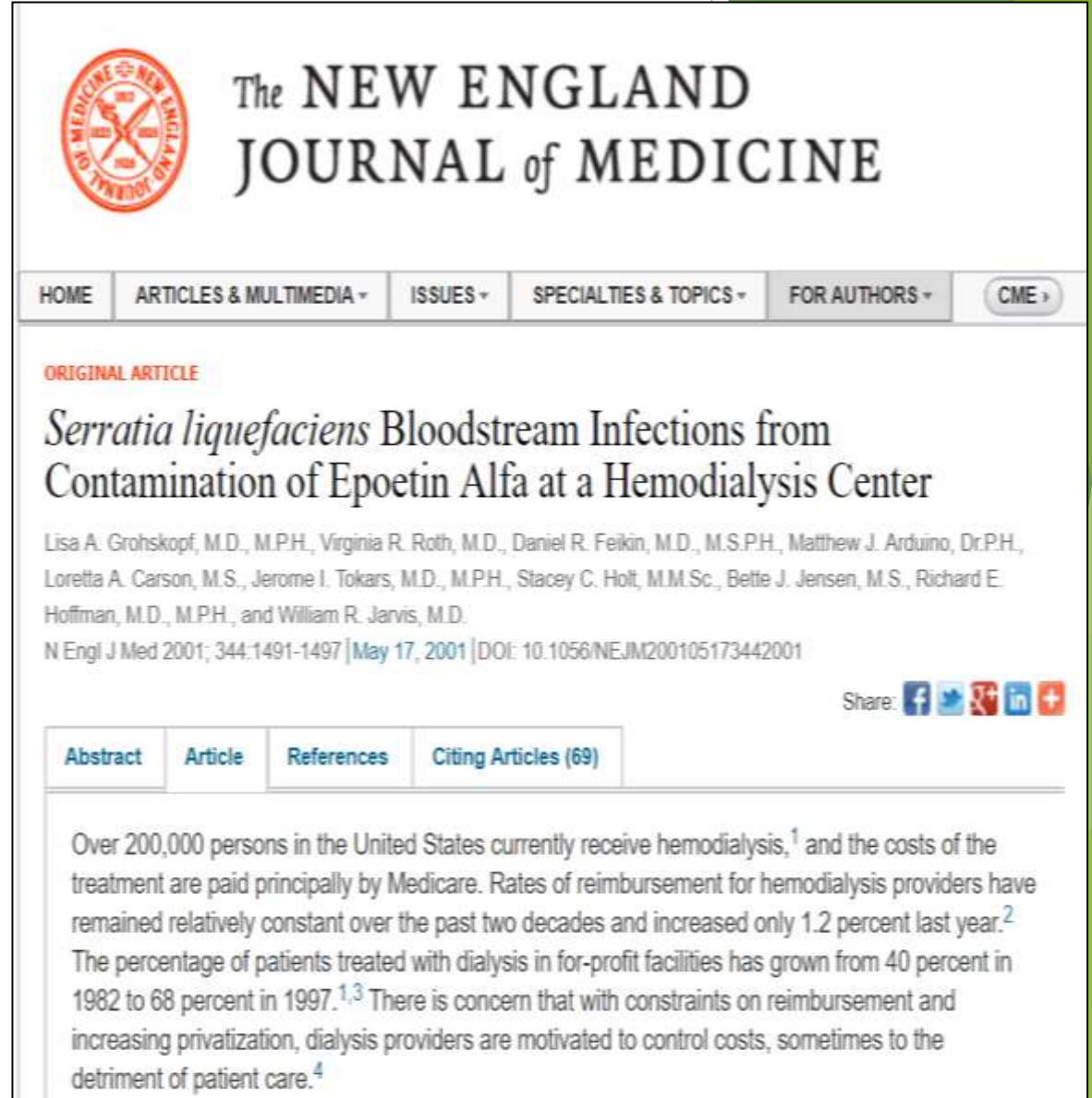
- ▶ Baltimore, Maryland....
  - ▶ 18 NICU neonates had cultures that grew MDR *S. marcescens*
  - ▶ The case-control study - 16 cases, 32 controls
- ▶ Results
  - ▶ PFGE analysis
    - ▶ 15 cases - a single strain of MDR *S. marcescens*
    - ▶ 2 cases unique strains/ 1 case isolate could not be subtyped
    - ▶ An unrelated MDR *S. marcescens* isolate was recovered from a sink drain
    - ▶ Exposure to inhalational therapy was an independent risk factor for MDR *S. marcescens* acquisition
  - ▶ Extensive investigation failed to reveal a point source for the outbreak
- ▶ Comments
  - ▶ Transient carriage on the hands of staff or on respiratory care equipment - likely mode of transmission
  - ▶ Cohorting patients and staff, at the cost of bed closures and additional personnel - interrupted transmission





# Outbreaks in healthcare facilities

- ▶ CDC/Division of Healthcare Quality Promotion (DHQP), 1990 -1999
  - ▶ 114 onsite outbreak investigations
    - ▶ 71% involved hospitals inpatients
      - ▶ 28% in ICUs, 72% non-ICU settings
    - ▶ 8% outpatients
    - ▶ 5% LTCFs
    - ▶ 4% home healthcare settings
    - ▶ 73% were caused by bacteria
    - ▶ 46% associated with invasive devices or procedures
      - ▶ Haemodialyzers (10 outbreaks)
      - ▶ Needleless devices (7 outbreaks)
      - ▶ Surgery (21 outbreaks)
      - ▶ Dialysis (16 outbreaks)



The screenshot shows the top portion of a web page from The New England Journal of Medicine. At the top left is the journal's logo, a red circular emblem with a caduceus and the text 'NEW ENGLAND JOURNAL OF MEDICINE'. To the right of the logo is the journal's title 'The NEW ENGLAND JOURNAL of MEDICINE'. Below the title is a navigation bar with buttons for 'HOME', 'ARTICLES & MULTIMEDIA', 'ISSUES', 'SPECIALTIES & TOPICS', 'FOR AUTHORS', and 'CME'. The main content area features the label 'ORIGINAL ARTICLE' in red, followed by the article title 'Serratia liquefaciens Bloodstream Infections from Contamination of Epoetin Alfa at a Hemodialysis Center'. Below the title is the list of authors: Lisa A. Grohskopf, M.D., M.P.H., Virginia R. Roth, M.D., Daniel R. Feikin, M.D., M.S.P.H., Matthew J. Arduino, Dr.P.H., Loretta A. Carson, M.S., Jerome I. Tokars, M.D., M.P.H., Stacey C. Holt, M.M.Sc., Bette J. Jensen, M.S., Richard E. Hoffman, M.D., M.P.H., and William R. Jarvis, M.D. Below the authors is the citation information: 'N Engl J Med 2001; 344:1491-1497 | May 17, 2001 | DOI: 10.1056/NEJM200105173442001'. To the right of the citation is a 'Share:' button with icons for Facebook, Twitter, Google+, LinkedIn, and a plus sign. Below the citation is a navigation bar with buttons for 'Abstract', 'Article', 'References', and 'Citing Articles (69)'. The main text of the article begins with the sentence: 'Over 200,000 persons in the United States currently receive hemodialysis,<sup>1</sup> and the costs of the treatment are paid principally by Medicare. Rates of reimbursement for hemodialysis providers have remained relatively constant over the past two decades and increased only 1.2 percent last year.<sup>2</sup> The percentage of patients treated with dialysis in for-profit facilities has grown from 40 percent in 1982 to 68 percent in 1997.<sup>1,3</sup> There is concern that with constraints on reimbursement and increasing privatization, dialysis providers are motivated to control costs, sometimes to the detriment of patient care.<sup>4</sup>

# Outbreaks in healthcare facilities

- ▶ Gastmeier et al review of 1,022 outbreak publications (majority 1990's)
  - ▶ 83% from hospitals
  - ▶ 46% occurred in ICU
  - ▶ 11% outpatient care setting
  - ▶ 37% not able to identify a source
  - ▶ 28% mode of transmission not clear
  - ▶ Pathogens
    - ▶ Staphylococcus aureus outbreaks -77% MRSA
    - ▶ Other Multi-drug resistances outbreaks
      - ▶ *K.pneumoniae* - 49.3% MDR
      - ▶ *Acinetobacter baumannii* -37.5% MDR
      - ▶ *M.Tuberculosis* - 66% MDR



# Outbreaks in healthcare facilities

- ▶ 2010 survey - USA ICPs
  - ▶ A Part 2 survey including - outbreak investigations
- ▶ Results
  - ▶ 822 responses
  - ▶ 386 outbreak investigations
  - ▶ 289 US hospitals
  - ▶ Nearly 60% of the outbreaks were caused by 4 organisms:
    - ▶ norovirus (18%)
    - ▶ *Staphylococcus aureus* (17%)
    - ▶ *Acinetobacter spp* (14%)
    - ▶ *Clostridium difficile* (10%)

The screenshot displays the AJIC website interface. At the top, the journal title 'American Journal of Infection Control' is visible, along with navigation links for 'Articles and Issues', 'Collections', 'Resource Centers', 'For Authors', 'Journal Info', 'Subscribe', 'About APIC', and 'More Periodicals'. A search bar is present with a dropdown menu set to 'All Content'. The article title is prominently displayed: 'Frequency of outbreak investigations in US hospitals: Results of a national survey of infection preventionists'. Below the title, the authors are listed: Emily Rhinehart, RN, MPH, CIC, Scott Walker, BBA, Denise Murphy, RN, MPH, CIC, Karen O'Reilly, BS, MBA, and Patty Leeman, MCE, MBA, CAE. The article is from February 2012, Volume 40, Issue 1, Pages 2-8. The DOI is provided as <http://dx.doi.org/10.1016/j.ajic.2011.10.003>. The article is available in PDF format (153 KB). The 'Background' section states: 'A survey of infection preventionists was conducted to determine the frequency of outbreak investigations in US hospitals.' The 'Methods' section states: 'A 2-part electronic survey was sent to Association for Professionals in Infection Control and Epidemiology, Inc, members in US hospitals in January 2010. Part 1 of the survey tool involved hospital demographics and the infection prevention/control program. Part 2 explored specific outbreak investigations allowing responses for up to 8 investigations within the previous 24 months.'

***Frequency of outbreak investigations in US hospitals: Results of a national survey of infection preventionists AJIC Feb 2012, Volume 40, Issue 1, Pages 2-8.***



# Outbreaks in healthcare facilities

- ▶ 2010 survey - USA ICPs.....
  - ▶ Norovirus occurred most often in behavioural health & rehabilitation/long-term acute care units
  - ▶ Other organisms occurred in medical/surgical units
  - ▶ Unit/department closure - 22.6%
    - ▶ Norovirus
  - ▶ Investigations were most frequently conducted in community/nonteaching hospitals and facilities with 201 to 300 beds
    - ▶ Mean number confirmed cases -10
    - ▶ Mean duration - 58 days

The screenshot displays the AJIC website interface. At the top, the journal title 'American Journal of Infection Control' is visible, along with navigation links for 'Articles and Issues', 'Collections', 'Resource Centers', 'For Authors', 'Journal Info', 'Subscribe', 'About APIC', and 'More Periodicals'. A search bar is present with a dropdown menu set to 'All Content'. The article title is 'Frequency of outbreak investigations in US hospitals: Results of a national survey of infection preventionists', published in February 2012, Volume 40, Issue 1, Pages 2-8. The authors listed are Emily Rhinehart, RN, MPH, CIC; Scott Walker, BBA; Denise Murphy, RN, MPH, CIC; Karen O'Reilly, BS, MBA; and Patty Leeman, MCE, MBA, CAE. The article is available as a PDF (153 KB) and has been cited in Scopus (24) times. The abstract section is highlighted, showing the background and methods of the survey.

**Frequency of outbreak investigations in US hospitals: Results of a national survey of infection preventionists**

Emily Rhinehart, RN, MPH, CIC, Scott Walker, BBA, Denise Murphy, RN, MPH, CIC, Karen O'Reilly, BS, MBA, Patty Leeman, MCE, MBA, CAE

DOI: <http://dx.doi.org/10.1016/j.ajic.2011.10.003>

**Abstract** Full Text References

**Background**  
A survey of infection preventionists was conducted to determine the frequency of outbreak investigations in US hospitals.

**Methods**  
A 2-part electronic survey was sent to Association for Professionals in Infection Control and Epidemiology, Inc, members in US hospitals in January 2010. Part 1 of the survey tool involved hospital demographics and the infection prevention/control program. Part 2 explored specific outbreak investigations allowing responses for up to 8 investigations within the previous 24 months.

# USA-Hepatitis B & C outbreaks 2008 - 2016

- ▶ **59 outbreaks (two or more cases) of viral hepatitis related to healthcare reported to CDC during 2008-2016**
  - ▶ 56 (95%) occurred in non-hospital settings
- ▶ **Hepatitis B**
  - Total 24 outbreaks including one of both HBV and HCV:
    - ▶ 179 outbreak-associated cases
    - ▶ >10,935 persons notified for screening
- ▶ **18 outbreaks occurred in long-term care facilities:**
  - ▶ 133 outbreak-associated cases of HBV
  - ▶ Approx. 1,680 at-risk persons notified for screening
  - ▶ 83% (15/18) of the outbreaks assoc with infection control breaks during assisted monitoring of blood
- ▶ **5 outbreaks occurred in other settings:**
  - ▶ A free dental clinic in school gymnasium
  - ▶ An outpatient oncology clinic a hospital surgery service
  - ▶ Two at pain remediation clinics
    - ▶ One outbreak of HBV and
    - ▶ One with both HBV and HCV
    - ▶ 46 outbreak-associated cases of HBV and
    - ▶ > 8,500 persons at-risk persons notified for screening

The screenshot shows the CDC website interface. At the top left is the CDC logo with the text 'Centers for Disease Control and Prevention' and 'CDC 24/7: Saving Lives. Protecting People™'. To the right is a search bar with the word 'SEARCH' and a magnifying glass icon. Below the search bar is a blue button labeled 'CDC-A-Z INDEX'. A green banner with the text 'Viral Hepatitis' is positioned below the search bar. Underneath the banner, there is a breadcrumb trail: 'Viral Hepatitis > Outbreaks'. The main heading of the page is 'Healthcare-Associated Hepatitis B and C Outbreaks (>2 cases) Reported to the Centers for Disease Control and Prevention (CDC) 2008-2016'. The text below the heading states: 'The tables below summarize healthcare-associated outbreaks of hepatitis B virus (HBV) and hepatitis C virus (HCV) infection reported in the United States during 2008-2016. Outbreaks previously reported in 1998-2008 can be found in [Thomson, et al. et](#) and [Reed, et al. et](#). Because of the long incubation period (up to 6 months) and typically asymptomatic course of acute hepatitis B and C infection, it is likely that only a fraction of such outbreaks that occurred have been detected, and reporting of outbreaks detected and investigated by state and local health departments is not required. Therefore, the numbers reported here may greatly underestimate the number of outbreak-associated cases and the number of at-risk persons notified for screening. Practical guidance on detecting and investigating such outbreaks may be found in the [Healthcare Investigation Guide](#). Resources for prevention include updated [hepatitis B immunization guidelines](#), and [infection control guidelines and resources](#). Note: this page is available in [printable form](#) (PDF - 32 pages).



# USA-Hepatitis B & C outbreaks 2008 - 2016

## ▶ Hepatitis C

- ▶ **36 total outbreaks including one of both HBV and HCV**
  - ▶ >288 outbreak-associated cases
  - ▶ >105,048 at-risk persons notified for screening
- ▶ **13 outbreaks occurred in outpatient facilities**
  - ▶ 111 outbreak-associated cases of HCV
  - ▶ >73,873 persons notified for screening
- ▶ **20 outbreaks occurred in haemodialysis settings**
  - ▶ 100 outbreak-associated cases of HCV
  - ▶ 2,979 persons notified for screening
- ▶ **Three outbreaks occurred because of drug diversion by HCV-infected health care providers**
  - ▶ 78 outbreak-associated cases of HCV
  - ▶ >26,217 persons notified for screening

The screenshot shows the CDC website interface. At the top left is the CDC logo with the text 'Centers for Disease Control and Prevention' and 'CDC 24/7: Saving Lives, Protecting People™'. To the right is a search bar with the word 'SEARCH' and a magnifying glass icon. Below the search bar is a blue button labeled 'CDC-A-Z INDEX'. A green banner with the text 'Viral Hepatitis' is positioned below the search bar. Underneath the banner, there is a breadcrumb trail: 'Viral Hepatitis > Outbreaks'. The main heading of the page is 'Healthcare-Associated Hepatitis B and C Outbreaks (≥ 2 cases) Reported to the Centers for Disease Control and Prevention (CDC) 2008-2016'. The text below the heading states: 'The tables below summarize healthcare-associated outbreaks of hepatitis B virus (HBV) and hepatitis C virus (HCV) infection reported in the United States during 2008-2016. Outbreaks previously reported in 1998-2008 can be found in [Thompson et al. et](#) and [Reid et al. et](#). Because of the long incubation period (up to 6 months) and typically asymptomatic course of acute hepatitis B and C infection, it is likely that only a fraction of such outbreaks that occurred have been detected, and reporting of outbreaks detected and investigated by state and local health departments is not required. Therefore, the numbers reported here may greatly underestimate the number of outbreak-associated cases and the number of at-risk persons notified for screening. Practical guidance on detecting and investigating such outbreaks may be found in the [Healthcare Investigation Guide](#). Resources for prevention include updated [hepatitis B immunization guidelines](#), and [infection control guidelines and resources](#). Note: this page is available in [printable form](#) (PDF - 32 pages).

# Outbreaks - Asia Pacific Region

Ye et al. BMC Infectious Diseases (2015) 15:179  
DOI 10.1186/s12879-015-0917-9



RESEARCH ARTICLE

Open Access

## A gloves-associated outbreak of imipenem-resistant *Acinetobacter baumannii* in Guangdong, China

Dan Ye<sup>1</sup>, Jinglan Shan<sup>1</sup>, Yongbo Huang<sup>2,3</sup>, Jianchun Li<sup>1</sup> and Pu Mao<sup>2\*</sup>



Journal of Clinical Microbiology

HOME | CURRENT ISSUE | ARCHIVE | ALERTS | ABOUT ASM | CONTACT US

### Abstract

**Background:** Imipenem-resistant *Acinetobacter baumannii* (IRAB) is a major cause of hospital-acquired infections. We aimed to describe an outbreak of IRAB infection at a tertiary care hospital in Guangdong, China.  
**Methods:** An environmental investigation was undertaken. Isolates were genotyped by use of rep-PCR; DiversiLab. The study included 11 patients in the case-control study, patients with chronic obstructive pulmonary disease (COPD) and IRAB. The hospital mortality of the case group was significantly higher than that of the control group.  
**Results:** Thirty-nine IRABs were isolated from patients in Guangdong, China, from January to December 2011. All isolates were resistant to imipenem. The outbreak was associated with the use of rep-PCR. There were four epidemic clones identified in the case-control study, patients with chronic obstructive pulmonary disease (COPD) and IRAB. The hospital mortality of the case group was significantly higher than that of the control group.  
**Conclusions:** The outbreak strains were transmitted from patients with IRAB. A combination of aggressive infection control and use of gloves. A combination of aggressive infection control and use of gloves.

JOURNAL OF CLINICAL MICROBIOLOGY, Jan. 2001, p. 228–234  
0095-1137/01/\$04.00+0 DOI: 10.1128/JCM.39.1.228–234.2001  
Copyright © 2001, American Society for Microbiology. All Rights Reserved.

### Epidemiology and Infection Control in Hong Kong *Acinetobacter* spp. in Hong Kong

ELIZABETH T. S. HOUANG,<sup>1\*</sup> Y. W. CHU,<sup>1</sup> C. M. LEUNG,<sup>1</sup>  
J. BERLAU,<sup>2</sup> K. C. NG,<sup>1</sup> AND A. F. B. CHEN<sup>3</sup>

<sup>1</sup>Department of Microbiology, The Chinese University of Hong Kong, Shatin NT, Hong Kong SAR, People's Republic of China, <sup>2</sup>and <sup>3</sup>Ophthalmology, University of Rostock, 18057 Rostock, Germany

Received 30 March 2000/Returned for modification 12 September 2000/Accepted 12 October 2000

American Journal of Infection Control

Articles and Issues ▾ Collections ▾ Resource Centers ▾ For Authors ▾ Journal Info ▾ Subscribe ▾ About ▾

All Content ▾ Search [Advanced Search](#)

< Previous Article [September 1, 2017](#) Volume 45, Issue 9, Pages 954–958 Next Article >

### Outbreak of health care-associated *Burkholderia cenocepacia* bacteremia and infection attributed to contaminated sterile gel used for central line insertion under ultrasound guidance and other procedures

[Ramon Z. Shaban](#), PhD, PGDipPH&TM, GradCertInfCon, MEd, MCHPrac(Hons), BSc(Med), BN, RN, CICP-E, FACN, FFCENA, [Samuel Maione](#), MBBS, BMedSc(Hons), FRCPA, [John Gerrard](#), MSc (Microbiology), MBBS, BSc(Med), DLSHTM, DTM&H (Lon), FRACP, [Peter Collignon](#), MBBS, BMedSc, FRACP, FRCPA, FASM, [Deborah Macbeth](#), PhD, RN, CICP-E, [Marilyn Cruickshank](#), PhD, RN, CICP-E, FACN, [Anna Hume](#), MBBS, BBiomedSc, [Amy V. Jennison](#), PhD, BSc(Hons), [Rikki M.A. Graham](#), PhD, BSc(Hons), [Haakon Bergh](#), BSc, AssDip(MedSc), [Heather L. Wilson](#), PhD, MBBS, FRACP, FRCPA, [Petra Derrington](#), MBBS, FRACP



# Outbreaks - Asia Pacific Region

South China Morning Post EDITION: INTERNATIONAL  
HEALTH & ENVIRONMENT  
CHINA HK ASIA WORLD COMMENT BUSINESS TECH LIFE CULTURE SPORT WEEK IN ASIA POST MAG STYLE TV

South China Morning Post  
Exclusive **INSIGHTS & ANALYSIS**

News / Hong Kong / Health & Environment

## Carrie Lam issues action call in Hong Kong hospital flu crisis

Authority in charge of public wards told to come up with urgent measures 'very soon' as doctors struggle to cope with deadly summer outbreak

PUBLISHED: Sunday, 16 July, 2017, 11:37pm  
UPDATED: Monday, 24 July, 2017, 4:26pm

COMMENTS



THE AUSTRALIAN LOG IN SUBSCRIBE plus 中文 (Chinese)

Anchors aweigh! Visit our new cruising section

Get on board >

Brought to you by PEARL CRUISES

## THE WEEKEND AUSTRALIAN

NEWS OPINION BUSINESS REVIEW NATIONAL AFFAIRS SPORT LIFE TECH ARTS TRAVEL HIGHER ED MEDIA PROPERTY

NEWS

## Seven die of flu at Victoria aged care home



St John's Retirement Village in Wangaratta. Picture: St John's Village

“Support for Sarah Palin cooled due to bizarre statements, intellectual thinness and general strangeness. Sound familiar? More >

PEGGY NOONAN

Advertisement

Anchors aweigh! Visit our new cruising section  
Get on board >  
Brought to you by PEARL CRUISES

Advertisement

The Australian · 3:17PM September 1, 2017

22



Save

The staggering cost of sleep deprivation

Sleep experts say the health

# Recognising and investigating an outbreak

- ▶ Infection control “detective”
  - ▶ Investigating an outbreak is like being an infection control “detective”
- ▶ Detection of outbreaks
  - ▶ Alert/s from an effective surveillance program
  - ▶ Alert/s from “alert” organism surveillance software
    - ▶ Laboratory
    - ▶ Infection control
  - ▶ Alert/s from staff
    - ▶ Physicians
    - ▶ Nurses
    - ▶ Microbiologist





# Recognising and investigating an outbreak

- ▶ **Determining the existence of an outbreak**
  - ▶ Exclude pseudo outbreaks
  - ▶ Define the case/s
  - ▶ Determine/ascertain the facts to define the case/s
  - ▶ Develop hypotheses
  - ▶ Evaluate hypotheses
  - ▶ Compare pre-epidemic and epidemic rates to confirm the existence of an outbreak
  - ▶ Implement control and prevention measures
  - ▶ Communicate findings





# Recognising and investigating an outbreak

- ▶ **Epidemiologic studies**
  - ▶ **Line listing**
    - ▶ **Line listing**
      - ▶ A list of cases and a few factors about each case to assist in generating your hypothesis
    - ▶ **Epidemic curve**
      - ▶ A plot of the number of cases
    - ▶ **Comparative studies**
      - ▶ Risk factor assessment
        - ▶ Case control study
        - ▶ Cohort study
  - ▶ **Additional studies**
    - ▶ Review practices/literature
    - ▶ Observational studies
    - ▶ Isolate typing



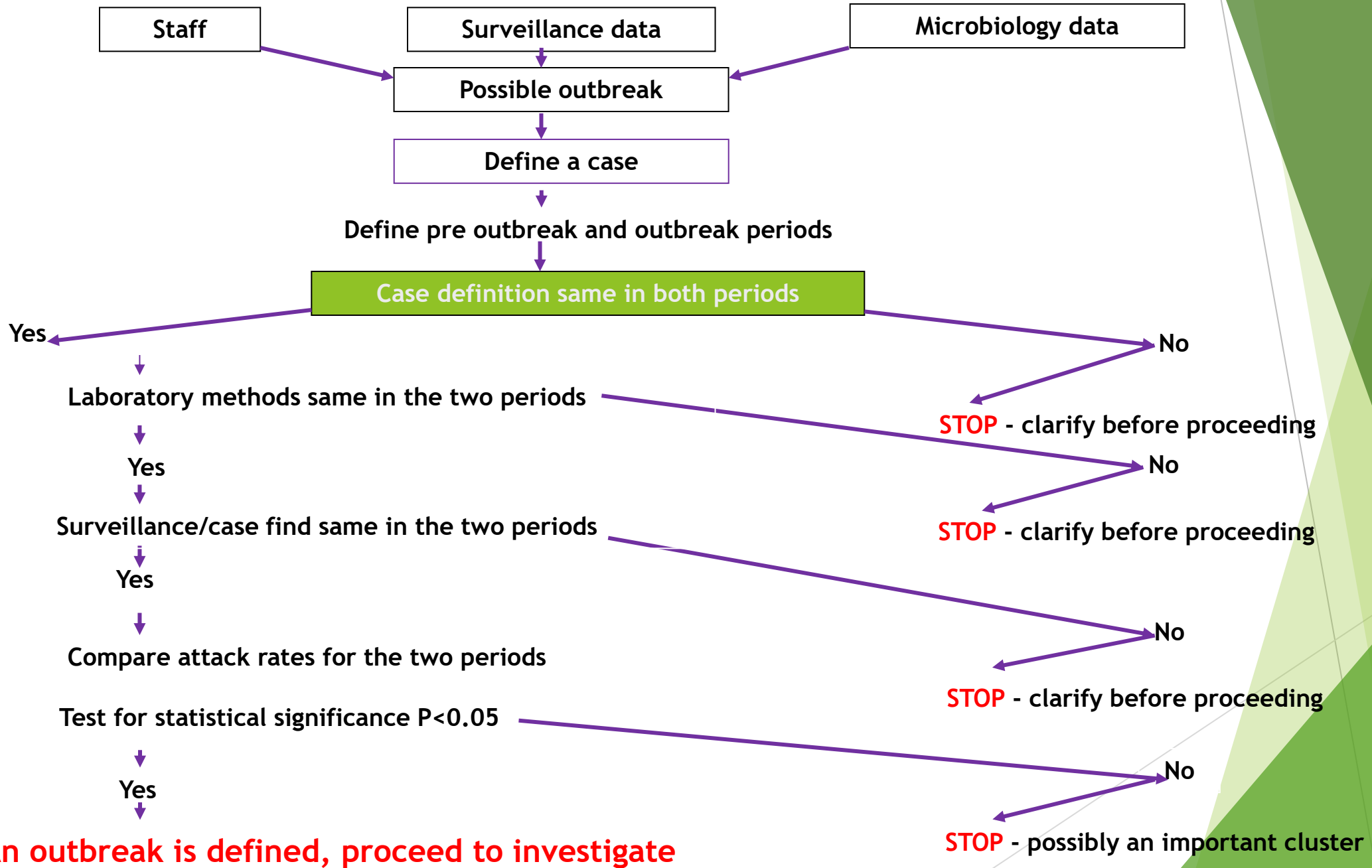
# What skills do you need?

- ▶ Logical thinking
- ▶ Problem solving
- ▶ Quantitative skills
- ▶ Epidemiological knowledge
- ▶ Judgement
- ▶ Diplomacy



*The Thinker, 1904, Auguste Rodin , Musée Rodin, Paris.*

# **Determining the existence of an outbreak**



**An outbreak is defined, proceed to investigate**

# Ask these questions?

- Do the laboratory findings correlate with the clinical findings?
- Has the data collection or surveillance method changed?
  - ▶ New data collector
  - ▶ New data collection tool
- ▶ Has the case finding methods changed?
- ▶ Have laboratory methods changed/improved?
  - ▶ Is there a new diagnostic test?





# Exclude pseudo-outbreaks

- ▶ **False clusters of infection**
  - ▶ Recovery of a specific micro-organism from clinical specimens in the absence of any evidence of infection
  - ▶ Contamination of clinical specimens
    - ▶ Collection/handling
    - ▶ Laboratory procedures
- ▶ **Real clusters of infection**
  - ▶ May be a chance clustering of unrelated cases in space and time



# Pseudo-outbreaks

## ▶ False Cluster

▶ May - Aug 1981

▶ 38 positive BC/18 patients - *Serratia marcescens*

▶ Patients rarely showed clinical symptoms

▶ Occurrence was random

▶ Multiple wards and units involved

▶ More on Mondays and Thursdays

▶ Some patients had positive → negative → positive results

▶ Skin prep suspected

▶ Alcoholic/chlorhexidine

▶ No growth



# Pseudo-outbreaks

- ▶ **False Cluster.....**
  - ▶ Number > in haematology/oncology ward
    - ▶ Screening BCs Mon & Thurs
  - ▶ Hypothesis - skin carriage
    - ▶ Venipuncture sites inspected
      - ▶ Bruising noted from previous venipuncture
      - ▶ Anticoagulant therapy
      - ▶ Frequent prothrombin time blood samples
  - ▶ Retrospective review of pathology records
    - ▶ BCs/prothrombin time specimen collected at the same time





# Pseudo-outbreaks

- ▶ Blood collection process
  - ▶ Some staff placing blood in prothrombin tube before BC bottles
  - ▶ End of syringe sometimes touched internal surface of prothrombin tube
- ▶ Prothrombin tube
  - ▶ Sodium citrate
    - ▶ *Serratia marcescens*
- ▶ Immediate withdrawal of tubes
  - ▶ Autoclaved tubes only
  - ▶ Outbreak terminated
  - ▶ Re-training in BC collection methods
- ▶ Shortly after:
  - ▶ New sodium citrate tubes (UK)
  - ▶ Micro and culture
    - ▶ *Acinetobacter* sp
    - ▶ *Pseudomonas maltophilia*





# Case definitions

## ▶ Case definition

- ▶ Review medical records of potential cases to formulate a case definition
  - ▶ Simple or complex
  - ▶ May evolve as more information becomes known
  - ▶ Uncertainty in the diagnosis
    - ▶ “definite” and “possible”

## ▶ Include:

- ▶ Who is affected (person)
- ▶ Where cases were occurring (when)
- ▶ Time period over which the cases occurred (time)
- ▶ Setting (place)
- ▶ Confirmatory laboratory tests, if available

# Case definitions

- ▶ **Include.....**
- ▶ Clinical information about the disease/infections
  - ▶ Signs and symptoms
  - ▶ Diarrhoea, vomiting or both
  - ▶ Type of infection
    - ▶ Bloodstream infection
  - ▶ Organism
- ▶ Case definitions are important to allow early identification of cases and implementation of control measures and limiting the risk of transmission
- ▶ Sometimes case definitions may be set by others
  - ▶ WHO, Health departments
    - ▶ SARs, MERs, H1N1

# Examples - case definitions

**7NEWS** LOCATION: Melbourne, Vic [Change](#)

Just In Australia World Business Sport Science Arts Analysis Fact Che

Print Email Facebook Twitter More

## Norovirus outbreak hits patients, staff at Royal Hobart Hospital paediatric ward

Updated 7 Jun 2017, 5:11pm

The Royal Hobart Hospital has been hit with an outbreak of norovirus in its paediatric ward, according to the State Government.

The current outbreak has affected patients and staff.

A spokesman said the Royal was managing the spread of the virus, including restricting access to the ward.

Visitors are restricted to immediate family but admissions have not been stopped.

The Health Department information on norovirus states it is sometimes called gastric flu or winter vomiting but "happens all year round".

"Norovirus is the most common cause of outbreaks of gastroenteritis (gastro) in Australia and worldwide."

### Hospital staff also hit by virus

Infectious diseases physician at the Royal Hobart Hospital, Dr Tara Anderson, said an outbreak management plan was in place.

"This has included isolation of patients, restricting visitors to the ward, enhanced environmental cleaning and with these measures in place we would hope that we have a reduction in numbers of patients and staff affected over the next 48 to 72 hours," she said.

Dr Anderson said about 20 patients were currently in the ward.

"We have nine patients who have had gastro-like illnesses and six staff members," she said.



PHOTO: Norovirus is highly contagious, with good hygiene the best preventative measure. ((StockPhoto/timsa))

MAP: Hobart 7000



7 Jun 2017, 5:11pm <http://www.abc.net>

## CASE DEFINITION VIRAL GASTROENTERITIS

Patients or staff with:

- Diarrhoea - Three or more loose stools in a 24 hour period

OR

- Vomiting - two or more episodes in a 24 hour period

OR

- Diarrhoea and Vomiting - one or more episodes of BOTH symptoms in a 24 hour period

But excluding:

- Long standing diarrhoea associated with disability or other medical cause and incontinence diarrhoea associated with ingestion of laxative drugs

## OUTBREAK THRESHOLD

Two or more cases in a room, area or ward/unit with dates of onset within 7 days of each other



# The infection control “detective”

- ▶ Look for additional cases
  - ▶ Review medical records, microbiology, pathology, ward/unit, pharmacy and infection control records (surveillance data)
  - ▶ Apply the case definition consistently and without bias
  - ▶ Seek assistance from other healthcare workers to identify cases
  - ▶ Observe what is happening
    - ▶ “Shoe leather” infection control
  - ▶ Keep good records during your investigation



**Confirm an outbreak is  
occurring**

# Epidemic Curve

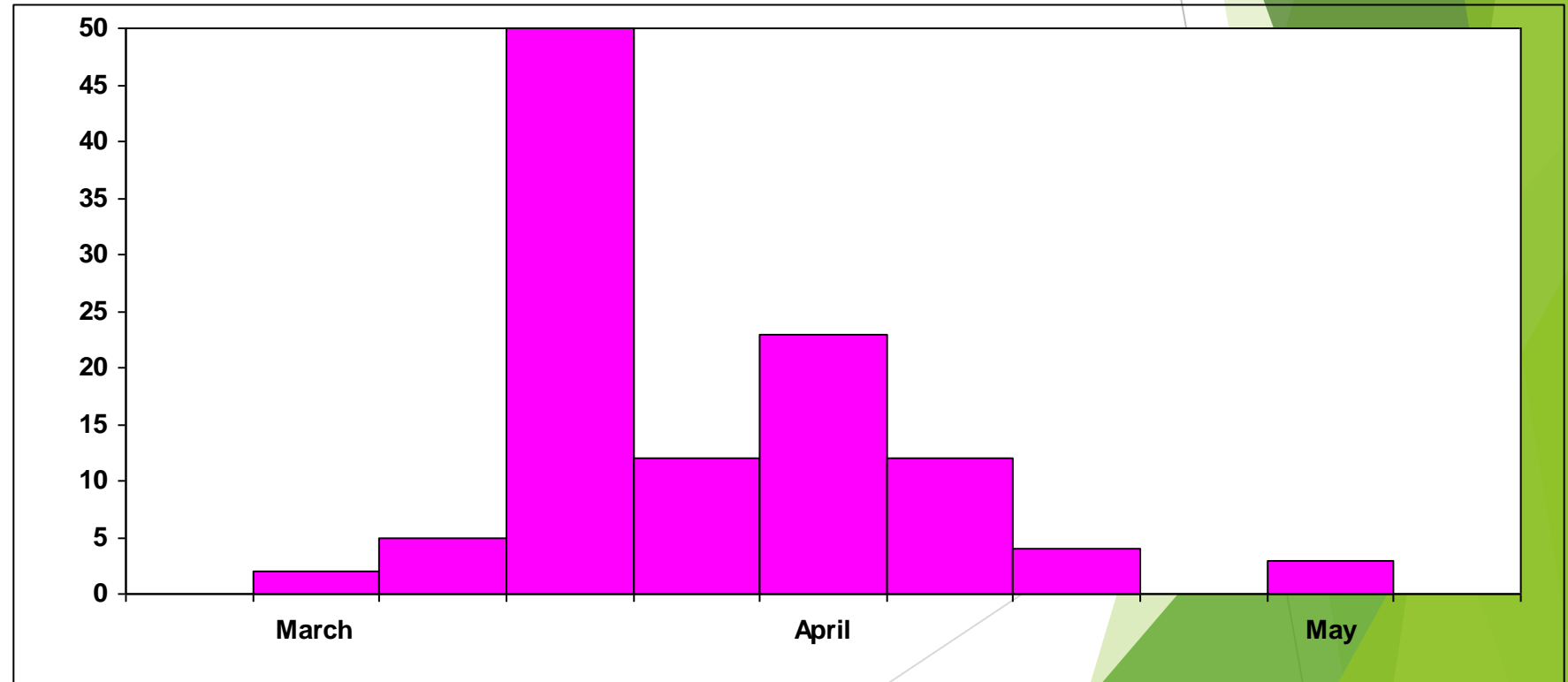
- ▶ Shows the time course
- ▶ Visual display
- ▶ Identifies where you are in the course of the outbreak
- ▶ May be able to estimate time periods of exposure (known source)
- ▶ Epidemic patterns
  - ▶ Common source exposure
  - ▶ Person to person spread
  - ▶ Both



# Epidemic Curve - person to person spread

## ▶ Scabies

- ▶ The number of cases increases slowly, levels off and then slowly decreases
- ▶ Time interval between cases may suggest the incubation period

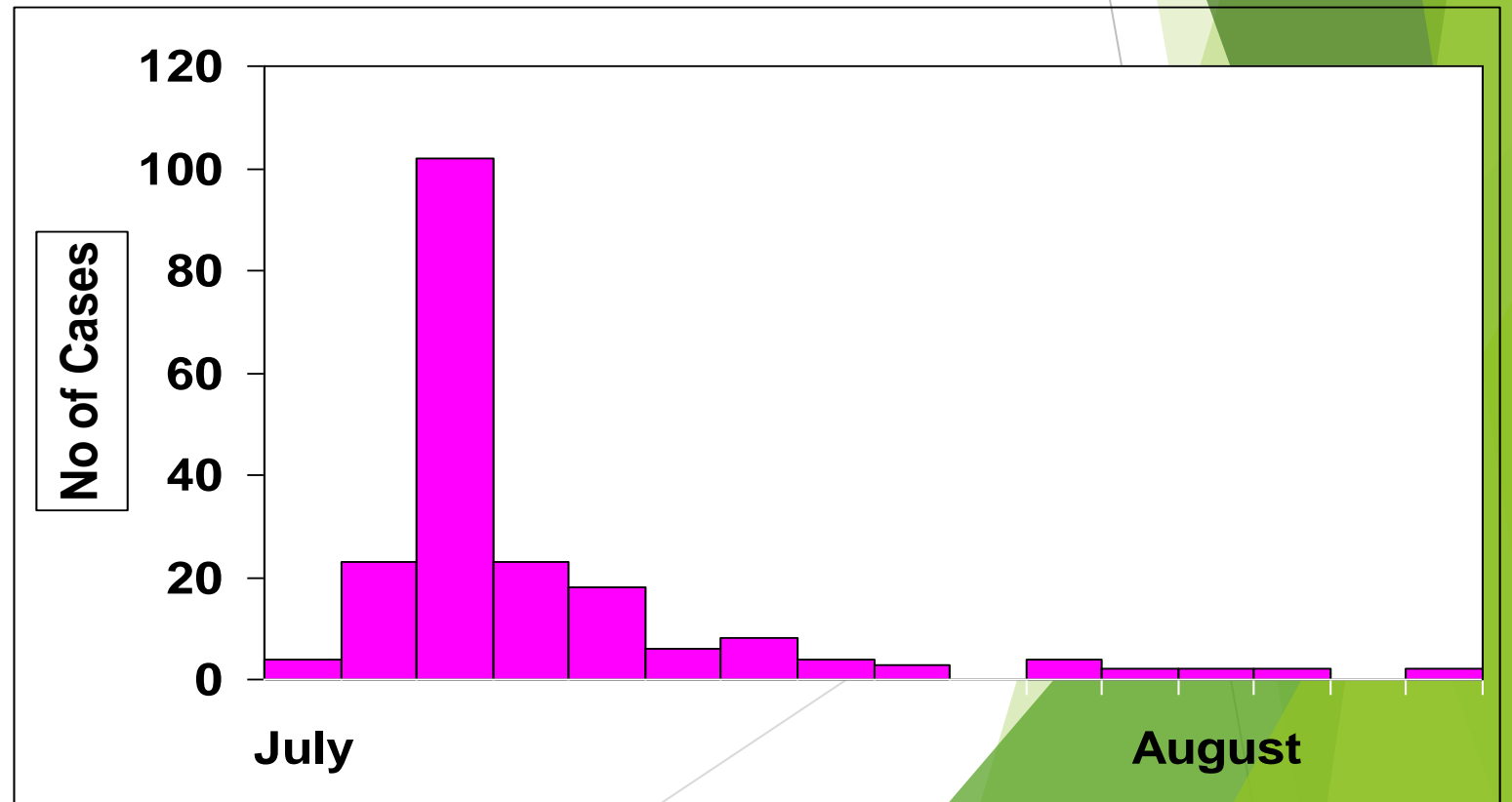


# Epidemic Curve - point sources

- ▶ **Salmonella foodborne outbreak**
  - ▶ The number of cases rises and falls rapidly
  - ▶ Transmission is from a point or a common source
  - ▶ All the cases occur within 1 incubation period

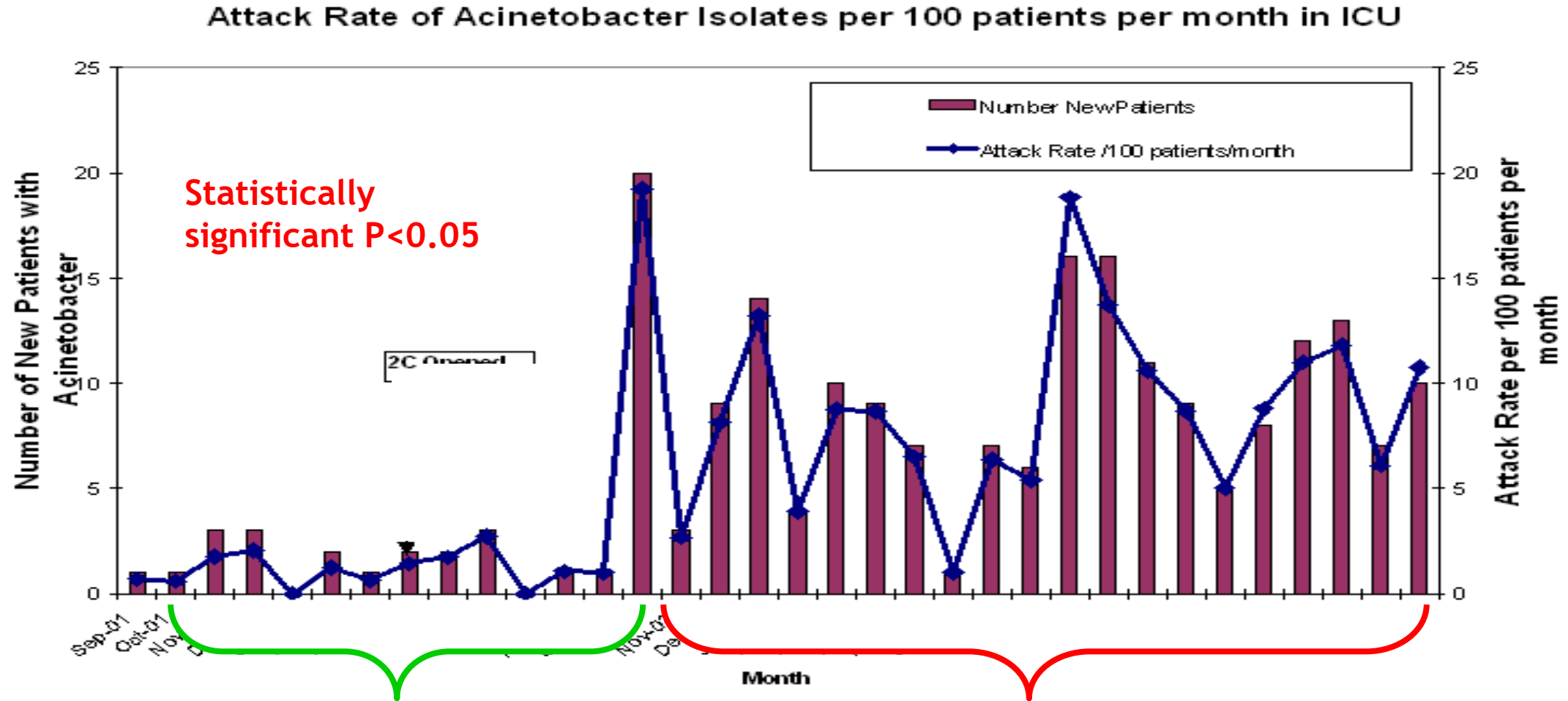
LARGE OUTBREAKS OF *SALMONELLA* TYPHIMURIUM PHAGE TYPE 135 INFECTIONS ASSOCIATED WITH THE CONSUMPTION OF PRODUCTS CONTAINING RAW EGG IN TASMANIA

Nicola Stephens, Cameron Sault, Simon M Firestone, Diane Lightfoot, Cameron Bell



# Confirm an outbreak is occurring

- ▶ Compare pre-epidemic and epidemic periods



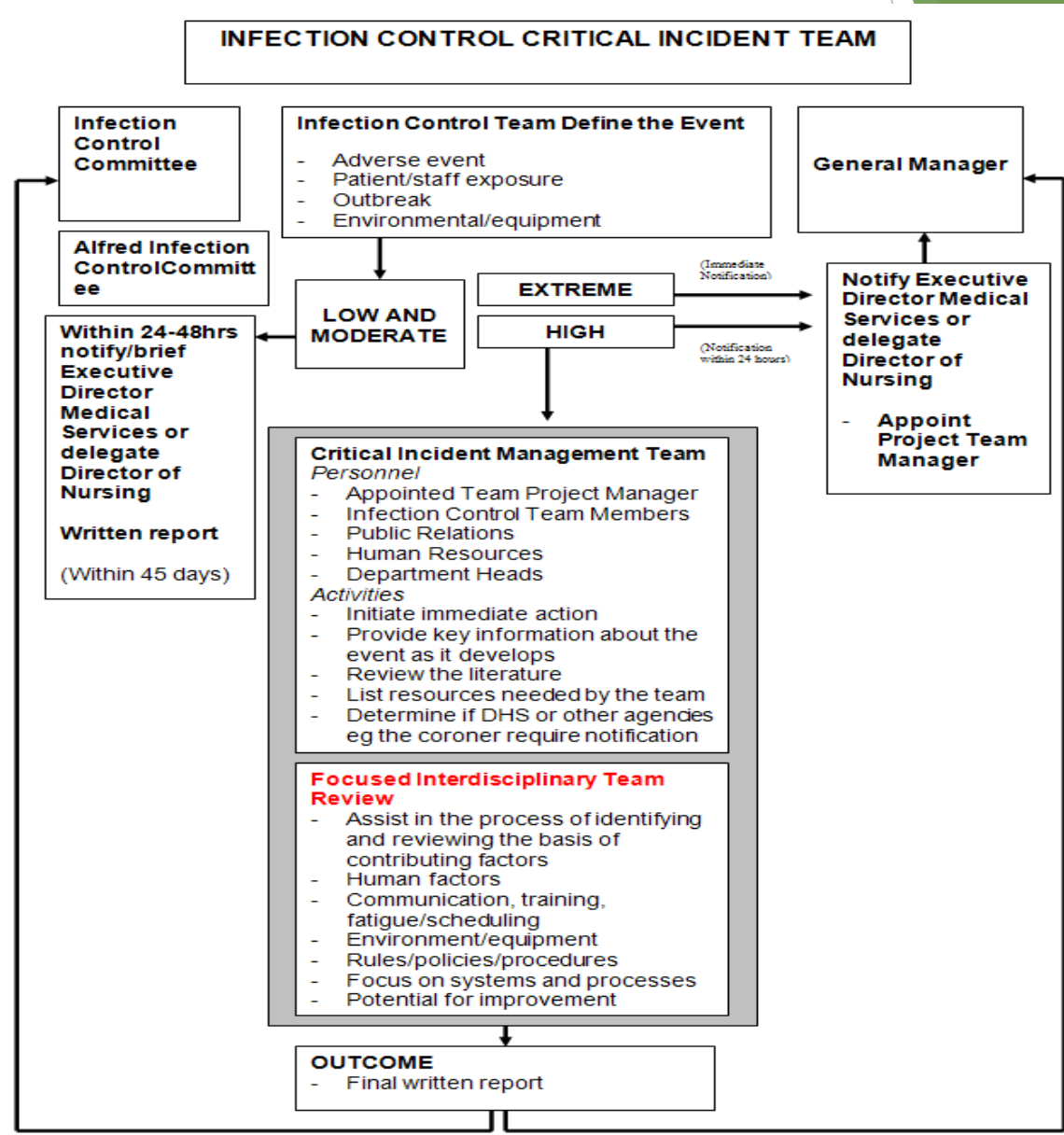
# Establishing an Outbreak Control Team

## • Outbreak Control Team

- Immediate or continuing hazard
- One or more cases of serious disease
- Large numbers of cases
- Involvement of one or more HCF

## ▶ Outbreak Control Team

- ▶ Focal point for flow of information
- ▶ Coordination of investigations
- ▶ Develop
  - ▶ Intervention strategies
  - ▶ Communicate strategies
- ▶ Determine the costs
- ▶ Maintain a log of events
- ▶ Prepare a final report

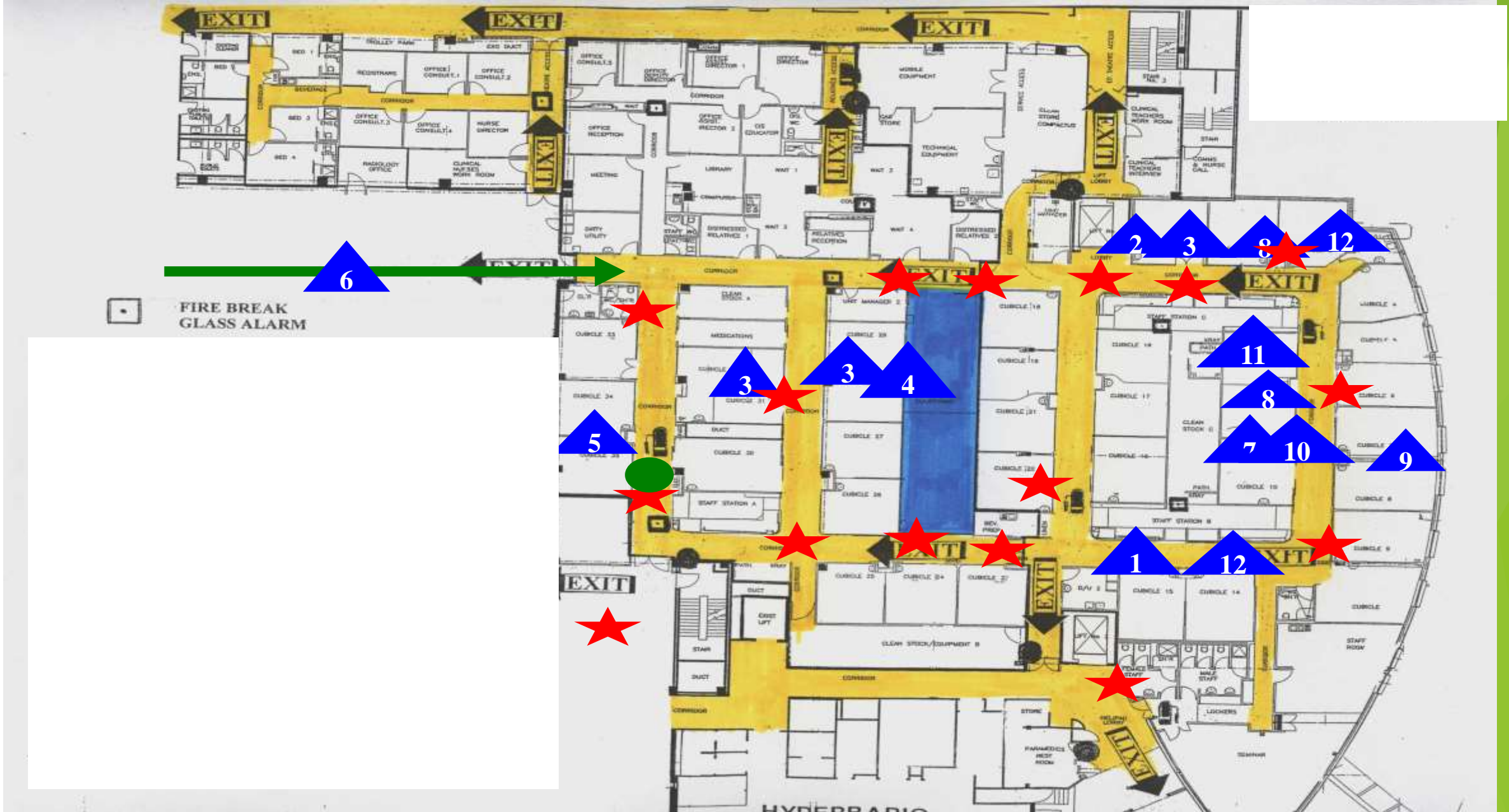




# Spot map - may suggest the location or pattern of transmission



# Spot map - may suggest the location or pattern of transmission





# Establishing an Outbreak Control Team

## ▶ Team representatives

- Executive mgt
- Wards/Unit dept heads
- Infection Control
- Infectious Diseases/Microbiology
- Public Affairs
- Staff Health services\*
- Pharmacy\*\*

## ▶ *\*if outbreak involves staff*

## ▶ *\*\*if outbreak involves drugs/infusions*

## ▶ Team communication

- Administration
- Department heads
- Frequent:
  - Telephone calls
  - Personal briefings



theage.com.au  
THE AGE, AGE

ANZ Business Visa Debit card  
The Small Business Account that's big on features  
Find out more  
ANZ  
We live in your world

jobs @ mycareer  
cars @ drive  
homes @ domain

news  
breaking  
national  
world  
business  
technology  
sport  
realfooty  
entertainment  
science

features:  
video  
photo galleries

commentary  
opinion  
editorials  
letters  
your say  
cartoons

time out  
adspot  
crosswords  
tv guide

travel  
money  
education

classifieds  
place an ad  
real estate

Home > Features > Science > Article

### Crack team trails killer bug

April 25, 2004

On the hunt: (left to right) Despina Kotsanas, infection control scientist; Dr Deborah Friedman, Southern Health's medical coordinator of infection control; Janet Courtot, consultant nurse; Professor Richard Doherty, head of pediatric infectious disease; Elizabeth Cooper, nursing co-ordinator; Dr Andrew Ramsden, director of newborn intensive care unit; Stephen Blamey, surgeon and chairman of infectious control committee.  
Picture: Wayne Taylor

**Hospital infection control experts are like detectives in white coats at Beaumont.**

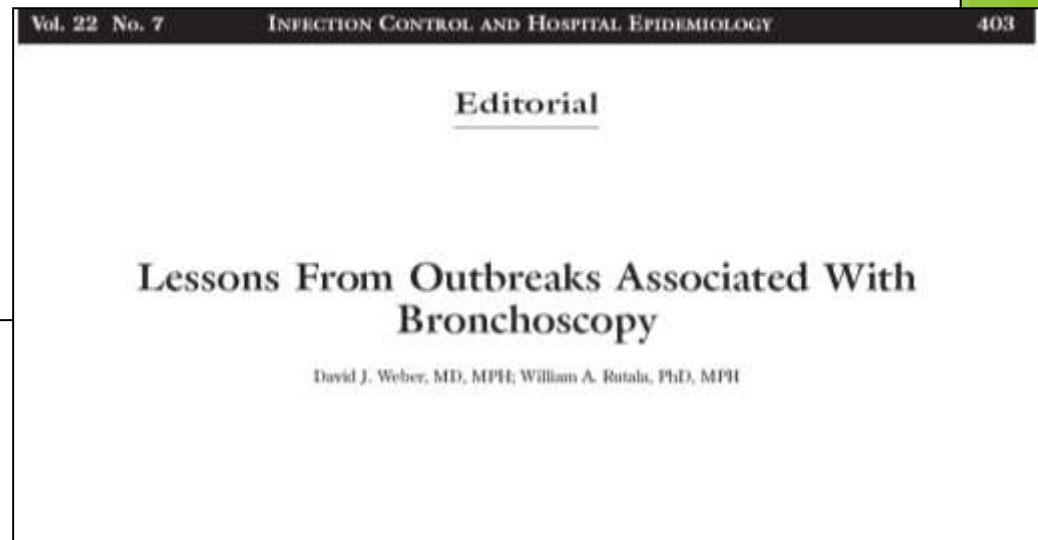
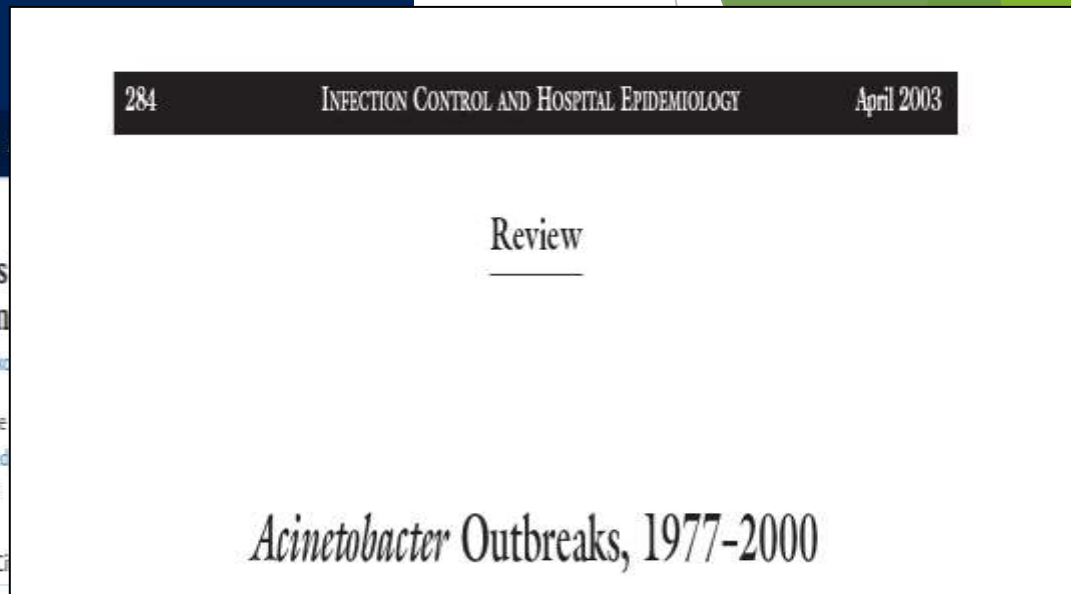
It was much like the perfect crime. The villain sneaked in silently and took the weak. Before staff at Monash Medical Centre knew they had an outbreak of bacteria, it had taken the life of one child and left its mark on three other



# Review of literature and facility Policies/Guidelines - helps to formulate a hypothesis

## ► Literature review

- Previous reports
- Possible reservoirs
- Modes of transmission
- Develop line listing
- Control measures
  - Most effective



Stebbins S et al. Preserving lessons learned in disease outbreaks and other emergency responses. *Journal of Public Health*, Volume 32, Issue 4, 1 Dec 2010, Pages 467-47.

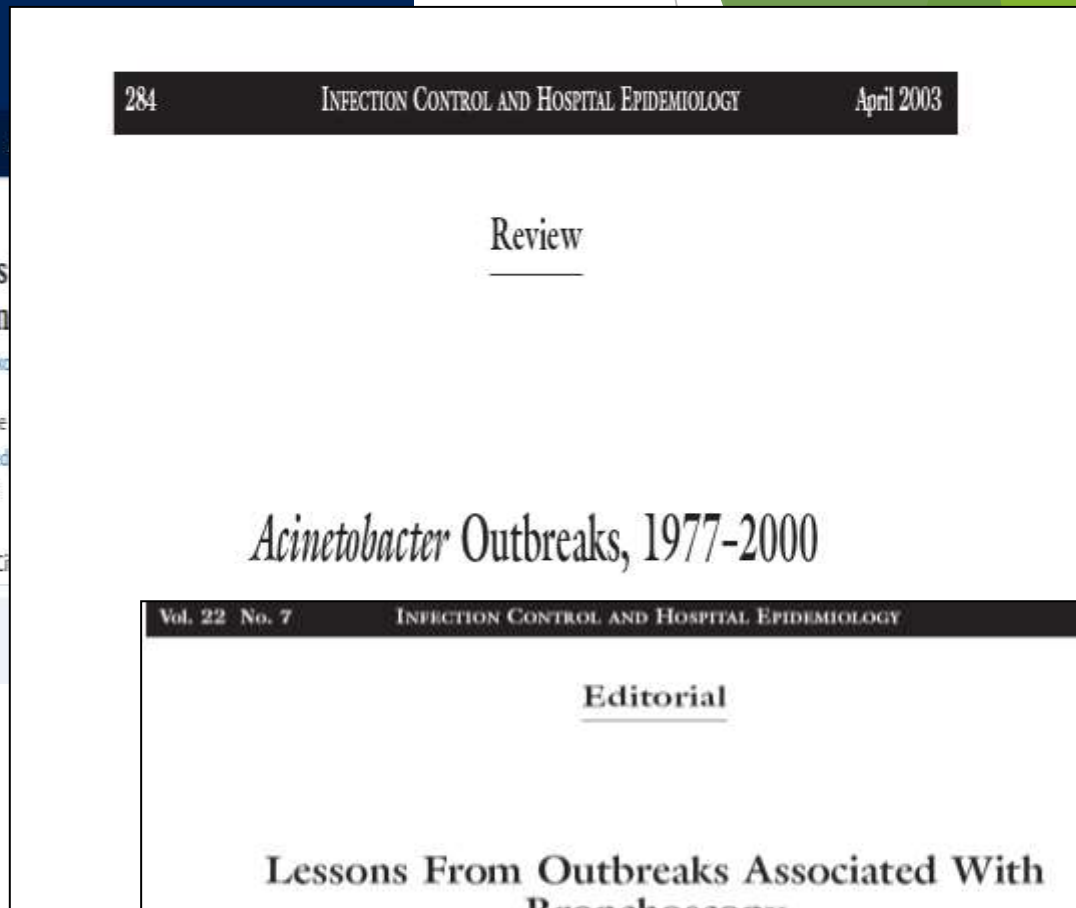
Villegas MV et al. *Acinetobacter* outbreaks, 1977-2000. *ICHE* 2003 Apr;24(4):284-95.

Weber DJ et al. Lessons from outbreaks associated with bronchoscopy. *ICHE* 2001 Jul;22(7):403-8.



# Review of literature and facility Policies/Guidelines - helps to formulate a hypothesis

- ▶ Policies/Guidelines
- ▶ Review with staff
  - ▶ Device use
  - ▶ Invasive procedures
  - ▶ Mechanical ventilation
  - ▶ Wound dressings
  - ▶ Specimen collection
  - ▶ Cleaning and disinfecting
    - ▶ procedures



Stebbins S et al. Preserving lessons learned in disease outbreaks and other emergency responses *Journal of Public Health*, Volume 32, Issue 4, 1 Dec 2010, Pages 467-47.  
Villegas MV et al. *Acinetobacter* outbreaks, 1977-2000. *ICHE* 2003 Apr;24(4):284-95.  
Weber DJ et al. Lessons from outbreaks associated with bronchoscopy. *ICHE* 2001 Jul;22(7):403-8.

# Check on laboratory support

- ▶ Essential that laboratory staff be involved in investigations
  - ▶ Save the isolates
  - ▶ Types of specimens
  - ▶ Help develop the hypothesis
  - ▶ Secular trends of pathogens
    - ▶ Automated or computerised pathogen detection systems



# Check on laboratory support

- ▶ Culture surveys
  - ▶ Epidemiologically directed
    - ▶ Based on the results of your epi investigation
  - ▶ Extensive cultures (personnel/environment) in the absence of epi data
    - ▶ Costly
    - ▶ May implicate the wrong organism/person
    - ▶ May be colonisation rather than true infections





# Check on the laboratory support

- ▶ Laboratory process
  - ▶ Accurate pathogen identification
  - ▶ Antimicrobial sensitivity testing
  - ▶ Assessment for similarity (clonality)
    - ▶ Phenotypic typing
      - ▶ Often lacks discriminatory features
    - ▶ Genotypic methods
      - ▶ Highly discriminatory
  - ▶ Organism the same clone
    - ▶ Supports evidence of a common source
    - ▶ Link between infected patients and reservoir
    - ▶ Link between all patients (clonally related)
    - ▶ The number and distribution of strains
    - ▶ Likely environmental source and mechanism of transmission

Victorian guideline on  
carbapenemase-producing  
*Enterobacteriaceae*

For health services

Version 2

April 2017

**All suspected CPE isolates  
should be referred to the MDU  
PHL for confirmatory testing  
and genomic analysis, unless  
excluded below**



# Line listings

- ▶ A line listing helps identify common exposures
  - ▶ Include:
    - ▶ Name of each patient
    - ▶ Date/s of illness
    - ▶ Location of patient
    - ▶ Initial demographic and exposure data
      - ▶ Gender/age
      - ▶ Underlying diagnosis
      - ▶ Invasive procedures and devices
      - ▶ Medical/surgical unit
- ▶ Data helps formulate a hypothesis
- ▶ Possible mode/s of transmission
- ▶ A line listing can help organize this crucial information and get below the “tip of the iceberg”

**NSW HEALTH**

**Line Listing for Gastroenteritis in an Institution (page 1)**

Name of Facility: \_\_\_\_\_ Total No: residents at facility: \_\_\_\_\_ Type of Aged Care Facility:  Hostel  Nursing Home  
Contact Person: \_\_\_\_\_ Position Title: \_\_\_\_\_ Telephone No: \_\_\_\_\_ Fax No: \_\_\_\_\_ Email: \_\_\_\_\_  
PHU Notified  (tick) Date Reported to PHU: \_\_\_\_\_ Date First Case: \_\_\_\_\_ Unique name/number for outbreak: \_\_\_\_\_

CASE DETAILS					DESCRIPTION OF ILLNESS				SPECIMEN		OUTCOME		
Case No.	Full Name	DOB & Age (yrs)	Gender (M or F)	Staff (S) or Resident (R)	Current Ward or Room	Date of Onset	Time of Onset	Length of Illness (hrs)	Symptoms (see key below)	Specimen Collected (Y/N) If Yes, specify type	Date Specimen Collected	Result (specify name of bacteria, virus, parasite or toxin)	Seen by Dr (Dr) Hospitalised (H) Died (D)

Symptoms Key: V=Vomiting D=Diarrhoea BD=Bloody Diarrhoea F=Fever>38.5C

Information Pack for Gastroenteritis in an institution September 2009

# Line listings

## Guidelines for the Prevention and Control of Influenza Outbreaks in Residential Care Facilities for Public Health Units in Australia

### Appendix 4: Respiratory Outbreak Line Listing - Residents ONLY

Part A – Residents ONLY

Name of Facility: .....						Name of Outbreak: .....					
DETAILS						SYMPTOMS					
ID	Surname, First Name	Location (unit/section)	Sex	Age	Flu vaccine (date)	Pneumococcal vaccine (date)	Onset (date)	Fever = or >38°C (Y/N)	Cough (Y/N)	Fatigue (Y/N)	Other Symptoms (state)

Key: (Y=Yes, N=No, U=Unknown)

**All line listings should include the components of the case definition**

Up to [Historical publications](#)

[TOC](#) | [n](#)

#### Table of contents

[Disclaimer](#)

[Acknowledgements](#)

[Preface](#)

[How to use this document](#)

[Summary Flow Chart](#)

[Chapter 1: Introduction](#)

[Chapter 2: Preventing Outbreaks](#)

[Chapter 3: Outbreak and Case Definitions](#)

[Chapter 4: Investigation and Management of Outbreaks](#)

[Chapter 5: References](#)

[Appendices](#)

[Appendix 1: Environmental Cleaning](#)

# Line listings



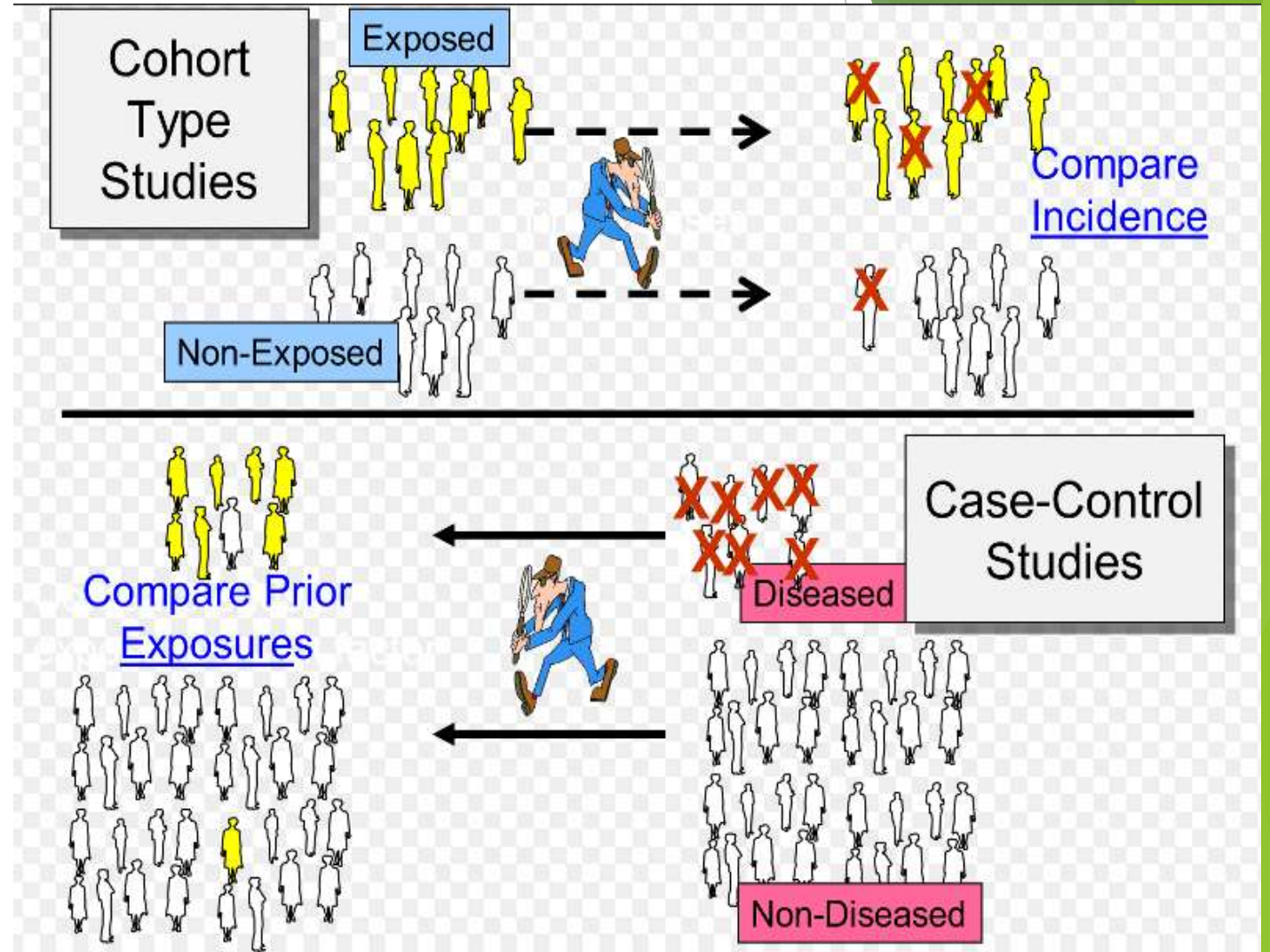
## Line Listing for Gastroenteritis in an Institution (page 1)

Name of Facility: \_\_\_\_\_ Total No: residents at facility: \_\_\_\_\_ Type of Aged Care Facility:  Hostel  Nursing Home  
 Contact Person: \_\_\_\_\_ Position Title: \_\_\_\_\_ Telephone No: \_\_\_\_\_ Fax No: \_\_\_\_\_ Email: \_\_\_\_\_  
 PHU Notified  (tick) Date Reported to PHU: \_\_\_\_\_ Date First Case: \_\_\_\_\_ Unique name/number for outbreak: \_\_\_\_\_

CASE DETAILS						DESCRIPTION OF ILLNESS				SPECIMEN			OUTCOME
Case No.	Full Name	DOB & Age (yrs)	Gender (M or F)	Staff (S) or Resident (R)	Current Ward or Room	Date of Onset	Time of Onset	Length of Illness (hrs)	Symptoms (see key below)	Specimen Collected (Y/N) If Yes, specify type	Date Specimen Collected	Result (specify name of bacteria, virus, parasite or toxin)	Seen by Dr (Dr) Hospitalised (H) Died (D)

# How to evaluate your hypothesis

- ▶ Seek advice/assistance
  - ▶ Statistician
  - ▶ Epidemiologist/epidemiology experience
- ▶ Utilise statistical packages
  - ▶ Epi-Info
- ▶ Control for confounding
  - ▶ Can affect the strength ( $p$ -value)
  - ▶ Can affect the magnitude of the measure of association

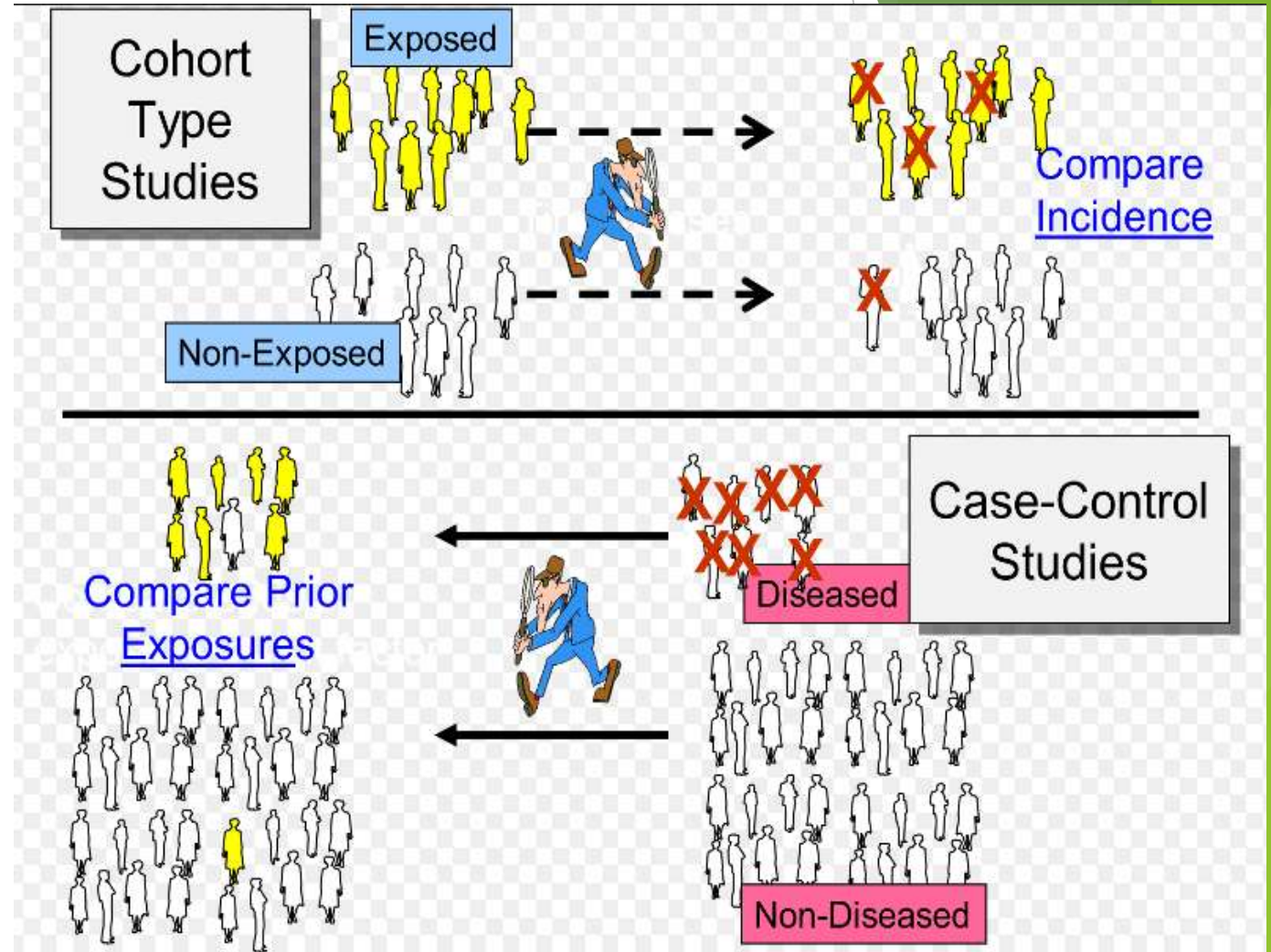




# How to evaluate your hypothesis - Cohort Study

## ► The cohort study

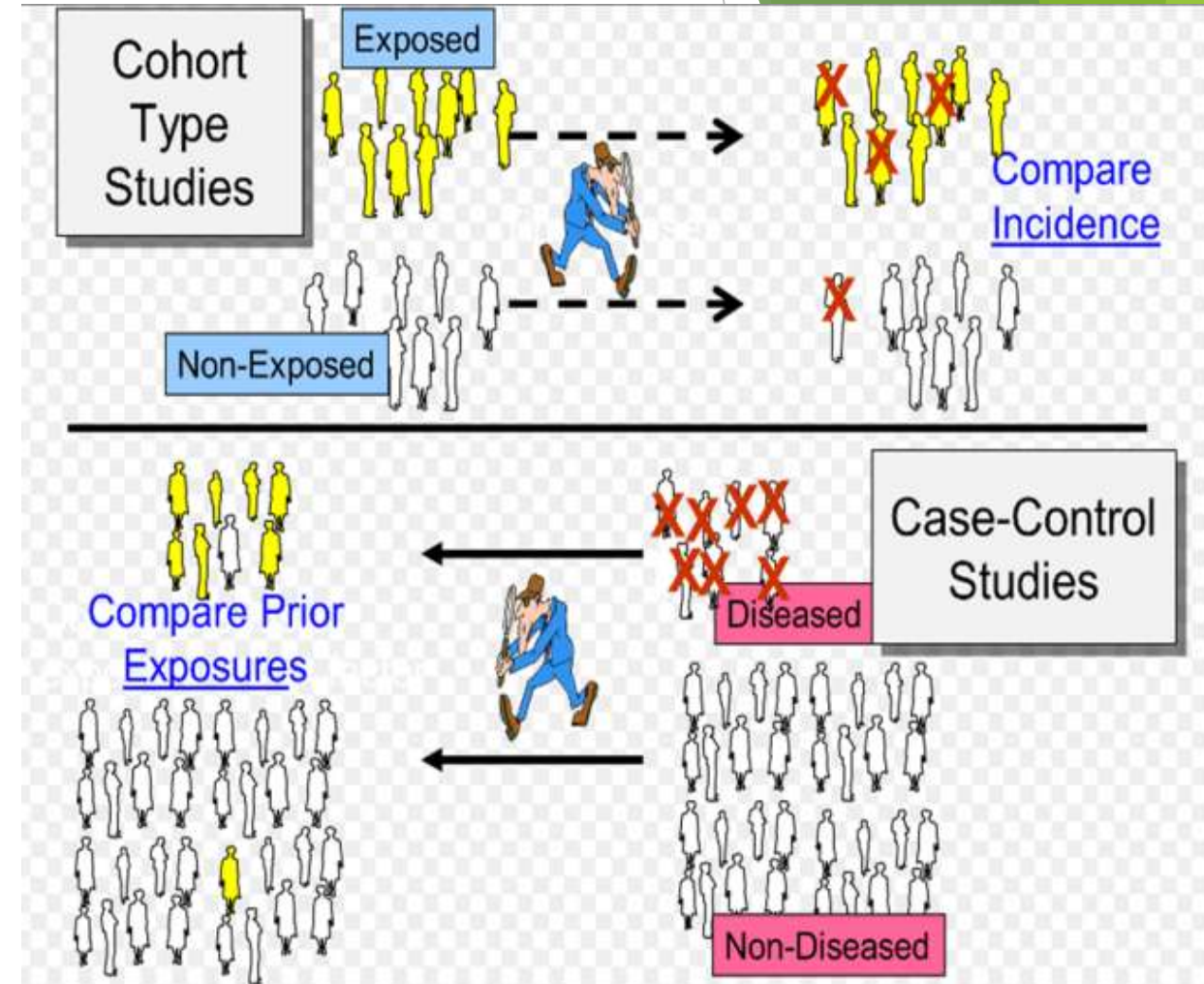
- People exposed to a particular factor and a comparison group that was not exposed
- Measures and compares the incidence of disease in the two groups
- A higher incidence of disease in the exposed group suggests an association
- Generally a good choice when dealing with an outbreak in a relatively small, well-defined source population
- Particularly if the disease being studied was fairly frequent



# How to evaluate your hypothesis -Case control study

## ► Case Control study

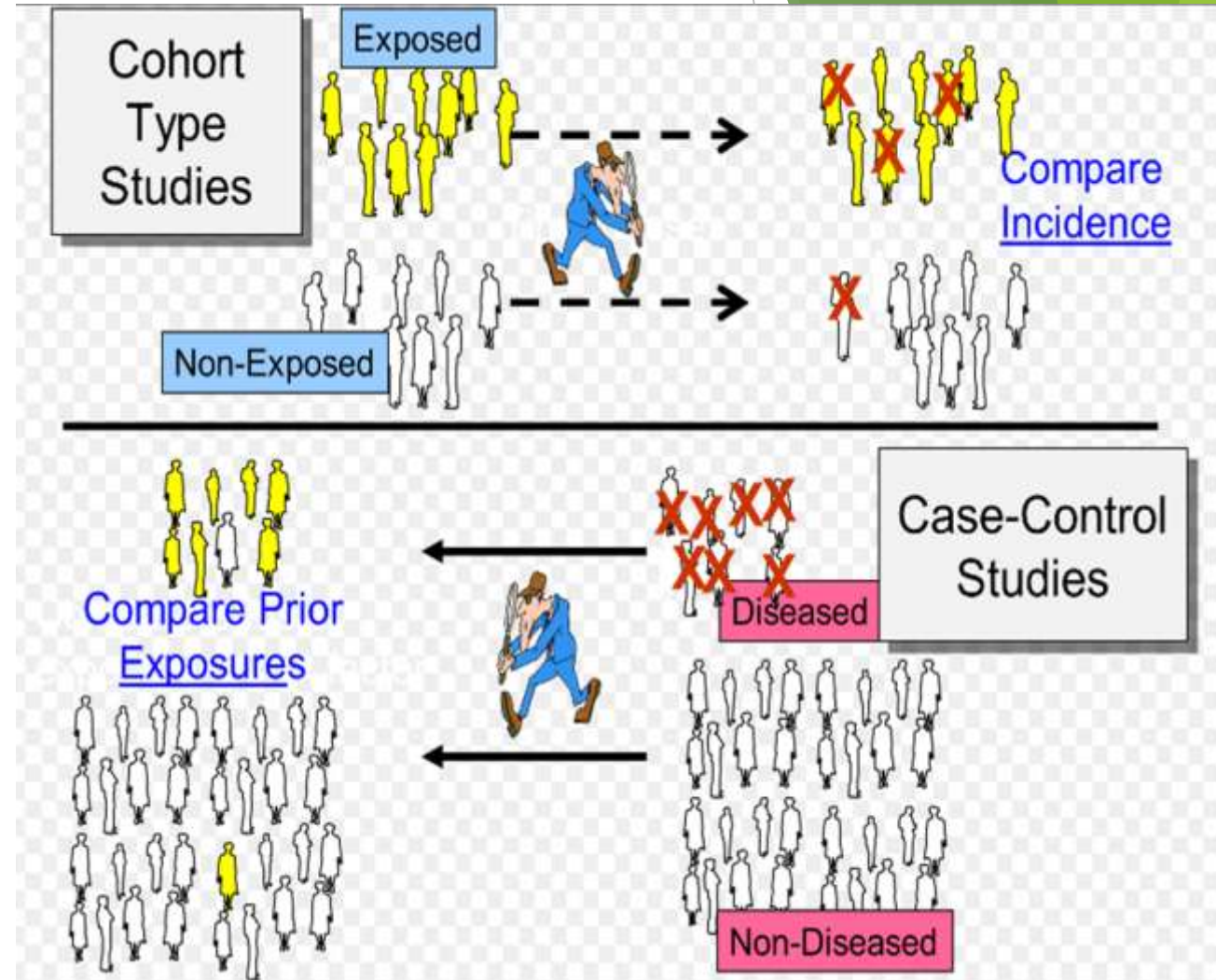
- In some outbreaks the population may not be well defined
  - Cohort studies not feasible
  - Use Case Control
- Ask the same questions in relation to cases and controls
- The mathematical measure of association to quantify the relationship between exposure and disease is:
  - “Odds ratio (OR)”
    - Contrasts the odds of exposure among cases with the odds of exposure among controls
- Does not prove the exposure caused the disease
- Helpful in evaluating the source of the disease





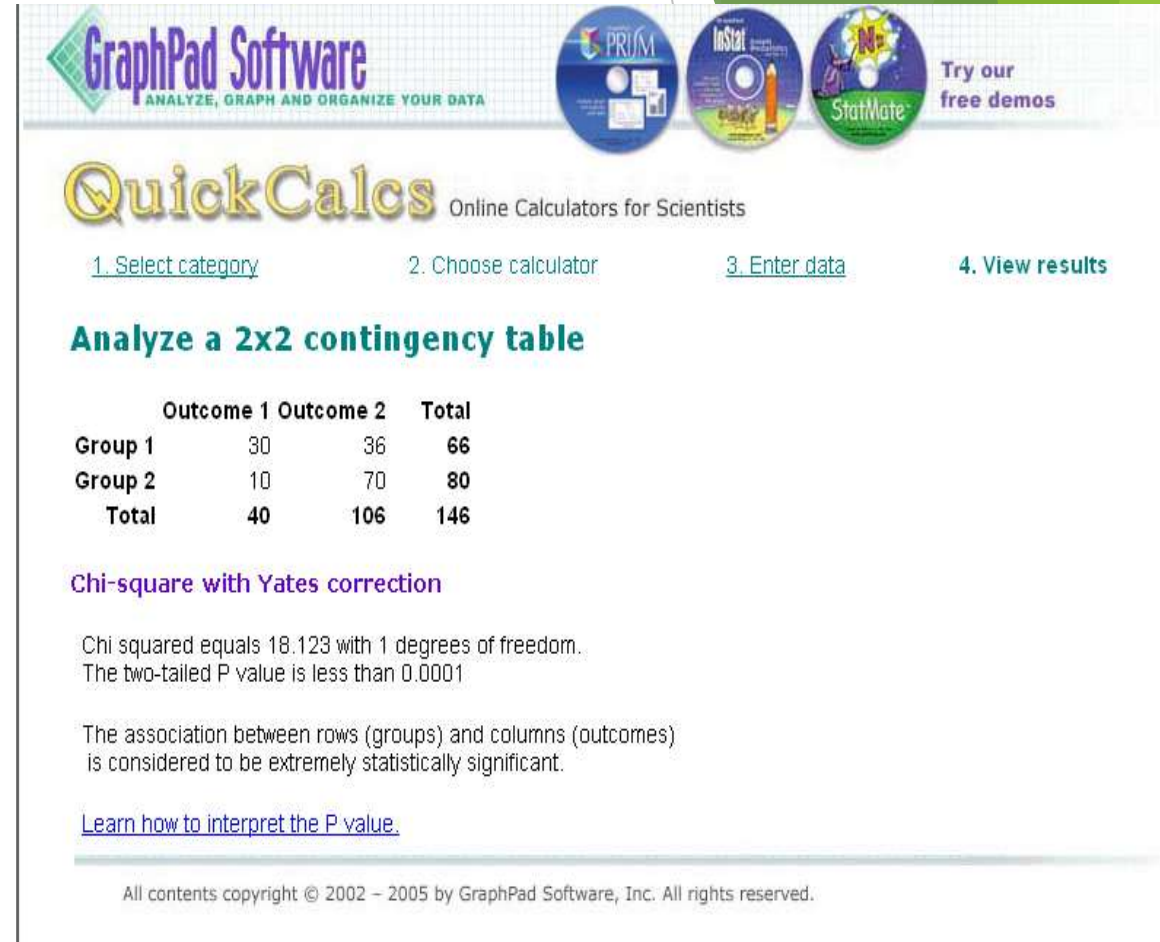
# How to evaluate your hypothesis -Case control study

- ▶ **Case Control study**
- ▶ Identifies a group of individuals who had developed the disease (the cases) and a comparison of individuals who did not have the disease of interest
- ▶ The cases and controls are then compared with respect to the frequency of one or more past exposures
- ▶ If the cases have a substantially higher odds of exposure to a particular factor compared to the control subjects, it suggests an association
- ▶ This strategy is a better choice when the source population is large and ill-defined, and it is particularly useful when the disease outcome was uncommon



# How to evaluate the hypothesis - testing statistical significant

- ▶ The mathematical measure of association to quantify the relationship between exposure and disease is:
  - ▶ “Odds ratio (OR)”
    - ▶ Contrasts the odds of exposure among cases with the odds of exposure among controls
  - ▶ Does not prove the exposure caused the disease
- ▶ Test for statistical significance
  - ▶ **Chi-square and Fishers Exact test**
- ▶ Common cut off point .05
- ▶ When the p-value is below .05
  - ▶ Statistically significant
  - ▶ The smaller the p-value the stronger the significance



GraphPad Software  
ANALYZE, GRAPH AND ORGANIZE YOUR DATA

PRIM InStat StatMate Try our free demos

## QuickCalcs

Online Calculators for Scientists

1. [Select category](#)
2. [Choose calculator](#)
3. [Enter data](#)
4. [View results](#)

### Analyze a 2x2 contingency table

	Outcome 1	Outcome 2	Total
Group 1	30	36	66
Group 2	10	70	80
Total	40	106	146

Chi-square with Yates correction

Chi squared equals 18.123 with 1 degrees of freedom.  
The two-tailed P value is less than 0.0001

The association between rows (groups) and columns (outcomes) is considered to be extremely statistically significant.

[Learn how to interpret the P value.](#)

All contents copyright © 2002 – 2005 by GraphPad Software, Inc. All rights reserved.

Online statistical calculators

<http://www.graphpad.com/quickcalcs/>



# Interventions/control measures

## ▶ Control measures

- ▶ Need to be flexible
- ▶ May need to be changed/revised as the situation unfolds

## ▶ Implementation:

- ▶ Before all information is available or
- ▶ Studies completed

## ▶ Isolation

- ▶ Designated room/area separating cases from non-cases

## ▶ Cohorting

- ▶ Cases sharing rooms
- ▶ Designated staffing

## ▶ Support of local administration/management

- ▶ Authority to investigate and enforce control measures
- ▶ Resources
  - ▶ staffing
  - ▶ funding



# Interventions/control measures

- ▶ **Observe/review infection control practices and procedures**
  - ▶ Hand washing
  - ▶ Isolation precautions
  - ▶ Sterilisation and disinfection
  - ▶ Suspend certain procedures
  - ▶ Removal or disposal of certain equipment or medications
- ▶ **Decisions to close a ward should be on a case-by-case basis**
  - ▶ Risk from the outbreak vs the benefits of continued care (i.e. ICU)
- ▶ **Reporting/notification requirements**
  - ▶ Local, state or federal government
- ▶ **Government and non government organisations**
  - ▶ Provide guidance
  - ▶ Provide personnel for onsite assistance

# Assess the efficacy of interventions/control measures

- ▶ **Ongoing surveillance and follow-up**
  - ▶ Confirm the end of the outbreak
  - ▶ Establish a new baseline
    - ▶ Comparison for the future
- ▶ **Evaluate**
  - ▶ Outbreak investigation process
  - ▶ Control measures
  - ▶ Cost
  - ▶ Compliance
  - ▶ Acceptability of intervention

# Communicating findings

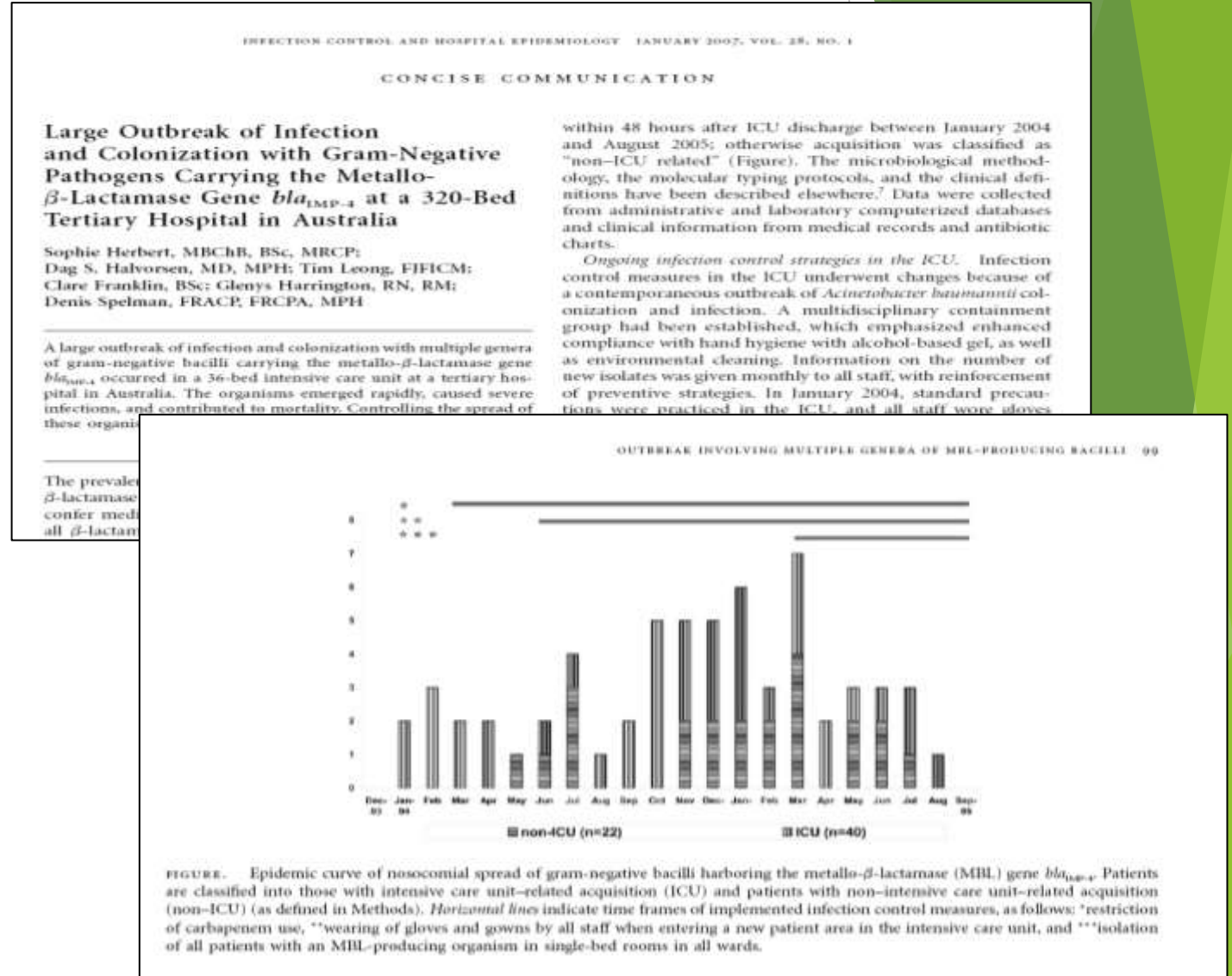
- ▶ Those who need to know
  - ▶ Oral briefings
  - ▶ Written reports
    - ▶ Describe what you did
    - ▶ What you found
    - ▶ What you think should be done
  - ▶ Be scientific and objective
  - ▶ Should be able to defend your conclusions and recommendations
- ▶ Outbreak reports
  - ▶ What we did
  - ▶ What we found
  - ▶ What we learned
- ▶ Consider publishing your outbreak and findings

The image shows a screenshot of a journal article page. At the top left is the logo for CMI (Clinical Microbiology and Infection). At the top right is the logo for ESCMID (European Society for Clinical Microbiology and Infectious Diseases) with the text "Explore this journal >". Below the logos, the word "Review" is displayed. The main title of the article is "Combating the spread of carbapenemases in *Enterobacteriaceae*: a battle that infection prevention should not lose". The authors listed are P. Savard and T. M. Perl. Below the authors, it says "First published: 11 August 2014" and "DOI: 10.1111/1469-0691.12748". There is also a "Cited by (CrossRef): 1 article" and an "Am score" of 5. The article is categorized as a "RESEARCH ARTICLE". The title of the article is "Outbreak of Multidrug Resistant NDM-1-Producing *Klebsiella pneumoniae* from a Neonatal Unit in Shandong Province, China". The authors are Yan Jin, Chunhong Shao, Jian Li, Hui Fan, Yuanyuan Bai, and Yong Wang. It was published on March 23, 2015, with the DOI link: https://doi.org/10.1371/journal.pone.0119571. Below the title and authors, there is a navigation bar with tabs for "Article", "Authors", "Metrics", "Comments", and "Related Content". The "Article" tab is selected. The "Abstract" section is visible, starting with "Introduction" and "Materials and Methods". The abstract text reads: "Despite worldwide dissemination of New Delhi metallo-β-lactamase 1 (blaNDM-1), outbreaks remain uncommon in China. In this study, we describe the characteristics of the outbreak-related blaNDM-1-producing *K. pneumoniae* isolates in a neonatal unit in Shandong province, China. We recovered 21 non-repetitive carbapenem-resistant *K. pneumoniae* isolates with a positively modified Hodge test (MHT) or EDTA synergistic test from patients and environmental samples in Shandong provincial hospital. Pulsed-field gel electrophoresis (PFGE) and multilocus sequence typing (MLST) data show *K. pneumoniae* isolates from 19 patients were clonally related and belong to the clonal groups ST20 and ST17. We note two outbreaks, the first caused by ST20 during August 2012 involving four patients, and the second caused by ST20 and ST17 during January 2012 and September 2013 involving fourteen patients. We found the bed railing of one patient was the source of the outbreak. We verified the presence of the blaNDM-1 gene in 21 *K. pneumoniae* isolates. The genes blaCTX-M-15, blaCTX-M-14,



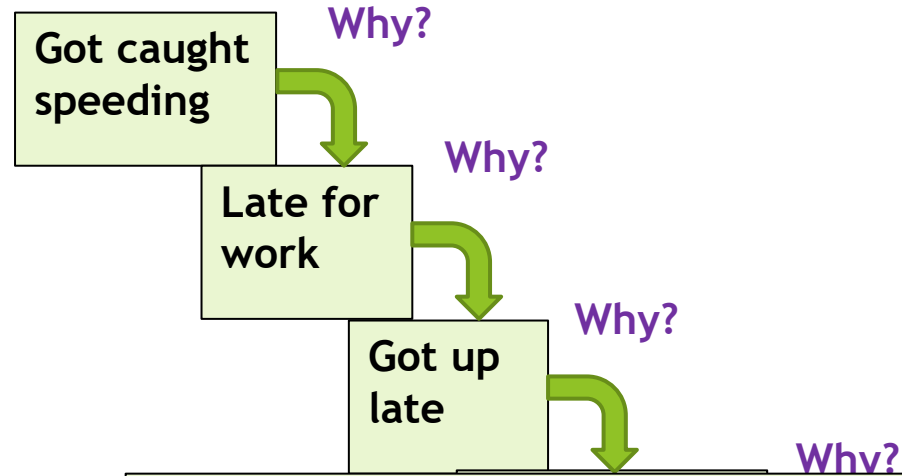
# Communicating findings

- ▶ Written report
  - ▶ Introduction
  - ▶ Background
  - ▶ Methods
  - ▶ Results
  - ▶ Discussion
  - ▶ Recommendations
- ▶ Outcome
  - ▶ Blueprint for action
  - ▶ Record of performance
  - ▶ Documentation for potential legal actions
  - ▶ Reference for others who experience similar problems in the future
- ▶ Publication
  - ▶ Contributes to the scientific knowledge base



# WHAT IS ROOT CAUSE ANALYSIS (RCA)?

- ▶ A root cause is a factor that caused a non conformance and should be permanently eliminated through process improvement
- ▶ Root cause analysis (RCA) is a tool
- ▶ Seeks to identify the origin of a problem using a specific set of steps
  - ▶ Determine what happened
  - ▶ Determine why it happened
  - ▶ Figure out what to do to reduce the likelihood that it will happen again



**By repeatedly asking the question “why?” you can peel away the layers of an issue and get to the root cause of the problem.**

**Keep asking why until you reach an actionable level.**

# WHAT IS ROOT CAUSE ANALYSIS (RCA)?

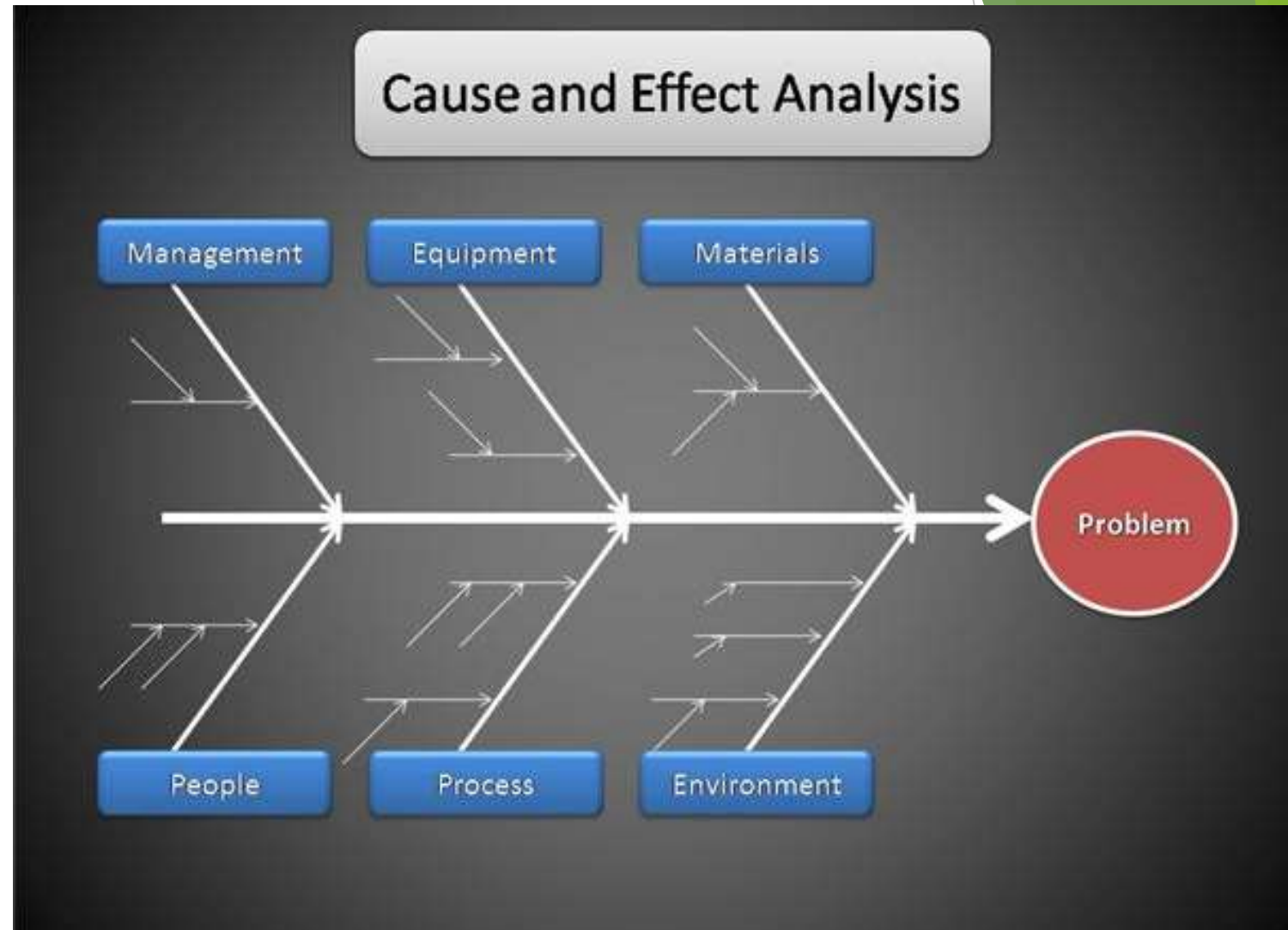
- ▶ You'll usually find three basic types of causes:
- ▶ **Physical causes**
  - ▶ Tangible, material items failed in some way
- ▶ **Human causes**
  - ▶ People did something wrong, or did not do something that was needed
- ▶ **Organizational causes**
  - ▶ A system, process, or policy that people use to make decisions or do their work is faulty



# Understanding a problem

## ► Steps:

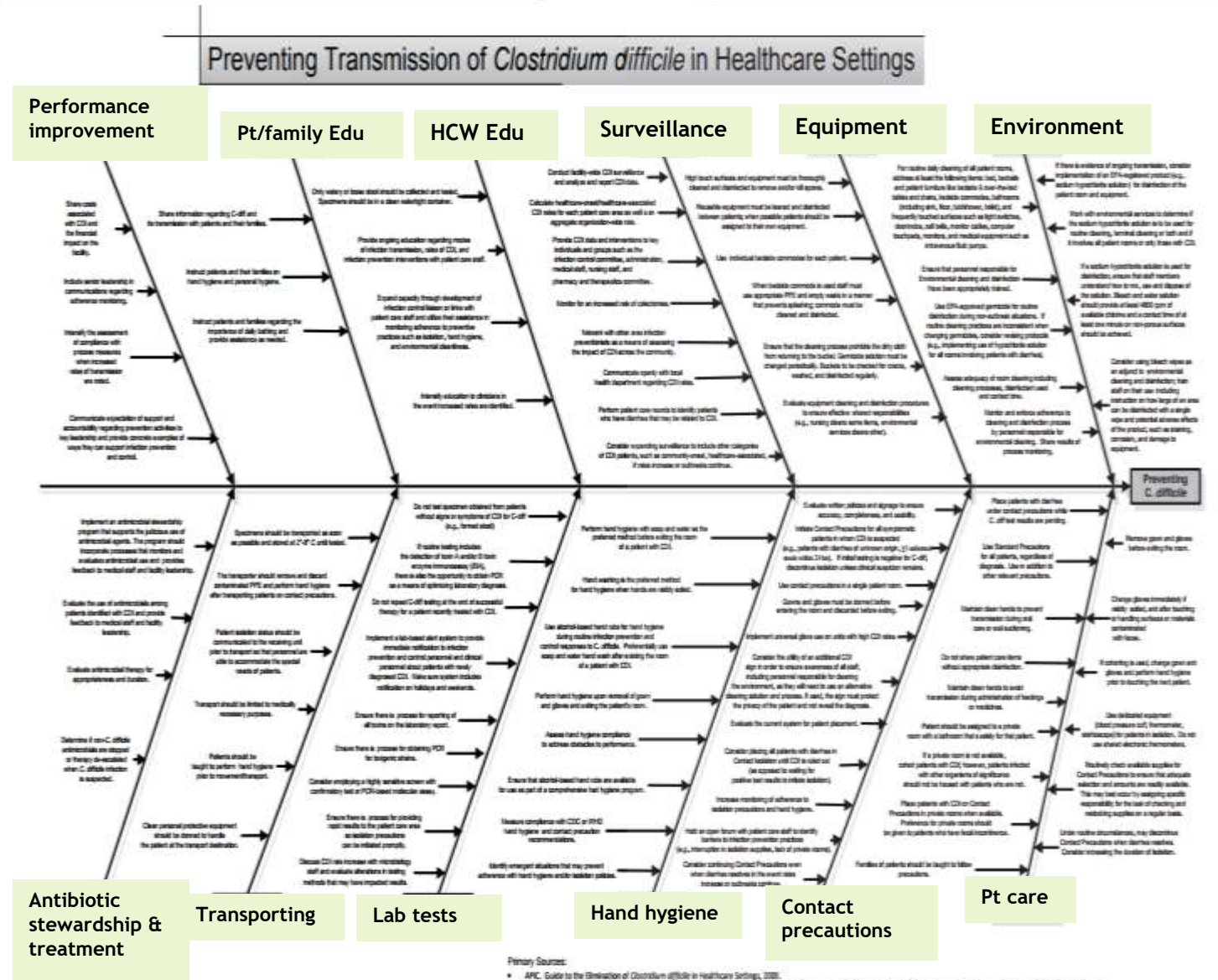
- Problem understanding
- Problem cause brainstorming
- Problem cause data collection
- Problem cause data analysis
- Root cause identification
- Route cause elimination
- Solution implementation





# Understanding a problem

- ▶ **Multidisciplinary team**
  - ▶ Small team supplemented by line manager with decision authority
    - ▶ QI expert if other members of the team have limited experience
  - ▶ Trained in RCA methodology
  - ▶ Use RCA tools
    - ▶ Brainstorming
    - ▶ Flowchart
    - ▶ Cause & effect diagram (Fishbone)
  - ▶ **Involve those who know the problem best in solving the problem!**
- ▶ Map the process to illustrate where problems occur and which problems should be solved
- ▶ Drill down
- ▶ Rank improvement actions/ideas
  - ▶ Objective, measurable
- ▶ Implement your improvement plan



Compiled by Ruth Cantor, PhD RN, CC, University of Louisville, School of Public Health and Information Sciences (Ruth.cantor@louisville.edu), April 2011.

Primary Sources:

- APIC. Guide to the Elimination of Clostridium difficile in Healthcare Settings, 2008.
- Dublerstein E, Savelle DA, Clouse J, Aron A, Padgugis K, et al. Strategies to Prevent Clostridium difficile Infections in Acute Care Hospitals. ICHE, October 2009, Vol. 29, Supp 1, S91-S92.
- APIC. Clostridium difficile (CDI) Infections Toolkit. Activity C. EIC Prevention Collaboratives, 2009.
- Cohen SH, Barling BA, Johnson S, Kelly CP, Loo VG, McDonald JC, Peplin J, Wilson KH. Clinical practice guidelines for Clostridium difficile infection in adults: 2010 update by the Society for Healthcare Epidemiology of America (SHEA) and the Infectious Diseases Society of America (IDSA). Infect Control Hosp Epidemiol. 2010;135(12):2705-2732.

# ROOT CAUSE ANALYSIS TO SUPPORT INFECTION CONTROL

- ▶ ICT that correctly uses RCA implements:
  - ▶ More effective prevention measures
  - ▶ Improves practice and collaborative working
  - ▶ Enhances teamwork and
  - ▶ Reduces the risk of HCAI

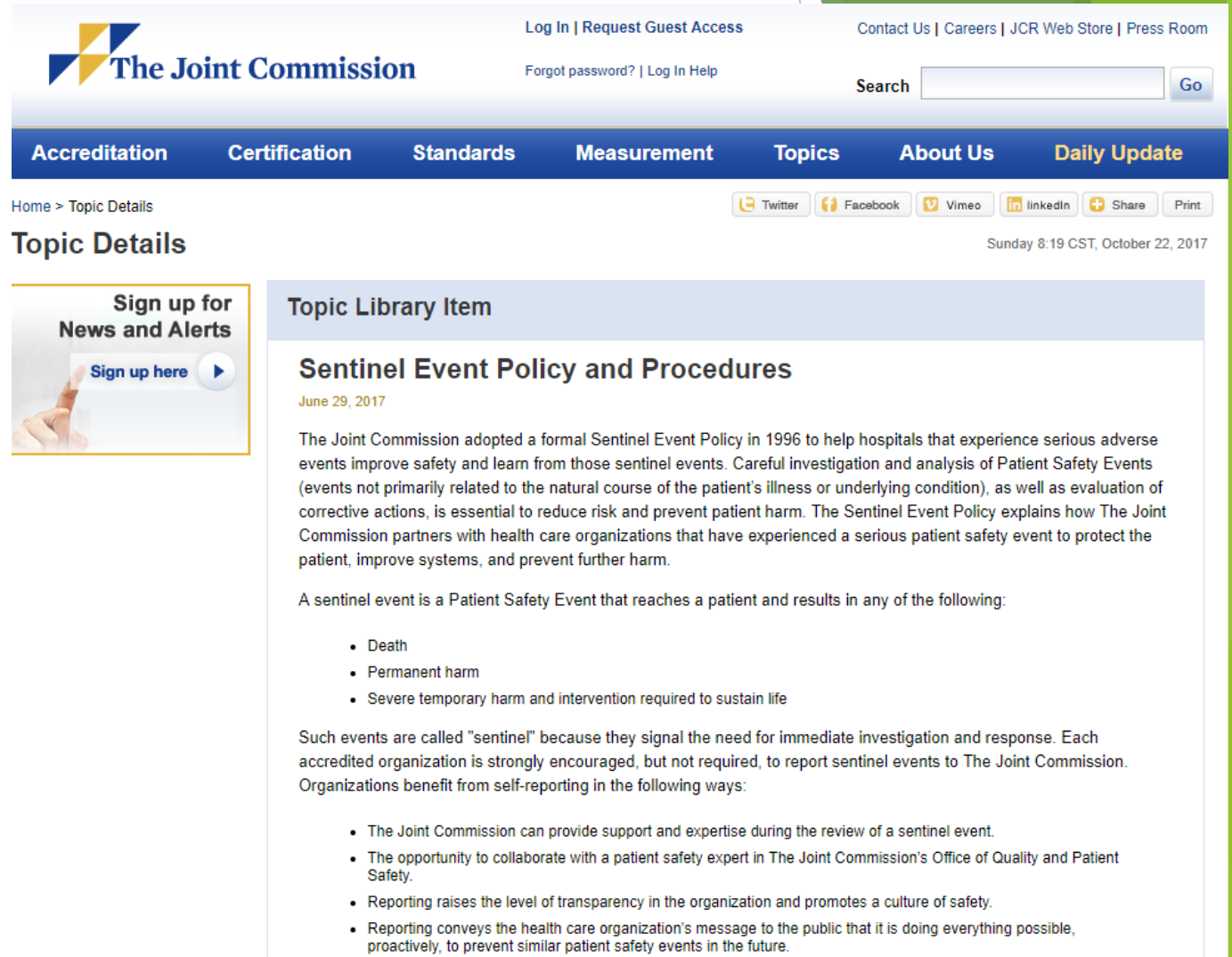


The screenshot shows the journal's header with the title 'THE JOURNAL OF HOSPITAL INFECTION' and a logo. Below the header is a navigation bar with links for 'Articles and Issues', 'Collections', 'Press Releases', 'For Authors', 'Journal Info', 'HIS Info', and 'Subscribe'. A search bar is present with a dropdown menu set to 'All Content' and a 'Search' button. The article information bar indicates the current article is from 'April 2015', Volume 89, Issue 4, Pages 331-334. The article title is 'Root cause analysis to support infection control in healthcare premises' by A.-G. Venier, from the South West France HCAI Control Centre (CCLIN Sud-Ouest), Bordeaux University Hospital, F-33000, France. The page includes a PlumX Metrics icon, a DOI link (http://dx.doi.org/10.1016/j.jhin.2014.12.003), a CrossMark logo, and social media icons for Facebook, Twitter, and Email. There are tabs for 'Abstract', 'Full Text', and 'References', with 'Abstract' selected. The 'Summary' section begins with the text: 'Infection control teams (ICTs) seek to prevent healthcare-associated infections (HCAIs). They undertake surveillance and prevention, promote safety and quality of care, and evaluate and manage risk. Root cause

*Venier AG. Root cause analysis to support infection control in healthcare premises. JHI April 2015. Volume 89, Issue 4, Pages 331-334*

# RCA - Key points to remember

- ▶ It is unproductive to apply a complicated problem solving process to common place problems we already know how to solve
- ▶ If you perceive the problem as important and don't know the nature or causes, attack it systematically to ensure that you find the root causes and ultimately eliminate the problem for good
- ▶ The goal is to be proactive rather than reactive
- ▶ To be credible, root cause analysis requires rigorous application of established qualitative techniques
- ▶ Good for sentinel events



The screenshot shows the website for The Joint Commission. The header includes the logo, navigation links (Log In, Request Guest Access, Contact Us, Careers, JCR Web Store, Press Room), and a search bar. The main navigation bar lists Accreditation, Certification, Standards, Measurement, Topics, About Us, and Daily Update. The page title is 'Topic Details' and the date is 'Sunday 8:19 CST, October 22, 2017'. The main content area is titled 'Topic Library Item' and features the article 'Sentinel Event Policy and Procedures' dated June 29, 2017. The article text describes the policy's purpose and lists criteria for sentinel events.

**Sign up for News and Alerts**  
Sign up here ▶

## Topic Library Item

### Sentinel Event Policy and Procedures

June 29, 2017

The Joint Commission adopted a formal Sentinel Event Policy in 1996 to help hospitals that experience serious adverse events improve safety and learn from those sentinel events. Careful investigation and analysis of Patient Safety Events (events not primarily related to the natural course of the patient's illness or underlying condition), as well as evaluation of corrective actions, is essential to reduce risk and prevent patient harm. The Sentinel Event Policy explains how The Joint Commission partners with health care organizations that have experienced a serious patient safety event to protect the patient, improve systems, and prevent further harm.

A sentinel event is a Patient Safety Event that reaches a patient and results in any of the following:

- Death
- Permanent harm
- Severe temporary harm and intervention required to sustain life

Such events are called "sentinel" because they signal the need for immediate investigation and response. Each accredited organization is strongly encouraged, but not required, to report sentinel events to The Joint Commission. Organizations benefit from self-reporting in the following ways:

- The Joint Commission can provide support and expertise during the review of a sentinel event.
- The opportunity to collaborate with a patient safety expert in The Joint Commission's Office of Quality and Patient Safety.
- Reporting raises the level of transparency in the organization and promotes a culture of safety.
- Reporting conveys the health care organization's message to the public that it is doing everything possible, proactively, to prevent similar patient safety events in the future.

# Outbreaks investigation summary

- ▶ **Step 1:** Prepare yourself for outbreak investigations
- ▶ **Step 2:** Establish the existence of an outbreak
- ▶ **Step 3:** Verify the diagnoses
- ▶ **Step 4:** Identify and count cases
- ▶ **Step 5:** Describe and orient the data in terms of time, place and person
- ▶ **Step 6:** Develop hypothesis
- ▶ **Step 7:** Evaluate hypothesis
- ▶ **Step 8:** Refine hypotheses and carry out additional studies
- ▶ **Step 9:** Implementing control and prevention measures
- ▶ **Step 10:** Communicate your findings



# Thankyou

**Glenys Harrington**  
**Consultant**  
**Infection Control Consultancy (ICC)**  
**Melbourne, Australia**  
**[infexion@ozemail.com.au](mailto:infexion@ozemail.com.au)**