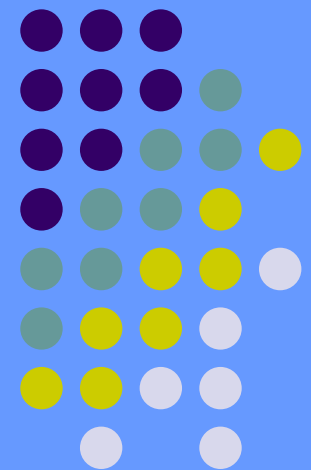


# BASIC CONCEPTS OF INFECTION CONTROL

## Outbreak Management

International Federation of  
Infection Control





# Introduction

- Outbreak investigation reflects knowledge of epidemiology
- Analysis of patterns of disease leads to an understanding of their spread and control
- Outbreaks affect morbidity, cost, and institutional image
- Outbreak investigation may lead to sustained improvement in patient care



# Introduction

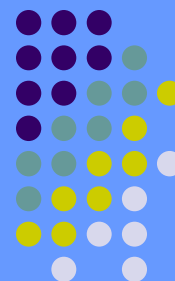
- Early identification of an outbreak important to limit spread
- A potential problem may be identified by healthcare workers or through an infection surveillance program
- Investigations are required to identify the source and to justify control measures



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# Definitions



- *Outbreak or epidemic*
  - Excess over the expected level of a disease within a geographic or spatial area (hospital)
  - One case of an unusual disease may constitute an epidemic
- *Pandemic*
  - An epidemic that spreads in several countries
- *Endemic*
  - The usual level of a disease within a geographic or spatial area (hospital)



# Why Epidemics Occur



- Individuals travel to area where the infectious disease exists
- Humans or animals travel from an endemic area to a susceptible human population
- Contamination of food, water or other vehicles by an agent not normally present
- Pre-existing infection occurs in an area of low endemicity and reaches susceptible persons
- Host susceptibility and response are modified by natural or drug-induced immunosuppression



# Types of Outbreaks



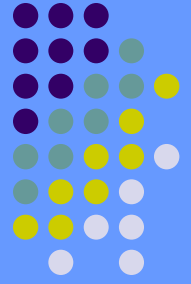
- Community-acquired
  - Water or food borne
  - Other, e.g., measles
- Healthcare-associated
  - Two or more cases of infection which appear to be epidemiologically related
  - Typically related to hand or environmental contamination, invasive devices, procedures



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# Investigating an Outbreak



- Purpose - to identify ways to prevent further transmission of the disease
- Main objectives
  - Identify etiologic agent
  - Find the source of infection
  - Formulate recommendations to prevent further transmission



# Case Definition



- Should be developed
- Must include
  - Unit of time and place
  - Specific biological or clinical criteria
- Inclusion/exclusion criteria must be identified
- Differentiate between infection and colonisation

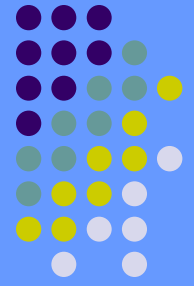




# Example of Case Definition

A patient hospitalized in the geriatric ward  
in January  
with diarrhea, cramps, vomiting  
and in whom culture of faeces  
identifies enterotoxin-producing staphylococci



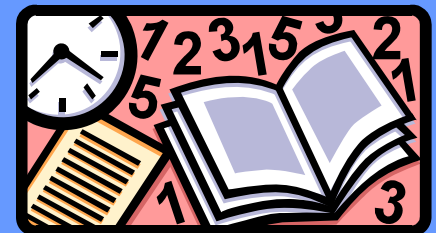


# Relative Risk (RR)

Measure of association between a disease or condition and a factor under study



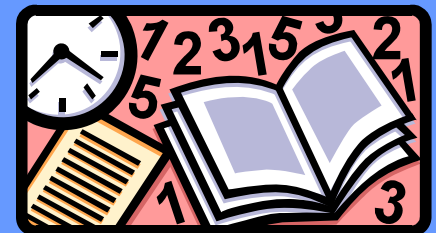
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# Relative Risk (RR)

- Incidence rate of exposed/incidence rate of not exposed
  - RR = 1
    - No association between exposure and disease
  - RR > 1
    - Exposure seems to increase the probability of developing the disease
  - RR < 1
    - Exposure seems to decrease the probability of developing the disease



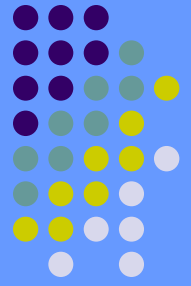


# Outbreak Investigation Tasks

- Verify if an outbreak really exists
  - Compare current cases with the baseline incidence
  - If local data not available, compare to information of national surveillance systems or the literature
- Define cases based on common factors:
  - Population risk factors: e.g., age, race, sex
  - Clinical data
  - Laboratory results



# Outbreak Investigation Tasks



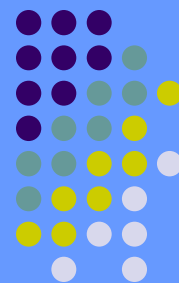
- Search for other cases that may have occurred retrospectively or concurrently
- Characterize cases
  - Assemble and organize in terms of time, place, and person



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# Outbreak Investigation Tasks



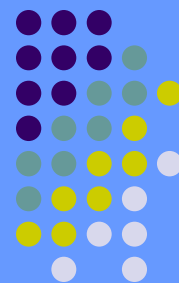
- Characterize cases by *Time*
  - The exact period of the outbreak
  - The probable period of exposure
  - Date of onset of illness for cases
  - Epidemic curve
  - Common source or propagated



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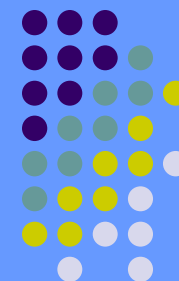
# Outbreak Investigation Tasks



- Characterize cases by *Place*
  - Service, ward, operating room
  - Clustering of cases
- Characterize cases by *Person*
  - Patient characteristics (age, sex, underlying disease)
  - Possible exposures (surgery, staff, patients)
  - Therapeutic modalities (procedures, medications, devices)



# Outbreak Investigation Tasks



- Calculate rates
  - Incidence rate
    - Number of new cases during a specified period of time /  
Number of persons exposed to the risk during that period  
of time
  - Attack rate
    - Number of people at risk who are infected /  
Total number of people at risk
  - Rates can be stratified by
    - Sex
    - Age
    - Location
    - Specific exposure: ventilation, catheterization,  
operating rooms, or occupational exposure



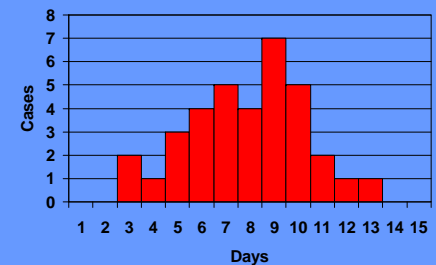
# Determining the Source of Infection in an Outbreak



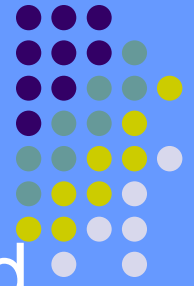
- Common source (single –point source)
  - Same origin (same person or vehicle)
- Propagated or continuing source (ongoing transmission)
  - Infections are transmitted from person to person
- Both common and propagated source (intermittent source)
  - Intermittent exposure to a common source produces an epidemic curve with irregularly spaced peaks



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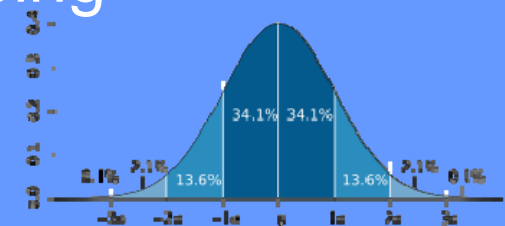
# Epidemic Curve



- The character of an epidemic is determined by an epidemic curve
- Reasons for constructing an epidemic curve
  - To determine whether the source of infection was common, propagated, or both
  - To identify the probable time of exposure of the cases to the source (s) of infection
  - To identify the probable incubation period
  - To determine if the problem is ongoing



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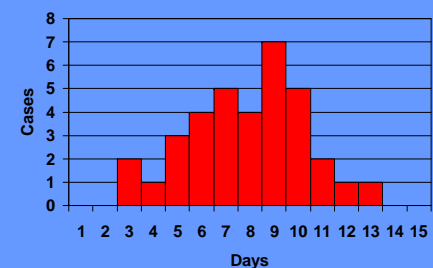
# Epidemic Curve Characteristics



- An epidemic curve is a histogram
- Cases are plotted by date of onset of illness
- Time intervals (on the X axis) based on the incubation or latency period of the disease and the length of the period over which cases are distributed



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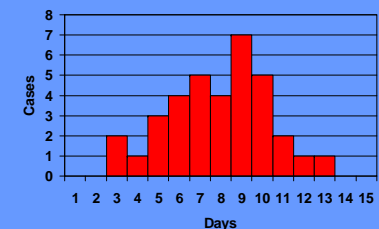
# Common vs Propagated Source



- Common source
  - Curve approximates to a normal distribution curve
  - Exposure may be continuous or intermittent
    - Intermittent exposure to a common source produces a curve with irregularly spaced peaks
- Propagated source
  - Cases occur over a long period
  - Explosive epidemics due to person-to-person transmission may occur (i.e., chickenpox)
  - If secondary and tertiary cases occur, intervals between peaks approximate the average incubation period



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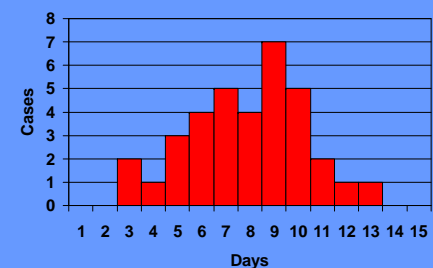
# Probable Period of Exposure in Common-Source Outbreaks



- Necessary information
  - Specific disease involved
  - Mean or minimum and maximum incubation period(s)
  - Date of onset of cases
- Calculate
  - Using the mean or median incubation period
  - Using minimum and maximum incubation periods

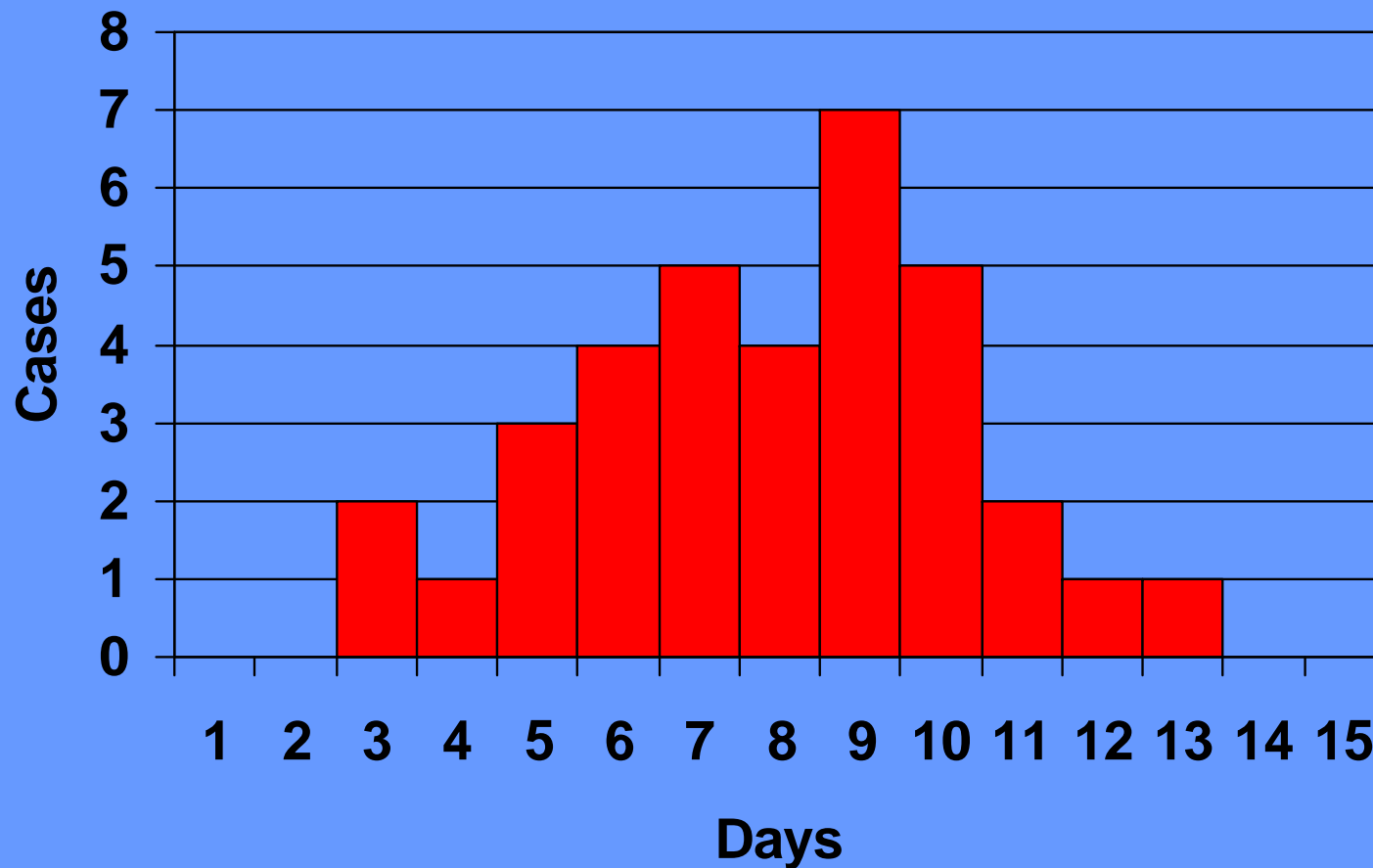


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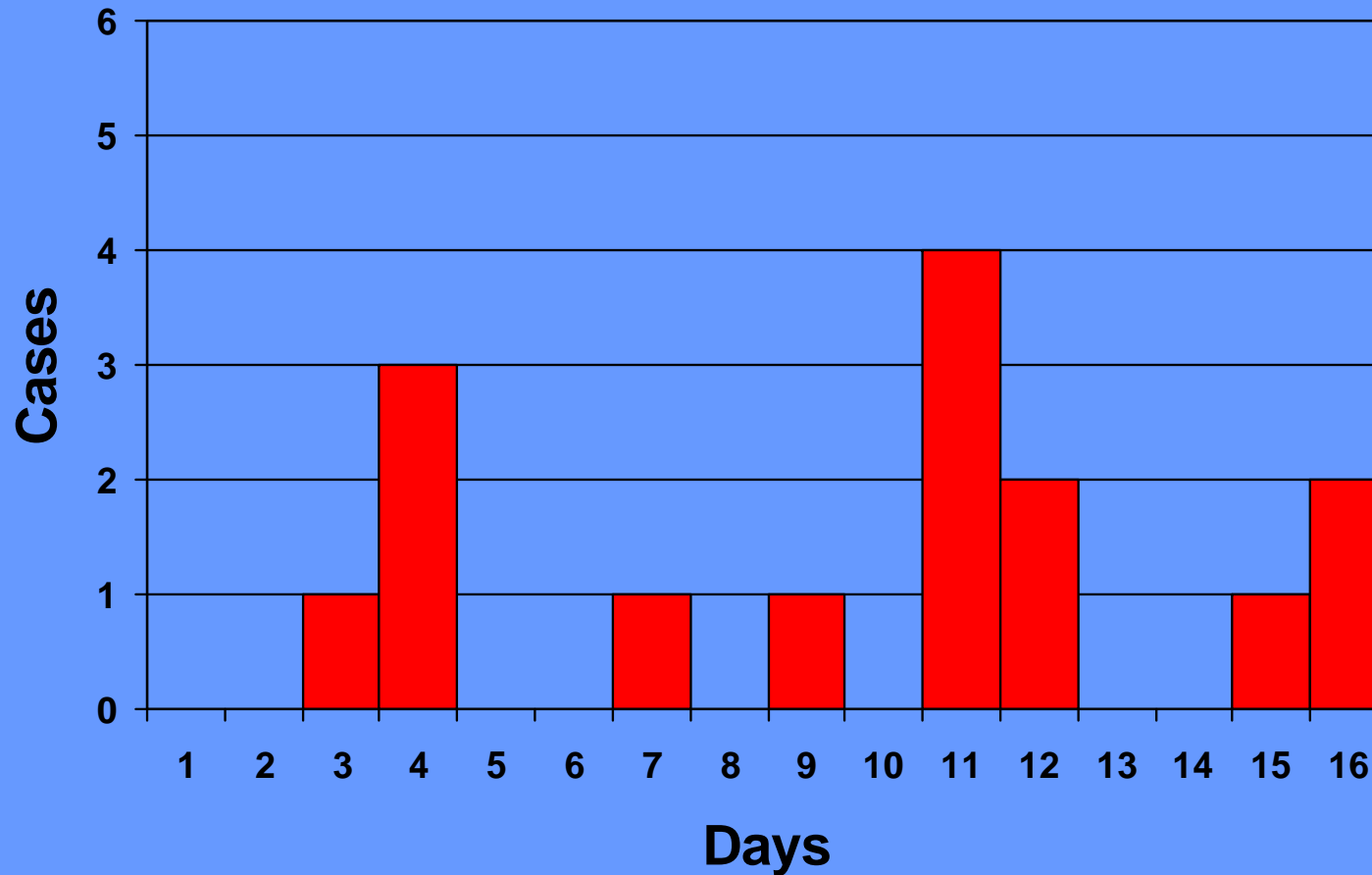
# Epidemic Curve - Common

**Source** (point exposure, e.g., Salmonellosis)

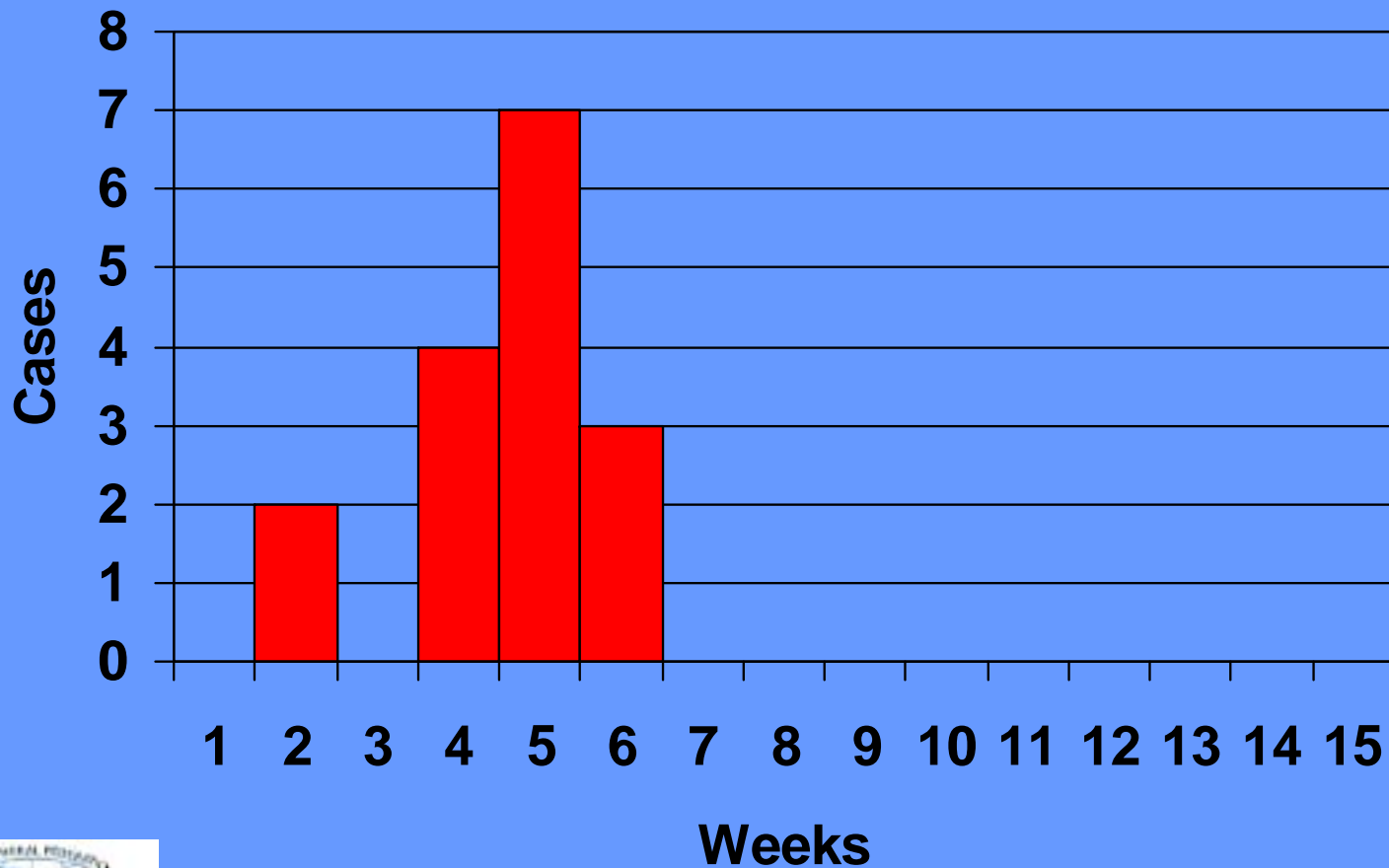
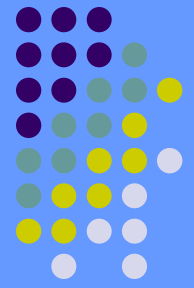


# Epidemic Curve - Common

**Source** (intermittent exposure, e.g., bacteraemia)

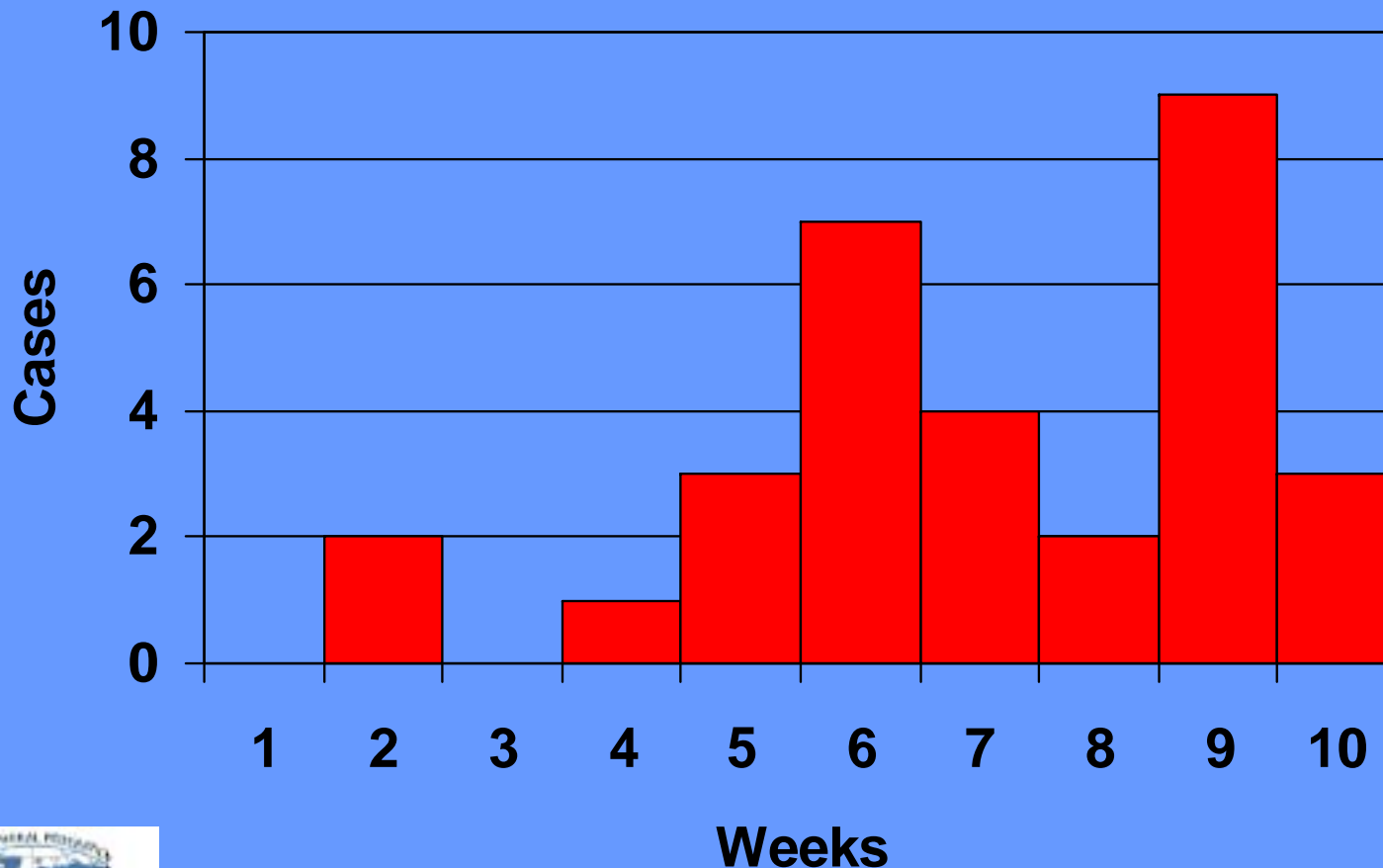
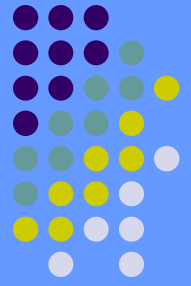


# Epidemic Curve - Propagated Source (single exposure, e.g., measles)



# Epidemic Curve - Propagated

**Source** (secondary and tertiary cases, e.g., Hepatitis A)



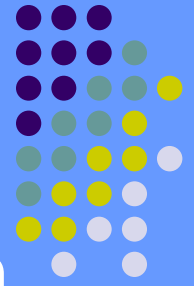
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# Outbreak Investigation Tasks



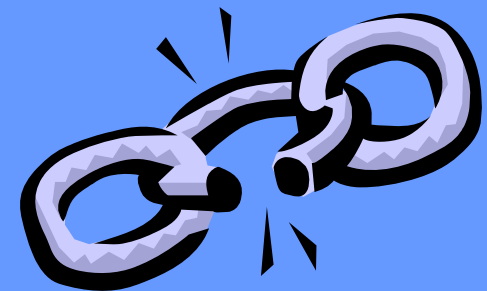
- Formulate a hypothesis
- Investigation may end with descriptive epidemiology
- Test the hypothesis (special study, e.g., case control study)
  - Available personnel
  - Severity of the problem
  - Resource allocation



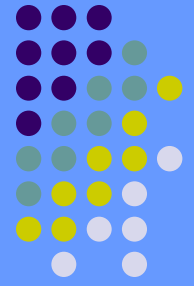


# Outbreak Investigation Tasks

- Analyze data derived from case investigation
  - Determine sources of transmission and risk factors associated with disease
- Refine hypothesis and carry out additional studies if necessary
- Institute control measures and follow up
  - Control the current outbreak by interrupting the chain of transmission
  - Prevent similar outbreaks



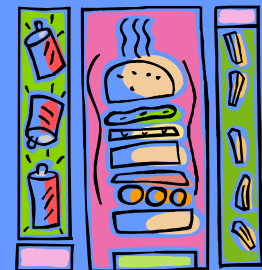
# Situations for Additional Study



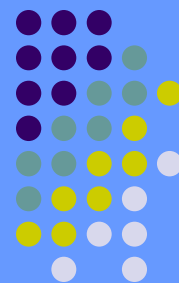
- Infection associated with a commercial product
- Infection associated with considerable morbidity (e.g., bacteraemia) and/or mortality
- Infections associated with multiple services
  - Example: Outbreak of food poisoning
  - Rate of disease in young children was 40% and in older individuals was 2%. The rate of disease was 65% for those who ate in a popular cafeteria and only 3% for those who ate in other places.
  - Therefore, young children eating in the popular cafeteria should be investigated regarding specific foods eaten



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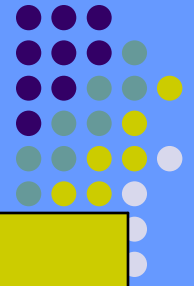


# Control Measures



- Control measures are determined by the results of the initial analysis in consultation with appropriate professionals
- Will vary depending on the agent and the mode of transmission

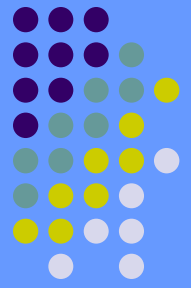




# Control Measures

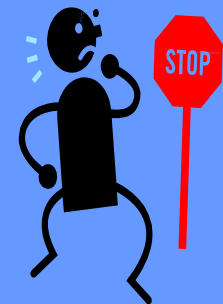
Suspected Method of Transmission	Suggested Actions
Cross-transmission (between individuals)	Patient isolation and barrier precautions determined by infectious agent(s)
Hand transmission	Improvements in hand washing
Airborne agent	Patient isolation with appropriate ventilation
Waterborne agent	Checking of water supply and all liquid containers Use of disposable devices
Foodborne agent	Elimination of the food at risk





# End of the Outbreak

- Evaluate efficacy of control measures
  - Cases cease to occur or return to endemic level
  - No change occurs
- Use the opportunity to review and correct other hospital practices which may contribute to an outbreak in the future
- Communicate and write a final report



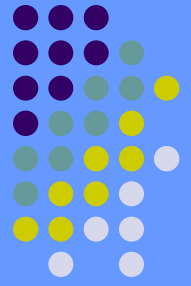
# Communication - Final Report



- Timely, up-to-date information must be communicated to hospital administration and public health authorities
- Information may be given to the public and to media
- Final report
  - Describe the outbreak, interventions, and effectiveness
  - Summarize the contribution of each team member
  - Recommendations to prevent any future occurrence
  - May be published in the medical literature
  - May be considered a legal document



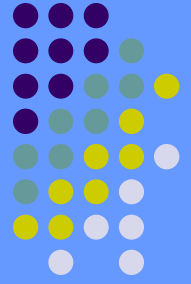
# Interventions Commonly Used



- Control the source of the pathogen
  - Remove the source of contamination
  - Remove persons from exposure
  - Inactivate or neutralize pathogen
  - Treat infected persons
  - Interrupt transmission
    - Isolation
    - Sterilize or disinfect environmental sources
    - Control mosquito or vector transmission



# Interventions Commonly Used



Control or modify the host response

- Immunization
- Prophylaxis
- Barriers



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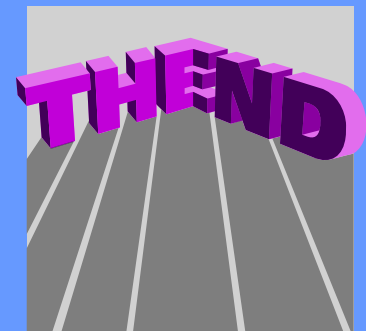


# Why Some Outbreaks End

- No more susceptible individuals
- No more exposure to the source
- No more source of contamination
- Individuals decrease their susceptibility
- The pathogen becomes less pathogenic



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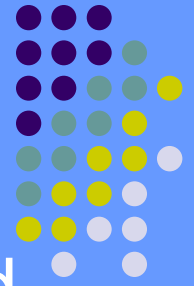


# Conclusions



- Outbreaks are important in terms of morbidity, mortality, cost, and institutional image
- Proper techniques should be used to investigate an outbreak
- Clear recommendations should be formulated to prevent further outbreaks
- Surveillance and monitoring trends detect outbreaks
- Elimination of sources, technical assistance, education and special epidemiologic studies are important for controlling outbreaks





# Key Points

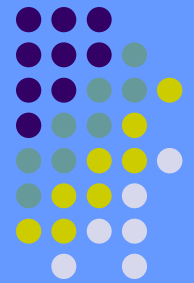
- Outbreaks of HAI should be defined, identified, and promptly investigated due to morbidity, cost, improvement of patient care practices and institutional image
- Proper steps and effective techniques should be used to investigate an outbreak
- Clear recommendations should be formulated to prevent further outbreaks



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