What Does This Outbreak Look Like?

- Introduction to Outbreak Investigation
- Module 5 – Descriptive Epidemiology

Outline

- Objectives for this module
- Review the steps in an outbreak (epidemiological) investigation
- Descriptive epidemiology
- Hierarchy of evidence
- Describing an outbreak
- *Mycobacterium bovis* example

Descriptive Epidemiology

Learning Objectives for this module:

1. Understand the steps used to describe an outbreak
2. Understand the benefits and limitations of descriptive epidemiology
3. Become familiar with the types of descriptive studies and which one to use depending on the situation.
4. Review an outbreak of bTB in California

9 Steps of an Outbreak Investigation

- Verify that an outbreak is occurring
- Confirm the diagnosis
- Case definition
- ✓ **Descriptive epidemiology**
- Hypothesis generation
- Analytic epidemiology
- Preliminary control/ prevention measure
- Communicate findings
- Establish disease surveillance / monitoring

Continuing the Outbreak Investigation

- At this point, we have:
  - Established the existence of an outbreak
  - Confirmed the diagnosis
  - Defined a Case (case definition)
- Now: Perform descriptive epidemiology

Types of Epidemiological Research

- **Descriptive** Epidemiology:
  - Provides information on the frequency and distribution of disease
  - No preconceived hypothesis
- **Analytic** Epidemiology:
  - **Observational**: More in depth studies to validate (or reject) a hypothesis
  - **Experimental**: Deliberate control of an exposure to evaluate the response and monitor its effect
  - More on these in upcoming modules

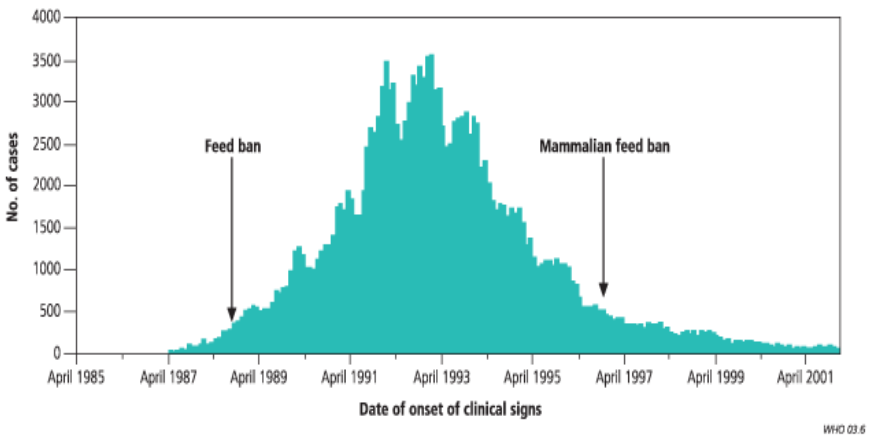
Epidemiology

Describes:

- Who? (what population?)
- What?
- Where?
- When?
- Why?
- How?

Descriptive Epidemiology

Fig. 1. **Distribution of cases of bovine spongiform encephalopathy (BSE) in Great Britain, by date of onset of clinical signs**



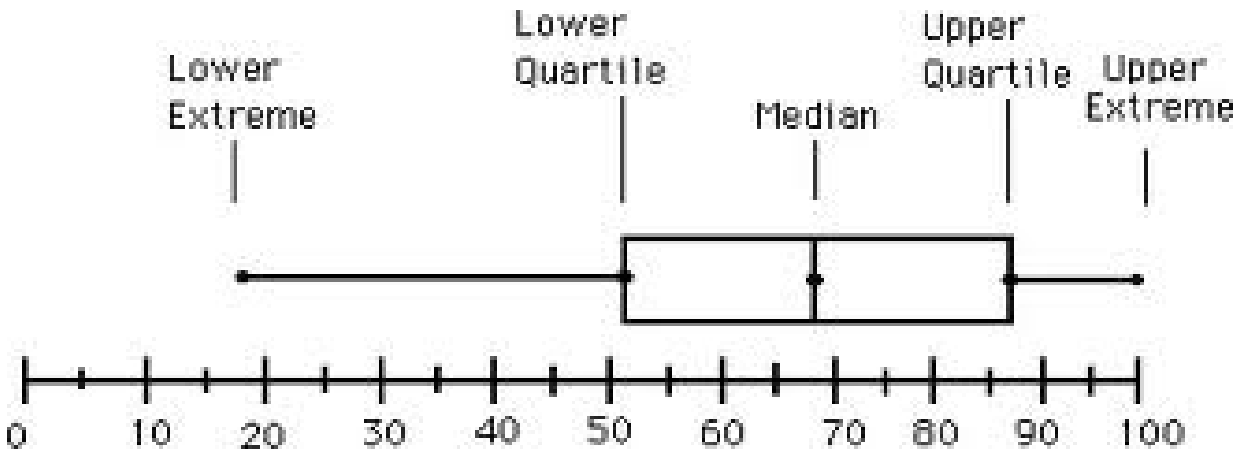
Describes:

- Who? (what population?)
- What?
- Where?
- When?
- Why?
- How?

Descriptive Epidemiology

Describing the outbreak

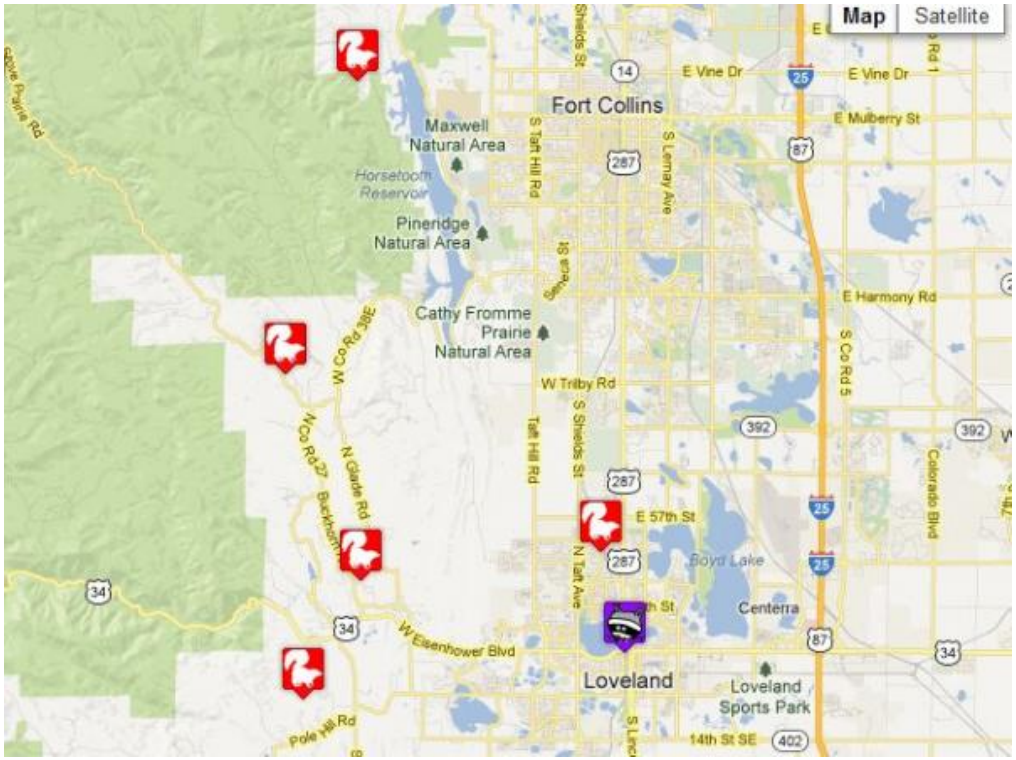
- Narrative summaries
- Summary statistics
  - Means
  - Ranges
  - Counts



Descriptive Epidemiology

Data Presentation

- Graphical form
  - Histograms
  - Line graphs
  - Bar charts



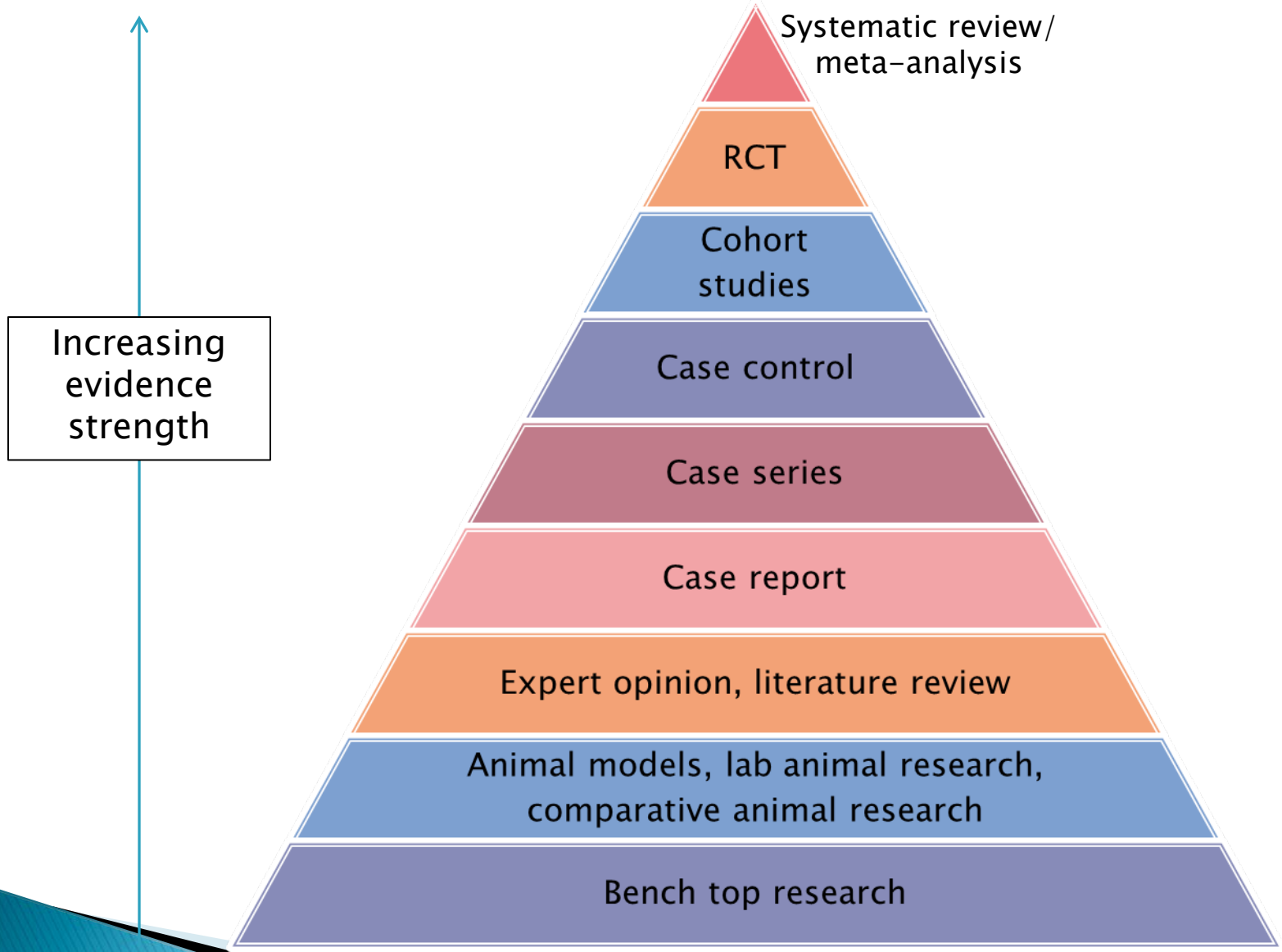
Descriptive Epi– Benefits

- Can be performed with relatively little data
- Usually not expensive or time consuming
- Can use small study population (Cases)
- Useful when little is known about the disease
- May detect disease outbreak patterns
- Useful to generate hypotheses

Descriptive Epi– Limitations

- **Explore associations to narrow the focus and develop hypotheses**
- Does not generate specific risk factor or odds ratio quantification
- Does not establish causation
- Limited use for generalizability
- Further studies are almost always needed
- Generally thought of as “weaker” evidence on the hierarchy of evidence

Hierarchy of Evidence



Types of Descriptive Epi Studies

- Ecologic studies
- Case reports
- Case series
- Survey

Types of Descriptive Epi Studies

- **Ecologic studies**
  - **Environmental / population exposure**
  - **Fracking article – Bamberger**
  - **Ecological fallacy**
- Case reports
- Case series
- Survey

Ecologic Studies

- One of the simplest/ easiest studies to do
- Data is collected at population level vs individual level
- Subject to bias and confounding
- Evaluate association but not causation

Ecologic studies

Home of Slope Farms

← Shale gas drilling and public health: From CDC's National Center for Environmental Health and Agency for Toxic Substances and Disease Registry. First publication of full text email.

Hydrofracking impact on the health of livestock and humans– new study from two Cornell researchers

Posted on January 9, 2012 by Ken Jaffe

Two Cornell researchers just released an important academic study on impact of hydrofracking on the heath of livestock and humans. This study also raises serious questions about safety and monitoring of the food supply. Dr. Oswald is a professor of molecular biology at Cornell Vet School, and Dr. Bamberger is a practicing veterinarian

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Types of Descriptive Epi Studies

- Ecologic studies
- **Case reports**
  - **Reporting to authorities (e.g. situation report) – collecting data**
  - **Publishing case characteristics (e.g. journal article)**
- Case series
- Survey

Case Reports

- Interface between clinical medicine and epidemiology
- Report of a single case of a new/ interesting/ previously unreported disease.
- May alert others to case/ increase awareness when published
- Need to be timely

Case Reports

Case Report

MANAGEMENT OF PELVIC FRACTURES IN DOG

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INTRODUCTION

Pelvic fractures are common sequelae of major traumatic injury of dogs and cat which, comprise of at least 25% of all fractures in veterinary practice (Piermattei et al., 2006). Fracture of ilium, the most common fracture seen in the pelvis account for 46% of all pelvic fracture (Henry, 1985; De Camp, 2005). Whereas, acetabular fracture comprises 12 % of pelvic fractures in dogs (De Camp, 2005). In smaller dogs, most of the pelvic fractures recover without surgery. But immediate surgery is required within 72 hours if the fracture is unstable (Harasen, 2007). We hereby report the successful surgical management of unstable fracture of ilium and ischium of pelvis in a Spitz dog.

Summary Report

Summary Report

California Bovine Spongiform Encephalopathy Case Investigation

July 2012

U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Veterinary Services

Summary Report

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Investigation Underway for Bovine Tuberculosis Case in CA

BY JAMES ANDREWS | FEBRUARY 12, 2013

Agriculture officials in California are currently investigating cases of bovine tuberculosis in a dairy cow herd first reported last Wednesday.

The bacteria that causes bovine tuberculosis (TB) can spread to humans via raw milk, but the cow belonged to a dairy in Tulare County which pasteurizes all of its milk, thus eliminating the risk of tuberculosis transmission.

The problem was originally detected at a slaughter yard where a cow from the dairy had been sent. Routine slaughter testing found TB in that cow, and follow-up testing by the California Department of Food and Agriculture (CFAD) found the presence of TB among the cow's dairy herd.

While state veterinarians perform genetic sub-typing of that herd's infections, they are also conducting a traceback investigation on the cows at the slaughter yard with which the infected dairy cow might have been in contact, a CFAD spokesman told **Food Safety News**.

In an email to associates in veterinary science and epidemiology, California State Veterinarian Annette Jones said that this most recent case was most likely not associated with multiple cases of bovine TB discovered in San Bernardino County dairy cows throughout 2011.

"We are just beginning to look into how this TB case was introduced and if it has spread — testing for TB is a long and arduous task with less than perfect tests at our disposal," Jones wrote, "so it may be weeks to months before we have additional information to share."

Types of Descriptive Epi Studies

- Ecologic studies
- Case reports
- **Case series**
  - **Accumulation of multiple cases**
- Survey

Case Series

- Similar to Case Report, but requires pooled data of multiple cases
- Report of a group or population with the same diagnosis
- Generally used to present a description of the usual clinical course, by grouping several similar cases together
- May help researches form a hypothesis about causal/risk factors, but no statistical association is established. Descriptive statistics can be applied.

Case Series

A case series of unilateral orbital aspergillosis in three cats and treatment with voriconazole

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Abstract

Feline orbital aspergillosis is increasingly described in the published reports and may be an emerging disease. Orbital mycotic infections were diagnosed in three cats with exophthalmos, significant dorso-temporal globe deviation and pronounced resistance to retropulsion. Advanced imaging was performed in all three cases to evaluate the extent of disease as well as to obtain guided orbital biopsies in two cases. Surgical intervention in the form of a lateral orbitotomy was pursued in the first case with the other two cases treated with enucleation or medical management alone. The available published reports concerning sino-orbital aspergillosis are reviewed. Oral therapy with a novel triazole, voriconazole, was instituted in two cases. Although voriconazole was apparently effective against the fungal organisms, it is also resulted in adverse reactions.

Ulster Med J 2007; **76 (1)** 37-38

Case Report

Bowel perforation caused by swallowed chicken bones – a case series

S Akhtar, N McElvanna, KR Gardiner, ST Irwin

Accepted 6 December 2006

INTRODUCTION,

Most foreign bodies pass through the gastrointestinal tract without any consequence. A very small percentage perforate the bowel, leading to acute abdomen and requiring surgical intervention. In most cases, the cause is discovered peroperatively. Foreign bodies such as dentures, fish bones, chicken bones, toothpicks and cocktail sticks have been known to cause bowel perforation. Three cases of bowel perforation caused by swallowed chicken bones within a period of one year are presented.

CASE 1

A 59 year old woman was admitted with a painful irreducible incisional hernia. There was a past history of left hemicolectomy for a diverticular stricture, hysterectomy and bilateral salpingo-oophorectomy, hypothyroidism, chronic obstructive pulmonary disease, hypertension, depression and morbid obesity. Examination revealed a tender, erythematous and irreducible large incisional hernia. It was felt that this was a strangulated incisional hernia. At operation, the hernial sac contained small bowel that had been perforated due to a chicken bone. A small bowel resection was performed with end to end anastomosis and the incisional hernia was repaired. The patient made an uncomplicated recovery (fig 1).

CASE 2

A 46 year old man was admitted as an emergency with a 12 hour history of severe colicky abdominal pain and vomiting which had become constant and aggravated by coughing. There was a past medical history of diverticular disease, chronic constipation and peptic ulcer disease. On examination there was generalised abdominal tenderness and guarding with rebound tenderness in the right iliac fossa. There was an associated leucocytosis (13,000/mm^3) and raised inflammatory markers (CRP 22mg/L). Erect chest X-ray showed free subdiaphragmatic air. A laparotomy revealed a perforation of the sigmoid colon due to a chicken bone in a diverticulum. The chicken bone was removed and the sigmoid colon was repaired. The patient made an uneventful recovery.

CASE 3

A 38 year old man with a previous end-colostomy for faecal incontinence (secondary to cauda equina syndrome) presented as an emergency with a six day history of fever, decreased stoma output and a painful parastomal swelling. On examination he was obese, pyrexic (40 ^{0}C), tachycardia and had generalised abdominal tenderness and cellulitis over a large irreducible parastomal hernia. He was thought to have a strangulated parastomal hernia and underwent emergency laparotomy. At operation he was found to have a parastomal abscess secondary to a colonic perforation within the hernia caused by a chicken bone. The stoma was revised and the parastomal hernia repaired. The patient made a full recovery.

Figure 1: Gross specimen of bowel showing the chicken bone.

DISCUSSION

There are more than 300 cases[1] of bowel perforation caused by foreign bodies reported in the literature. Fish bones, chicken bones and dentures are the commonest objects followed by toothpicks and cocktail sticks.[2-11] The majority of patients do not recall ingesting the foreign body, it being discovered either on investigation (abdominal X-ray or CT scan), or during operation. The greater risk is at extremes of age,[1] in those wearing dentures (dentures cover the most tactile area of the palate and the foreign body goes unnoticed) or in patients with previous bowel pathology (diverticular disease, intestinal stricture). Alcoholics and psychiatric patients are also at increased risk. The clinical presentation may include frank peritonitis, localised abscess formation, enterovesical fistula, intestinal obstruction and intestinal hemorrhage.[1,9]

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Types of Descriptive Epi Studies

- Ecologic studies
- Case (Situation) reports
- Case series
- **Survey**

Surveys

- Surveys are used to determine the frequency of disease along with related factors at a point in time – usually time-sensitive
- Attempt to find a source to stop the outbreak or the spread of an infectious agent
- Random sampling of population is used to measure differences in exposure to determine who may get the disease

Surveys

- Estimate prevalence of disease of interest and populations with increased exposure (risk)
- **Prevalence = the number of cases at a single point in time in the population of interest.**
- Repeat surveys can be used to monitor changes in prevalence or exposures over time

Surveys

Original Paper *Veterinarni Medicina, 51, 2006 (11): 512–522*

A prevalence study of bovine tuberculosis by using abattoir meat inspection and tuberculin skin testing data, histopathological and IS*6110* PCR examination of tissues with tuberculous lesions in cattle in Ethiopia

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ABSTRACT: *Post mortem* surveillances, for the detection of tuberculous lesions in particular depend on the work load time and the diligence of the inspector conducting the examination. The first aim of the study was to determine the trend of occurrence of tuberculous lesions in two abattoirs in Addis Ababa and Debre-Zeit (Ethiopia). The second aim of the study was to determine prevalence of the tuberculin skin test results in 10 dairy farm areas in Addis Ababa. The third aim was to detect tuberculous lesions and causal agents from tissue samples of the respiratory tract and mesenteric lymph nodes of the slaughtered cattle. The ten year (1996–2005) retrospective analysis of the meat inspection of 2 455 289 slaughtered animals showed that 707 (0.028%) were found with tuberculous lesions in parenchymatous organs of which were 699 (0.052%) of 1 336 266 cattle, 4 (0.001%) of 534 436 sheep, 3 (0.001%) of 573 767 goats and 1 (0.009%) of 10 820 pigs. The tuberculous lesions found in cattle were statistically highly significant ($P < 0.01$) than in other animals. The bovine tuberculin skin tests were conducted in Addis Ababa in 10 farm areas in 85 dairy farms having 2 098 cattle. Positive reactions were obtained from 9 farm areas in 41 (48%) herds which included 392 (19%) of the animals. In a current study, tuberculous lesions were found in 34 (3.5%) animals by the meat inspection surveillance of 984 cattle. Histopathologically, granulomatous inflammation was evident in 3 (8.8%) animals with tuberculous lesions. A highly sensitive PCR (IS*6110*) was positive in 4 of 34 (11.8%) animals with tuberculous lesions and in 1 (2.9%) of animal without lesions. The analyzed data and these study findings indicated that tuberculosis in cattle is an existing problem in Ethiopia which needs to be solved.

Summary– Descriptive Epi Studies

- Ecologic studies
- Case reports
- Case series
- Survey

Descriptive Epidemiology Example

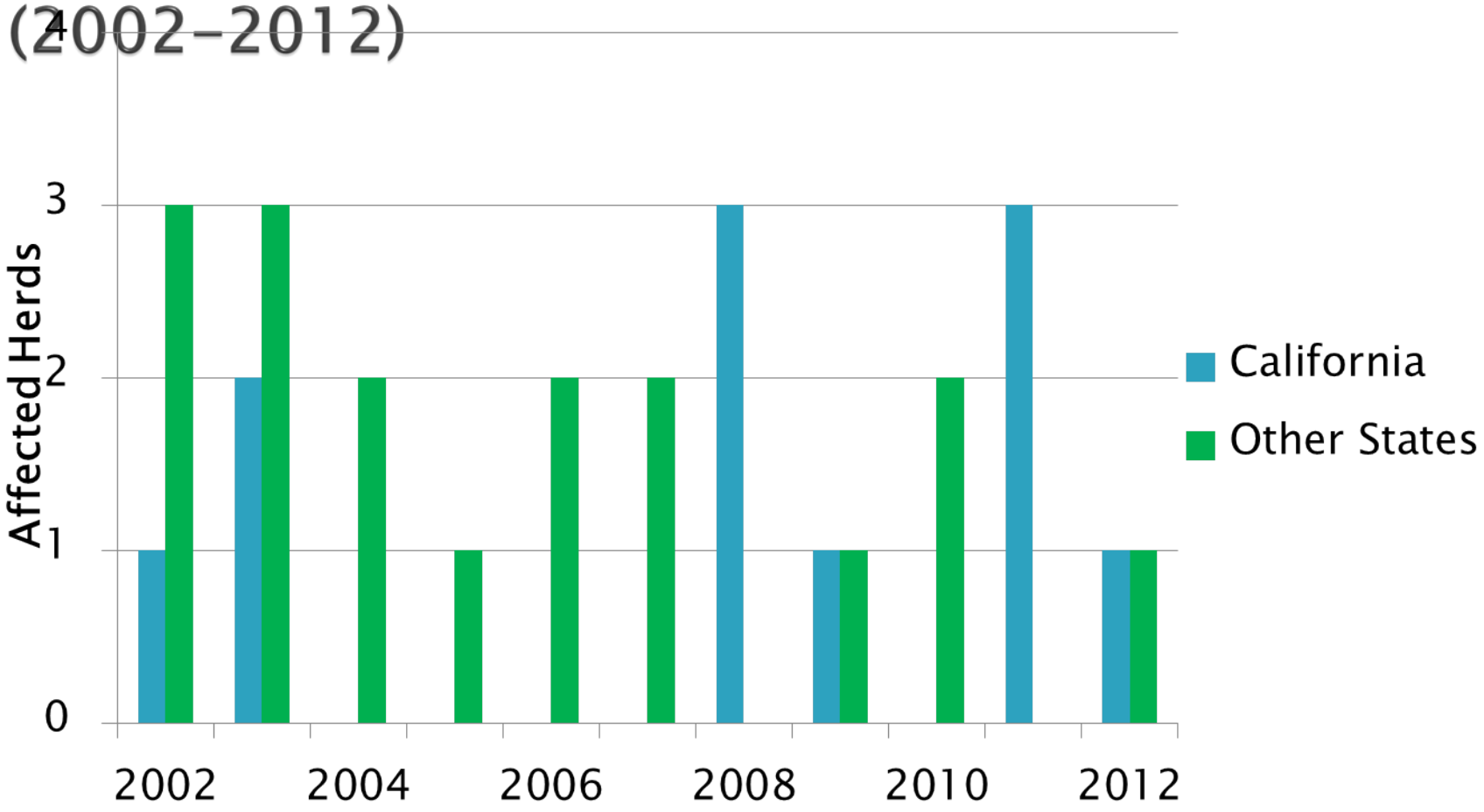
- California *M. bovis* infection in dairy cattle
  - 11 affected dairies since 2002

- Where would you start?
- What data would you need?
- What type of descriptive study would you use?
- Other information?

Descriptive Epidemiology Example

- California *M. bovis* infection in dairy cattle
  - 11 affected dairies since 2002
- Where would you start?
  - *Verify the outbreak, confirm the diagnosis as cases*
  - *Describe the cases*
- What data would you need?
  - *Who, what where, when*
- What type of descriptive study would you use?
  - *Case series*
- Other information?
  - *Management practices from survey, intensity of detection*

M. bovis Dairy Herds (2002–2012)



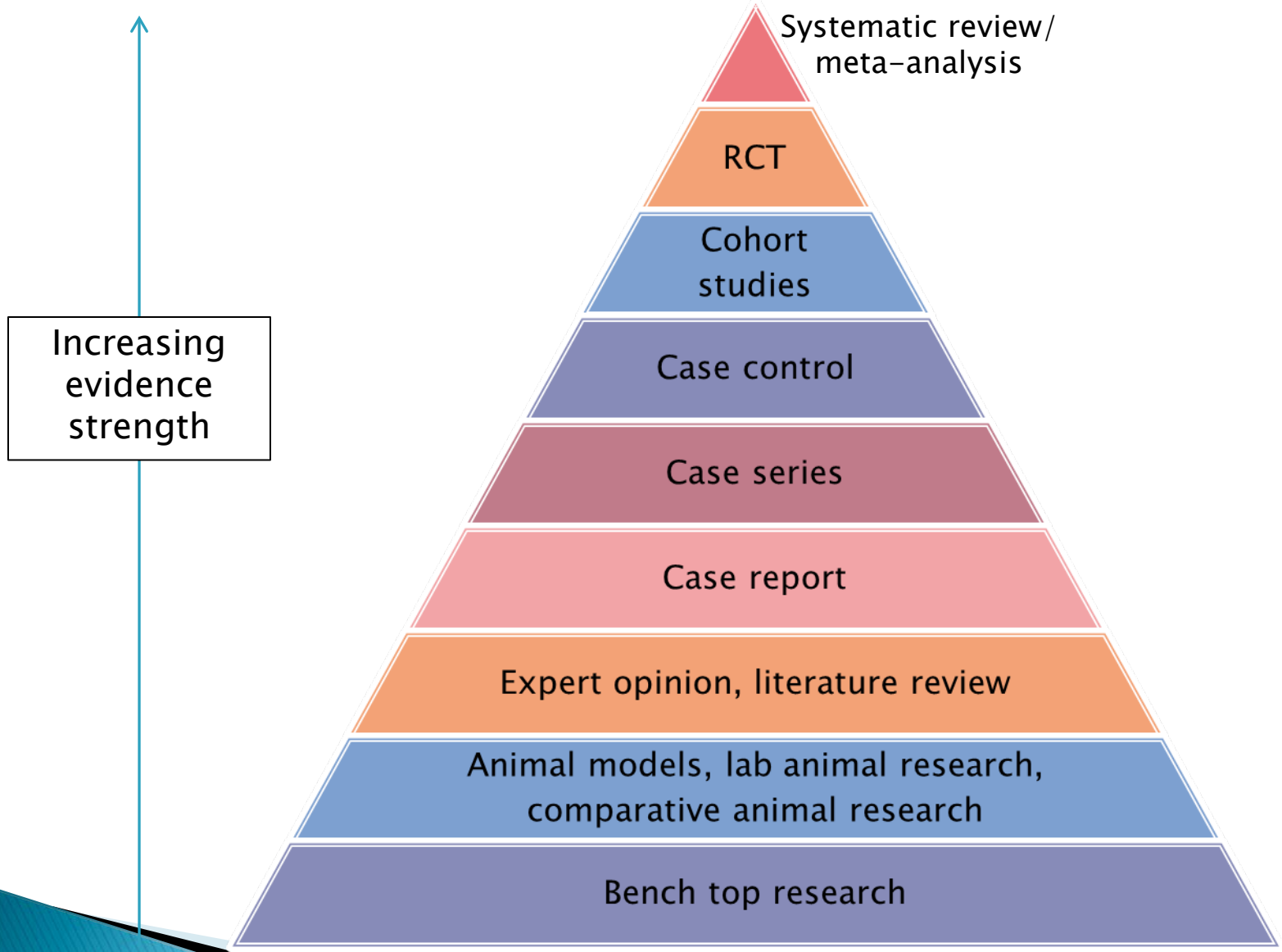
Descriptive Epidemiology Example

Parameter	*CA Herd Size*	*Other Herd size*	*CA Reactors*	*Other Reactors*
Mean	4185	1749	19.5	20.3
Standard Error	987	770	9.4	11.8
Median	3300	543	2	1.5
Mode	N/A	N/A	1	1
Standard Deviation	3272.3	3080.3	31.0	47.1
Kurtosis	1.0	8.7	1.2	7.9
Skewness	1.1	2.8	1.6	2.8
Range	10875	11965	88	172
Minimum	573	35	1	1
Maximum	11448	12000	89	173
Sum	46031	27987	214	324
Count	11	16	11	16

Descriptive Epidemiology Example

- California *M. bovis* infection in cattle – Plan
  - ✓Verify the outbreak – *histogram*
  - ✓Confirm the diagnosis – *NVSL*
  - ✓Case definitions – *already in place*
  - ✓Describe outbreak – *case series*
  - ✓Conduct a producer survey to gather more information – *in progress*
  - ✓Compare slaughter submission rates
    - ✓Large western dairy states
  - ✓Compare caudal fold test response
    - ✓Expected false positive rate

Hierarchy of Evidence



Outbreak Investigation

- Descriptive Epi seeks to answer the following:
- Who?
- What?
- Where?
- When?

Trying to establish:

population, place, time, type of outbreak, clinical signs, etc

9 Steps of Outbreak Investigation

- Prepare for field work
- Establish the existence of an outbreak
- Verify the diagnosis
- Define & identify cases
- ✓ Perform descriptive epidemiology
- Develop hypotheses
- Perform analytic epidemiology
- Refine hypotheses & conduct additional studies
- Implement control & prevention measures
- Communicate findings

- **After descriptive study, we can move on to developing hypotheses**

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