Descriptive Epidemiology

- A **sensitive case definition** is often applied early in an outbreak and captures all cases; includes many non-cases
- A **specific case definition** usually applied after an outbreak is considered more well-understood, will exclude most non-cases/atypical cases, and is likely to include only true cases

Person only refers to demographic characteristics not clinical features or exposures

Analytic Epidemiology

- use this to test their hypotheses generated from descriptive epidemiology
- key feature: comparison group
- concerned with the search for causes and effects/why and how
- determine the association between exposures and outcomes in order to test hypotheses about causal relationships

Experimental Studies

- determines through a controlled process the exposure for each individual (clinical trial) or community (community trial)
- tracks individuals or communities over time to detect effects of exposure
- Example would be assigning some of the participants with a new vaccine while other get a placebo shot; tracks the participants over a set period of time and observes the results
- type of experimental study is clinical trial

<u>Randomized Controlled Trials (RCT)</u>

- mainly used in testing new drugs and treatments
- sample of patients are randomly allocated to receive either the experimental treatment or the control treatment (usually the standard treatment for the condition)
- Might use placebo for the control but will usually avoid it when there is already an accepted treatment for the condition
- like a regular experiment in AP Stats

<u>Quasi-Experimental Designs</u>

- falls between observational and true experimental studies
- proposes some sort of treatment or intervention but also observes the subjects/effects and compares the current patterns with the old patterns
- Ex: study of the effects of removing ophthalmic services from the OHIP billing schedule: is there a decrease in eye tests after the change? The study might record the number of eye exams per thousand population over the years up to the policy change, and compare this pattern with the pattern afterwards. This is somewhat observational but also keep in mind there was an intervention.

Observational Studies

- epidemiologist simply observes the exposure and disease status of each participant
- Examples would be John Snow's cholera studies in London's water systems

<u>Cohort Study</u>

- like an experimental study but differs since the investigator observes rather than determines the participant's exposure status
- records whether each study participant is exposed or not and then tracks the participants to see whether they develop the disease or not
- after the allotted period of time, investigator compares the disease rate in the exposed group with the disease rate in the unexposed group (comparison group)
- if results show that the disease rate is substantively different in the exposed group, then the exposure is said to be associated with illness
- can calculate **relative risk**
- compare **incidence in exposed group** to the **incidence in the unexposed group**

- cannot estimate prevalence (which is the proportion of cases in a population at a given time) but can estimate incidence (which is the rate of occurrence of new cases)
- **Prospective:** participants are enrolled as the study begins and are then followed prospectively over time to identify occurrence of outcomes of interest
- **Retrospective:** both the exposure and outcomes have already occurred; commonly used in investigations of disease in groups of easily identified people such as workers in a factory or attendees at a wedding

Case Control Study

- investigators start by enrolling a group of people with the disease and then enroll a group of people without the disease (the control group)
- control group provides an expected amount of exposure in that population
- If the amount of exposure among the case group is substantially higher than the expected amount for the control group, the illness is said to be associated with the exposure
- key: identify an appropriate control group, comparable to the case group in most respects, in order to provide a reasonable estimate of the expected exposure
- it's retrospective meaning you are given the disease and need to hunt for potential causes
- there may be difficulty in determining whether the disease or exposure came first which relates to Law of Retrospection: "You cannot tell which way the train went by looking at the track."
- **cannot calculate incidence nor prevalence because you chose the number of case-controls and controls which changes the prevalence every time**
- **calculate odds ratio rather than relative risk**
- controls and case-controls can be matched together more

Cross-sectional Surveys

- a sample of persons from a population is enrolled and their exposures and health outcomes are measured at the same time
- assess the **prevalence** of the health outcome
- considered weaker than cohort and case-control because it cannot distinguish risk factors for occurrence of disease (incidence) from risk factors for survival with the disease
- weak for proving causation

Causation

- simplest model to disease causation is the epidemiological triad (external agent, susceptible host, and environment that links the host and agent)
- **Agent**: refers to an infectious microorganism or pathogen such as a virus, bacteria, parasite, etc.; also includes chemical and physical causes of disease or injury such as chemical contaminants, repetitive mechanical forces
- **Host**: refers to the human who can get the disease; risk factors can influence an individual's exposure, susceptibility or response to a causative agent
- **Environment:** refers to the extrinsic factors that affect the agent and the opportunity for exposure; environmental factors can include physical factors such as geology and climate, biological factors such as insects which serve as vectors, and socioeconomic factors like crowding, sanitation, and availability of health services

Natural History and Spectrum of Disease

- natural history is the progression of a disease process in an individual over time
- **incubation period** is the time between the exposure to disease to the onset of disease symptoms (known as **latency period** for chronic diseases); disease is **asymptomatic** since no symptoms are apparent

- onset of symptoms signals transition from subclinical to clinical disease; most diagnoses occur when disease is clinical
- disease may result in illness that may range from mild to severe to fatal known as the **spectrum of disease**
- persons who are infectious but have subclinical disease are called **carriers** (have incubating disease or asymptomatic disease)

Agent Characteristics

- **infectivity**- the proportion of exposed persons who become infected
- **pathogenicity-** proportion of infected individuals who develop clinically apparent disease
- **virulence**- proportion of clinically apparent cases are severe or fatal

Chain of Infection

- transmission occurs when the agent leaves its **reservoir/host** through **a portal of exit** which is conveyed by some **mode of transmission**, and enters through **a portal of entry** to infect a **susceptible host**

Reservoir

- habitat in which the agent normally lives, grows, and multiplies
- can or cannot be the source from which an agent is transferred to a host
- **Human reservoirs:** house common infectious diseases

`may or may not show effects of illness

`Different types of carriers are **asymptomatic/passive/healthy** (never experience symptoms), **incubatory** (transmit the agent during the incubation period before the clinical illness begins), **convalescent** (recovered from their illness but remain capable of transmitting to others), and **chronic** (continue to harbor a pathogen for months to years after initial infection)

- **Animal reservoirs:** commonly house zoonoses which are infectious diseases transmissible under natural conditions from vertebrate animals to humans

`Examples include brucellosis (cows and pigs), anthrax (sheep), plague (rodents), trichinellosis/trichinosis (swine), tularemia (rabbits), rabies (bats, dogs, raccoons, and other mammals), West Nile encephalitis (mosquitoes and birds), and monkeypox (prairie dogs)

- **Environmental reservoirs:** include plant, water, and soil

`popular for housing fungal agents which may cause histoplasmosis and Legionnaires disease

Portal of Exit

- path by which a pathogen leaves its host or reservoir
- usually the site where pathogen is localized
- examples include the *Mycobacterium tuberculosis* leaving respiratory tract, schistosomes through urine, and cholera vibrios through feces

Modes of Transmission

- the way an agent can be transmitted from its reservoir to a susceptible host

There are two main classifications: **direct** (direct contact and droplet spread) and **indirect** (airborne, vehicleborne, and vectorborne (mechanical or biological))

Direct Transmission

- **Direct contact**
- examples include skin-to-skin contact, kissing, and sexual intercourse (diseases include mononucleosis and gonorrhea)
- also refers to contact with soil or vegetation that harbor infectious organisms (diseases include hookworm which is direct contact with soil)
- **Droplet spread**
- refers to spray with relatively large, short-range aerosols produced by sneezing, coughing, or talking
- Diseases spread this way are pertussis and meningococcal infection

Indirect Transmission

- **Airborne**
- occurs when infectious agents are carried by dust or droplet nuclei suspended in the air
- droplet nuclei may remain suspended in the air for long periods of time and may be blown over great distances
- Example would be measles virus which remain suspended in the air
- **Vehicles**
- may indirectly transmit an infectious agent through food, water, and biologic products like blood, and **fomites** which are inanimate objects like bedding or scalpels
- may provide an environment for the agent to thrive
- example would be the production of the botulinum toxin from *Clostridium botulinum*
- **Vectors**
- include mosquitoes, fleas, and ticks which can carry an infectious agent through mechanical means or can support growth or changes in the agent
- mechanical transmission example includes flies carrying *Shigella* on their appendages
- biologic transmission example would be agents of malaria or guinea worm disease undergoing maturation in an intermediate host before being transmitted to humans

Portal of Entry

- the way a pathogen enters a susceptible host
- must provide access to tissues in which the pathogen can thrive or a toxin can act

Host

- final link in chain of infection
- Many factors such as genetic or constitutional factors, specific immunity, and resistance factors all affect the susceptibility of the host

Prevention

- patients sick with communicable disease can be treated with antibiotics
- community stricken with disease can maybe remove the contaminated soil to stop the agent spread
- educating the public on washing their hands and proper hygiene are also integral
- airborne disease strategies can be modifying ventilation/air pressure and filtering the air
- vectorborne disease strategies include controlling the vector population such as spraying to reduce the mosquito population
- to attack the portal of entry, use bed nets to protect people from mosquitos
- proper clothing such as long pants and masks are both ways to combat droplet transmission
- **herd immunity** suggests that if a high enough proportion of individuals in a population are resistant to an agent, then those few who are susceptible will be protected by the resistant majority since the pathogen will be unlikely to “find” those few susceptible individuals.

Epidemic Disease Occurrence

- amount of a particular disease that is usually present in a community is referred to as the baseline or **endemic** level of a disease (expected level of the disease)
- **Sporadic** refers to a disease that occurs infrequently and irregularly
- **Endemic** refers to the constant presence and/or usual prevalence of a disease or infectious agent in a population within a geographic area
- **Hyperendemic** refers to persistent, high levels of disease occurrence
- **Epidemic** refers to an increase, often sudden, in the number of cases of a disease above what’s normally expected in that population in that area
- may result from a recent increase in amount or virulence of the agent, recent intro of the agent in a new setting, change in susceptibility of the host response to the agent
- **Outbreak** refers to an epidemic in a more limited geographic area sadww

- **Cluster** refers to an aggregation of cases grouped in place and time that are suspected to be greater than the number expected
- **Pandemic** refers to an epidemic that has spread over several countries or continents usually affecting a large number of people

Epidemic Patterns

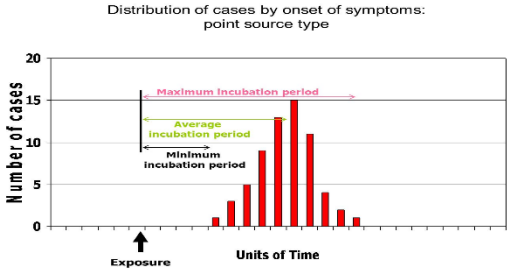
- epidemics are classified according to their manner of spread: **common source** (point, continuous, intermittent), **propagated, mixed,** and **other**

<u>Common-source</u>

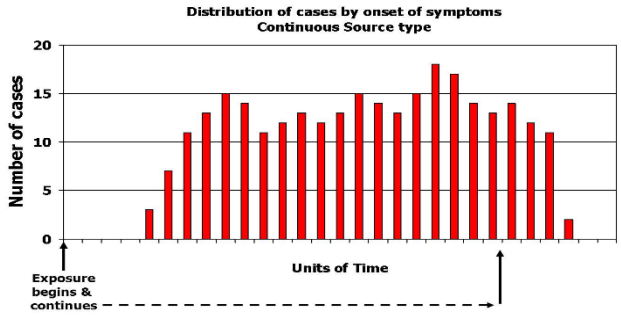
- a group of persons are all exposed to an infectious agent or toxin from same source
- type of common-source in which the people are exposed over a brief period and become ill **within one incubation period** is **point-source outbreak**
- examples of point-source are the leukemia epidemic in Hiroshima and hepatitis A epidemic in Pennsylvania
- What does **point-source** look like on an epi-curve? typically has a steep upslope and a more gradual downslope ("log-normal distribution")

How to find the exposure period for point source?

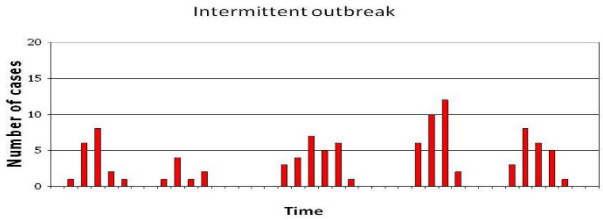
1. know the disease's average, minimum, and maximum incubation periods
2. locate the peak of the curve and count back the average incubation period. Note that date
3. locate the earliest case in the outbreak and count back the minimum incubation period. Note that date.
4. locate the last case in the outbreak and count back the maximum incubation period. Note that date.



- type of common-source in which case-patients may have been exposed over a period of days, weeks, or longer and the range of exposures is **continuous outbreak**
- What does **continuous outbreak** look like on an epi-curve? range of exposures and incubation periods tend to flatten and widen the peaks

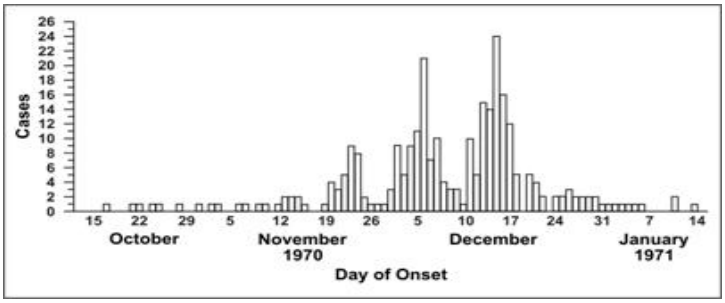


- type of common-source in which there is an irregular pattern of cases that reflects the timing and extent of repeated exposure and reflects the intermittent (irregular) nature of the exposure is **intermittent common-source outbreak**
- What does **intermittent common-source** look like on an epi curve? has irregular and different heights for the bars



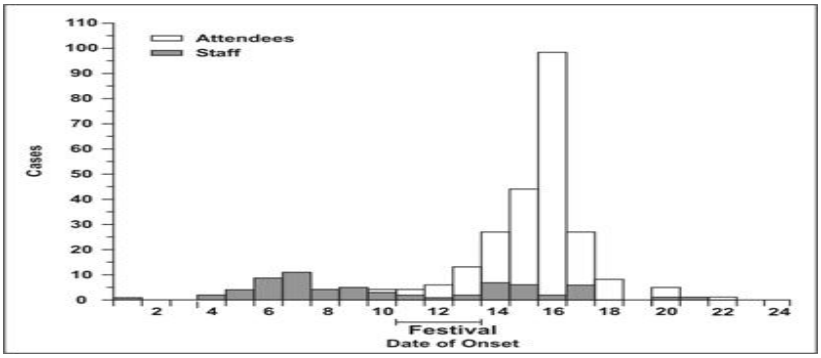
<u>Propagated</u>

- results from transmission from one person to another
- usually direct person-to-person contact like syphilis or can be vehicleborne like hepatitis B from sharing needles or can be vectorborne like encephalitis from mosquitoes
- cases occur over **more than one incubation period**
- lasts multiple waves
- has taller peaks than those of common-source curves



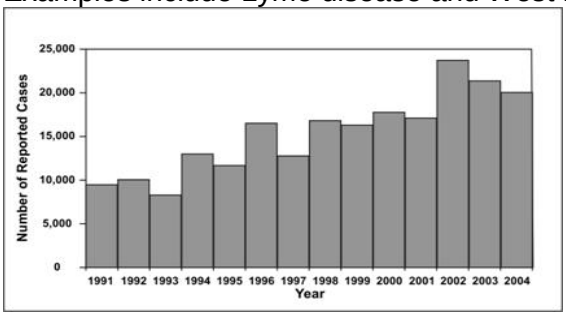
<u>Mixed</u>

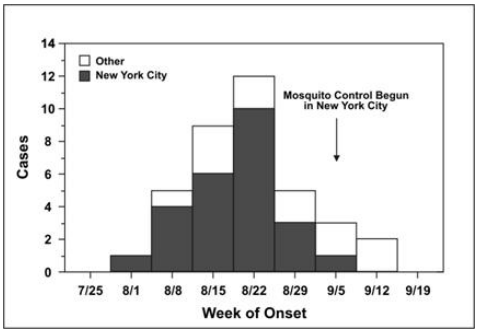
- has features of both common-source and propagated epidemics
- could have a pattern on common-source followed by secondary person-to-person



Other

- neither common-source nor propagated
- outbreaks of zoonotic disease may fall under this category since there is a human-vector interaction
- Examples include Lyme disease and West Nile





Frequency Measures

- characterizes only part of the distribution
- compare one part of the distribution to another part of the distribution, or to the entire distribution
- common frequency measures are **ratios, proportions,** and **rates**
- all follow the formula (numerator/denominator)*10^n
- When to use **ratios**: descriptive measures which include risk ratio (relative risk), rate ratio, and odds ratio

- common epidemiologic ratio: **death-to-case ratio** which is the (# of deaths attributed to a particular disease during a specified period/ # of new cases of that disease identified during the same period)
- **Proportion**: comparison of a part to the whole, and numerator is included in the denominator
- (# of persons or events with a particular characteristic/ total # of persons or events, of which the numerator is a subset) *10^n
- When to use **proportions**: used most in descriptive measures, also describe amount of disease that can be attributed to a particular exposure
- can be expressed as a fraction, decimal, or percentage
- type of epidemiologic proportion: **proportionate mortality** which is the proportion of deaths in a specified population during a period of time that are attributable to different causes
- **Rate:** a measure of frequency with which an event occurs in a defined population over a specified period of time
- it is a measure of risk
- **attack rate** or **incidence proportion** is the proportion of population that develops the illness during an outbreak
- **prevalence rate** is the proportion of the population that has a health condition at a point in time (e.g. There are 70 influenza case-patients in March 2005)
- **case-fatality rate** is the proportion of persons with the disease who die from it (e.g. one death due to meningitis among County A's population)

Morbidity Frequency Measures

- morbidity is the departure from a state of physiological or psychological well-being
- morbidity encompasses disease, injury, or disability

Measures of morbidity

Measure	**Numerator**	**Denominator**
Incidence proportion (attack rate/risk)	# of new cases of disease during a specified time interval	population at start of time interval
Secondary attack rate	# of new cases among contacts	total # of contacts
Incidence rate (person-time rate)	# of new cases of disease during specified time interval	summed person-years of observation or avg population during time interval
Point prevalence	# of current cases (new and preexisting) at a specified point in time	population at the same specified point in time
Period prevalence	# of current cases (new and preexisting) over a specified period of time	Avg or mid-interval population

- **Incidence**: occurrence of new cases of disease or injury in a population over a specified period of time
- could mean # of new cases in a community or # of new cases per unit of population

<u>Incidence proportion or risk (attack rate)</u>

- proportion of initially disease-free population that develops disease, becomes injured, or dies during a specified period of time
- same thing as attack rate/risk, probability of getting disease, and cumulative incidence

FORMULA: **# of new cases of disease during specified period/size of population at start of period**

Attack Rate

- synonym for risk and is the risk of getting the disease during a specified period such duration of an outbreak

Types of Attack Rates:

- **Overall Attack rate** is the (total # of new cases/ total population)
- **Food-specific attack rate** is the (# of persons who ate a specified food and became ill/ total # of person who ate that food)
- **Secondary attack rate** is used to document the difference between community transmission of illness versus household transmission of illness; formula: (# of cases among contacts of primary cases/ total # of contacts)*100%

Incidence Rate

- measure of incidence that incorporates time directly into denominator
- calculated from a long-term cohort follow-up study

FORMULA: **# of new cases of disease or injury during specified period/time each person was observed, totaled for all persons**

- [(Number of people at risk at the **beginning** of the time interval + Number of people at risk at the **end** of the time interval) / 2] x (Number of time units in the time interval)]
- When to use incidence rate: describes how quickly disease can occur in a population
- ADV: can accommodate persons coming in and leaving the study and allows enrollees to enter study at different times
- DISADV: person-time assumes that probability of disease during the study period is constant

Prevalence Rate

- proportion of persons in a population who have a particular disease or attribute at a specified point in time or over a specified period of time
- Prevalence includes all cases while incidence includes only new ones
- **Period prevalence** is the prevalence measured at a particular point in time; proportion of persons with a particular disease or attribute on a particular date
- **Period prevalence** is the prevalence measured over an interval of time; proportion of persons with a particular disease or attribute at any time during the interval
- Prevalence is used for chronic diseases

Mortality Frequency Measures

- a measure of the frequency of occurrence of death in a defined population during a specified interval

FORMULA: (Deaths occurring during a given time period/size of population among which the deaths occurred)*10^n

Types of mortality rates:

- crude (rate from all causes of death for a population)
- cause-specific (rate from a specified cause for a population)
- age-specific (rate limited to a particular age group)
- infant mortality (# of deaths among children less than one year of age reported during a given time period/# of live births reported during the same time period)*1000
- neonatal (infant mortality rate but covers the number of deaths for children under age of 28 days)

- postneonatal (infant mortality rate but covers number of deaths for children from 28 days of age up to but not including 1 year of age)

Case-fatality rate

- proportion of persons with a particular condition who die from that condition; measure of the severity of the condition

FORMULA: # of cause-specific deaths among the incident cases/# of incident cases)*10^n

Natality measures

- population-based measures of birth

Measures of Association

- quantifies relationship between exposure and disease among two groups
- include relative risk, rate ratio, odds ratio, and proportionate mortality ratio

Relative Risk

- AKA risk ratio (relative risk) and compares the risk of a health event (disease, injury, death, etc) among one group with the risk among another group
- **divide attack rate in group 1 by attack rate in group 2**
- two groups are usually differentiated by demographic factors like gender or by exposure to a suspected risk factor (e.g. ate potato salad or not)
- usually EXPOSED and UNEXPOSED group

FORMULA: (attack rate of group of primary interest/ attack rate in comparison group)

- =1.0 indicates identical risk among the two groups
- < 1.0 indicates an increased risk for the group in numerator (usually exposed group)
- > 1.0 indicates decreased risk for exposed maybe insinuating that exposure might protect against disease occurrence
- Example: risk ratio is 0.28. That means vaccinated children against varicella were about a quarter as likely to develop varicella as unvaccinated children.

Odds Ratio

- another measure of association that quantifies the relationship between an exposure with two categories and health outcome
- could be called cross-product ratio
- ADVANTAGES: when health outcome is uncommon, odds ratio provides reasonable approximation of the risk ratio; can be calculated with a case-control study

FORMULA: (ad/bc) OR (a/b)*(c/d)

- a is # of persons exposed and with disease
- b is # of persons exposed but without disease
- c is # of persons unexposed but with disease
- d is # of persons unexposed and without disease
- a+c is total # of persons with disease (case-patients)
- b+d is total # of persons without disease (controls)

Vaccine efficacy or effectiveness

- measure the proportionate reduction in cases among vaccinated persons
- vaccine efficacy (VE) is used when a study is carried out under ideal conditions such as during a clinical trial
- vaccine effectiveness (VE) is used when a study is carried out under typical field conditions
- greater the percentage reduction of illness in the vaccinated group, the greater the vaccine efficacy/effectiveness

FORMULA: **Risk among unvaccinated group-risk among vaccinated group/risk among unvaccinated group** OR **1- relative risk**

- example: A VE of 72% indicates that there is a 72% reduction in disease occurrence among the vaccinated group

Epidemic Curves

- a histogram that displays # of cases of disease during an outbreak or epidemic by times of onset (x= date/time of onset of illness and y= # of cases)
- If purpose is to show temporal relationship between time of exposure and onset of disease, then use the rule that intervals should be approx ¼ (or between ⅛ and ⅓) of the incubation period

5 things epi cruves can tell you about an outbreak

1. Outbreak's time trend, which is the distribution of cases over time
2. outliers; cases that stand apart from overall pattern
3. general sense of illness magnitude
4. Inferences about outbreak's mode of spread
5. most likely period of exposure

Public Health Surveillance

- systematic collection, consolidation, and evaluation of morbidity and mortality reports and other relevant data
- using data to monitor health problems in order to facilitate their prevention or control
- **passive surveillance** (provider-initiated) is a form of data collection in which health-care providers send reports to a health department on the basis of a known set of rules and regulations
- **active surveillance** (health department-initiated) is usually limited to specific disease over a limited period of time, such as after a community exposure or during an outbreak

Key characteristics of surveillance

- **Timeliness**: implement effective control measures
- **Representation:** provide an accurate picture of temporal trend of the disease
- **Sensitivity:** allow identification of individual persons with disease to facilitate treatment; quarantine, or other appropriate control measures **(A/A+C)**
- **Specificity**: exclude persons not having disease **(D/B+D)**

	YES	**NO**
YES	**true positive (A)**	**false positive (B)**
NO	**false negative (C)**	**true negative (D)**

Hill's Criteria for Causality

1. Temporal Relationship
   - exposure ALWAYS precedes the outcome
   - If factor A is believed to cause a disease, then factor A must precede the occurrence of the disease
2. Strength
   - the size of the association as measured by appropriate stats tests
   - stronger the association, the more likely it is that the relation of "A" to "B" is causal
   - E.g. the more highly correlated hypertension is with a high sodium diet, the stronger is the relation between sodium and hypertension
3. Dose-Response Relationship
   - increasing amount of exposure increases the risk
   - if dose- response is present, it;s strong evidence for a causal relationship
   - absence of dose-response doesn't rule out a causal relationship
4. Consistency

- association is consistent when results are replicated in studies in different settings using different methods
- if a relationship is truly causal, we would see the results to be consistent throughout different studies in different populations

5. Plausibility
   - association agrees with currently accepted understanding of pathological processes
   - there has to be be some theoretical basis for positing an association between a vector and a disease
   - has to be logically sound
6. Consideration of Alternate Explanations
   - necessary to determine the extent to which researchers have taken other possible explanations into account and have effectively ruled out such alternate explanations
   - always necessary to consider multiple hypotheses before making conclusions about causal relationships between any two items under investigation
7. Experiment
   - condition can be altered (prevented or ameliorated) by an appropriate experimental regimen (prescribed course of medical treatment, way of life, or diet)
8. Specificity
   - established when a single supposed cause produces a specific effect
   - considered to be WEAKEST of all criteria
   - provides additional support for causal relationship
   - absence of specificity in no way negates a causal relationship
   - Since there are multiple factors influencing outcomes, it's highly unlikely to have a 1-1 cause-effect relationship between two phenomena
9. Coherence
   - association should be compatible with existing theory and knowledge
   - necessary to evaluate claims of causality within context of current state of knowledge within a given field and in related fields

Steps of an Outbreak

1. prepare for field work
2. establish the existence of an outbreak
3. verify the diagnosis
4. construct a working case definition
5. find cases systematically and record information
6. perform descriptive epidemiology
7. develop hypotheses
8. evaluate hypotheses epidemiologically
9. as necessary, reconsider, redefine, and re-evaluate hypotheses
10. compare and reconcile with laboratory and/or environmental studies
11. implement control and prevention measures
12. initiate or maintain surveillance
13. communicate findings

Step 1: Prepare for field work

- must have appropriate scientific knowledge, supplies, and equipment to carry out the investigation before departing for the field
- discuss situation with someone knowledgeable about the disease and field investigations
- know who to contact and which organizations need notification/plan of action

Step 2: Establish existence of an outbreak

- outbreak or epidemic is the occurrence of more cases of disease than expected in a given area or among a specific group of people over a particular period of time

- epidemic sometimes means situations involving larger numbers of people over a wide geographic area
- cluster is antipodal of outbreak and epidemic since it refers to an aggregation of cases in a given area over a particular period without regard to whether the number of cases is more than expected
- need to confirm that the cluster of cases matches the qualifications of an outbreak
- some clusters could turn out to be true outbreaks with a common cause, some are sporadic and unrelated cases of the same disease, and others are unrelated cases of similar but unrelated disease
- observed is compared with the expected which in this case could refer to the number of cases from the previous few weeks or months, or from a comparable period during the previous few years

Step 3: Verify the diagnosis

- ensures that the disease has been properly identified since control measures are often disease-specific
- rules out laboratory error as the basis for increase in reported cases

1. review clinical findings and laboratory results
2. visit one or more patients with the disease which helps with understanding the clinical features and developing a mental image of the disease and patients affected by it
3. summarize clinical features using frequency distributions

Step 4: Construct a working case definition

- case definition is a standard set of criteria for deciding whether an individual should be classified as having the health condition of interest
- case definition clinical criteria, restrictions by time, place, and person
- clinical criteria should be based on simple and objective measures such as fever>40 degrees C, three or more loose bowel movements per day, or myalgias (muscle pain) severe enough to limit patient's usual activities
- time e.g. to persons with onset of illness within past 2 months
- place e.g. residents of the nine-county area
- person e.g. persons with no previous history of a positive tuberculin skin test or premenopausal women
- case definition does NOT include exposure of interested risk factor (common mistake)
- different classes of case definitions include confirmed, probable, possible/suspect
- for confirmed, case usually needs laboratory verification
- for probable, has typical clinical features of the disease without lab confirmation
- for possible, has fewer of the typical clinical features
- case definition is a tool for classifying someone as having or not having the disease of interest, but few case definitions are 100% accurate
- try to avoid false-positive cases; usually miss people who are infected but do not display symptoms

Step 5: Find cases systematically and record info

- Investigators could conduct stimulated or enhanced **passive surveillance** by sending a letter describing the situation and asking for reports of similar cases
- could conduct **active surveillance** by telephoning or visiting the facilities to collect info on any additional cases

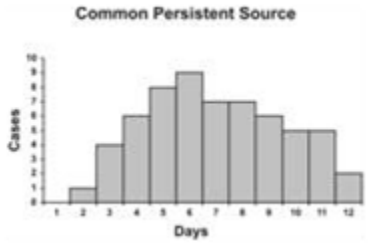
Step 6: Perform descriptive epidemiology

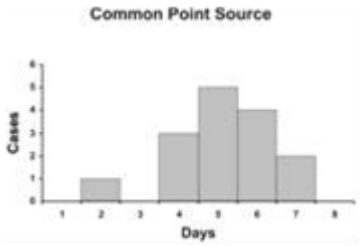
- systematically describe some of the key characteristics of the sick people and outbreak is characterized by time, person, and is called **descriptive epidemiology**

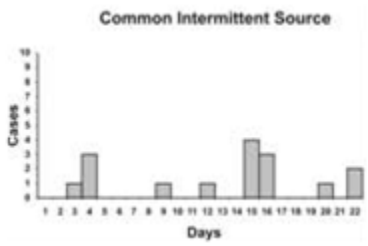
Time

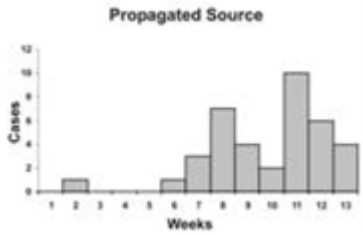
- use epi curves

- displays magnitude of the epidemic and permits investigators to distinguish from endemic and epidemic
- to draw an epi curve, must know the time/date of onset of illness for each case
- consider epi curve's overall shape
- steep upslope and more gradual down slope (log-normal curve) is characterized as a **point-source epidemic** which persons are exposed to the same source over a relative brief period
- any sudden rise in the number of cases suggests exposure to a common source an incubation period earlier
- all cases occur within one incubation period in **point-source**
- if the duration of exposure is longer, the epidemic is a **continuous common- source epidemic,** and the epidemic curve has a plateau rather than a peak
- **intermittent common-source epidemic** (in which exposure to the causative agent is sporadic over time) usually produces an irregularly jagged epi curve reflecting the intermittence and duration of exposure and number of persons exposed
- **propagated epidemics** which are spread from person-to-person with increasing numbers of cases in each generation should have a series of progressively taller peaks in one incubation period apart, but few produce this pattern in reality









Place

- can demonstrate clusters or patterns which provide important etiologic clues
- spot map is a useful technique for illustrating where cases live, work, or may have been exposed
- spot map by site of presumed exposure is more informative than one by residence
- use area map instead if need to calculate incidence for different areas with different population densities

Person

- provide description of whom the case-patients are and who is at risk
- usually describe host characteristics (age, race, sex, and medical status) and possible exposures (occupation, leisure activities, and use of medications, tobacco, drugs)
- two most commonly described host characteristics are age and sex since they are easily collected and often related to exposure and risk of disease
- occupation, race, or other personal characteristics specific to the disease under investigation and the setting of the outbreak may also be important

Evaluating hypotheses epidemiologically (analytic epidemiology)

- key feature is a comparison group which compares the observed pattern among case patients/exposed with the expected pattern among noncases/unexposed persons

Retrospective cohort studies

- study of choice for an outbreak in a small, well defined population, such as outbreak of gastroenteritis among wedding guests
- investigator contacts each member of the defined population, determines each person's exposure to possible sources and vehicles, and notes whether the person later becomes ill with the disease in question
- then calculate attack rate for those exposed to a particular item and an attack for those who were not exposed

Three following criteria is considered a strong suspect:

1. attack rate is high among those exposed to the item
2. attack rate is low among those not exposed, so difference between attack rates is high
3. most of the case-patients were exposed to the item, so that the exposure could "explain" or account for most, if not all, of the cases

Relative and attributable risk

- investigator compares the attack rate in the exposed group to the attack rate in the unexposed group to measure assoc. between the exposure and disease (risk ratio/relative risk)
- when attack rate for the exposed is same as attack rate for unexposed, the RR is 1.0 which means the exposure is said to not be associated with disease
- the greater the difference in attack rates between the exposed and unexposed groups, the larger the RR, and the stronger the assoc between exposure and disease

Case-control studies

- used in many more settings since more often than not, the population is not well defined and speed of investigation is important since cohorts take longer
- asks both case-patients and a comparison group of people without the disease (controls) about their exposures
- calculate odds ratio to quantify the relationship between exposure and disease

Odds ratio

- (# of exposed cases* # of unexposed controls)/(# of exposed controls * # of unexposed cases)
- e.g. if an odds ratio were 11.6, then the data would seem to indicate that persons exposed to grocery store A had 11.6 times the odds of developing legionellosis that persons not exposed to that store

Vocabulary

contagious disease- one that is transmitted through contact (leprosy, trachoma, scabies)
infection- entry and development or multiplication of an infectious agent in the body of man or animals; doesn't always cause illness (several levels/gradients of infection which are colonization (S. aeureus in skin), subclinical or inapparent infection (polio), latent infection (herpes), or manifest/clinical infection)
infestation- lodgement, development, and reproduction of arthropods on surface of body or in clothing such as lice or itch mites; can also refer to the invasion of the gut by parasitic worms (ascariasis)
contamination- presence of an infectious agent on a body surface, on or in clothes, beddings, toys, surgical instruments or dressings, or other articles or substances including water and food
holoendemic- expresses a high level of infection beginning early in life, and affecting most of child population, leading to a state of equilibrium such that the adult population shows evidence of the disease much less commonly than do children (malaria)
exotic- describes disease which are imported into a country in which they do not otherwise occur
primary or index cases- person who comes into and infects the population is the primary case
secondary cases- those who subsequently contract the infection

epizootic- outbreak or epidemic of disease in an animal population (rift valley fever)
enzootic- endemic occurring in animals (bovine TB)
nosocomial infection- (hospital acquired) an infection originating in a patient while in a hospital or another health care facility; has to be a new disorder unrelated to patient's primary condition
opportunistic infection- infection by organisms that take the opportunity provided by a defect in host defense to infect the host and thus cause disease
eradication- termination of all transmission of infection by extermination of the infectious agent through surveillance and containment
elimination- sometimes used to describe eradication of a disease from a large geographic region
isolation- separate ill persons who have a communicable disease from those who are healthy; restricts the movement of ill persons to help stop spread of certain disease
quarantine- separate and restrict the movement of well persons who may have been exposed to a communicable disease to see if they become ill; people don't show symptoms
arenavirus- type of RNA virus which causes Lassa fever
autogenous infection- results from a patient's own microflora
toxin- microbial product or component that at low concentrations can injure a cell/organism
plague- seriously life threatening infectious disease that is usually transmitted to humans by the bites of rodents/fleas; three major forms: bubonic, septicemic, pneumonic

Acronyms
HIV- human immunodeficiency virus
ICU- intensive care unit
MRSA- menthicillin-resistant staphylococcus aureus
UTI- urinary tract infection
IBS- irritable bowel syndrome

Misc. Notes
Difference between intoxication and infection: intoxication is usually caused by toxins and chemicals while infection is usually caused by pathogens such as bacteria and parasites (usually takes much longer to produce symptoms which also last longer)

Difference between active, herd, and passive immunity:
active- resistance developed in response to stimulus by an antigen and usually characterized by the presence of antibody produced by the host
herd- resistant to a group to invasion and spread of an infectious agent, based on resistance to infection of a high proportion of individual members of the group
passive- immunity conferred by an antibody produced

Types of Diseases and other terminology
aneurysm- excessive enlargement of an artery caused by a weakening of the artery wall
Ascariasis (parasitical)- caused by *Ascaris lumbricodes* which is hookworm/whipworm aka soil-transmitted helminths
Shingles (viral)- caused by *Varicella zoster*
Anthrax (bacterial)- caused by *Bacillus anthracis* a gram-positive bacteria
Cat Scratch Disease, Trench Fever, and Carrion's Disease (bacterial)- *Bartonella* bacteria
Pediculosis (parasitic)- infestation with lice
Scabies (parasitic)- contagious skin disease marked by itching and small raised red spots caused by itch mite
Lyme Disease (parasitic)- caused by blacklegged ticks

Botulism (bacterial)- food poisoning found on improperly sterilized meat/other foods; caused by *Clostridium botulinum*; it's a rare illness that paralyzes its victims and the bacteria produces a nerve toxin which induces the paralysis
Bovine Spongiform Encephalopathy (prion)- mad cow disease
Bronchiolitis (viral)- infects the lungs and breathing passages
Aspergillosis (fungal)- a common mold that lives indoors and outdoors and makes others sick through its spores
Type of Meningitis infection, Meningococcal infections (bacterial)- infects bloodstream or meninges which line the brain and spinal chord
Dengue Hemorrhagic Fever (viral)- disease in the tropics transmitted by mosquitoes which causes sudden fever and acute pain the joints
Capillariasis (parasitic)- transferred through fecal matter of infected animals and can lead to hepatitis
Leprosy (bacterial)- AKA Hansen's Disease which causes discoloration and lumps on skin from malfunctions in nerves and mucous membranes
Listeriosis (bacterial) caused by food contamination
Meningitis (viral)- spread thru fecal contamination or bacterial- spread through respiratory ways) caused by the inflammation of the protective membranes covering the brain and spinal cord known as the meninges
Ebola Hemorrhagic Fever (viral): spread through bodily fluids and Crystic/Alveolar
Echinococcosis (parasitic): infection with tiny tapeworms
SARS (caused by a coronavirus)- Severe Acute Respiratory Syndrome
Pertussis (bacterial)- Whooping Cough caused by *Bordetella pertussis*
Measles (viral)- highly contagious and is preventable thru vaccine; characterized by rash, coughs, fever, etc.; targets young children; genus *Morbillivirus*
Mumps (viral)- preventable through vaccine; starts out with fever, headache, muscle aches then slowly develops into swollen salivary glands
Chikungunya Fever (viral)- transmitted through mosquitoes
Cholera (bacterial)- caused by *Vibrio cholerae*
Cyclosporiasis (parasitic)- caused by protozoan *Cyclospora cayetanesis;* transmitted by feces or fecally contaminated produce or water
Syphilis (bacterial)- sexually transmitted disease caused by *Treponema pallidum*
Legionnaires disease (bacterial)- respiratory disease which can infect lungs causing pneumonia or may be a milder form that leaves patient with the flu known as **Pontiac Fever**
Histoplasmosis (fungal)- can be found in bird and bat droppings and caused by breathing in fungal spores
Toxoplasmosis (parasitic)- caused by the common parasite Toxoplasma gondii parasite; those with weak immune systems are at risk but most of the times those with strong immune systems aren't affected
Schistosomiasis (parasitic)- caused by flatworms and also goes by the name of **bilharzia, Snail Fever, Katayama fever,** infects clean water and parasites leave infected freshwater snails into the water
Giardiasis (parasitic)- infection of the small intestine which is caused by a microscopic parasite *Giardia lamblia*
Phthiriasis (parasitic)- pubic "crab" lice; direct contact (sexual activity)
Tetanus (bacterial)- caused by bacterium *Clostridium tetani* and induces pain in the jaws and neck thus claiming the name lockjaw
Brucellosis (bacterial)- highly contagious zoonotic disease usually contracted after ingesting unpasteurized milk or consuming infected meat or coming in contact with infected animals' secretions

Amebiasis (parasitic)- infection with amoebae usually referring to *Entamoeba histolytica*; symptoms include severe dysentery
Zika virus (viral)- spread through mosquito bites- making is vectorborne; common symptoms include fever, rash, joint pain, and conjunctivitis (red eyes)
Gullain-Barre Syndrome (viral or bacterial)- body's immune system attacks one's own peripheral nervous system

More Study Designs

Ecologic Study

- **Ecologic study** involves making comparisons between variables where the unit of analysis is the population rather than an individual
- EX:) determining an association between eating five or more servings of fruits and veggies per day and obesity
- Limitation of ecologic data is that they're unable to control for potential confounding factors which may contribute to the association
- Possible for those that don't eat 5 more servings of fruits and veggies per day are less active which leads to obesity
- **Ecologic fallacy** is when the researcher mistakenly assumes that because the majority of a group has a characteristic, the characteristic is definitively associated with those experiencing a health-related state or event in this group
- Appropriate for environmental settings

Case Reports and Case Series

- **Case report** is a profile of a single individual
- **Case series** involves a small group of patients with a similar diagnosis
- EX:) from october 4 to november 2, 2001, first 10 cases of inhalational anthrax were identified in US
- Both case reports and series can suggest new rise of a disease of epidemic if the disease exceeds what is expected
- HIV example with 1981 homosexual reports and then growing into other causes such as sharing needles and blood transfusions in 2007

Cross-Sectional Surveys (AKA prevalence surveys)

- **Cross sectional survey** is conducted over short period of time (few days or weeks) and the unit of analysis is individual
- No follow up period
- Useful for examining association among health-related events and personal characteristics like age, gender, race, ethnicity, marital status, etc
- Reveal who is at greatest risk and provide clues as to causes of the disease
- Useful for estimating prevalence data
- Establish prevalence of knowledge and attitudes about diseases
- Strengths:
- Can study several associations at once
- Conducted over short period of time
- Produce prevalence data
- Relatively inexpensive
- Provide evidence of need for analytic epidemiologic study
- Limitations
- Weak in establishing whether an exposure preceded or followed a health outcome (temporality)
- Cannot prove causation
- Method not feasible for studying rare conditions and has potential for response bias

- **Response bias** is a type of selection bias where those who respond to a questionnaire are systematically different from those who don't respond
- Those who don't respond could be smokers and undereducated people making the study less representative of the population

Serial Surveys

- **Serial study** is a cross sectional routinely conducted
- Reveal changes in patterns of health-related states or events over time