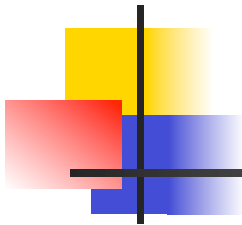


2017 DISEASE DETECTIVES (B,C)

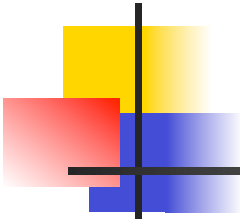
KAREN LANCOUR
National Bio Rules Committee
Chairman



Event Rules – 2017

DISCLAIMER

This presentation was prepared using draft rules. There may be some changes in the final copy of the rules. The rules which will be in your Coaches Manual and Student Manuals will be the official rules.

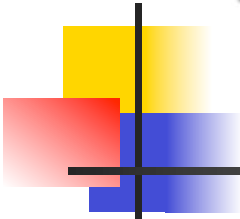


Event Rules – 2017

There is a three topic rotation for Disease Detectives: Environmental Quality, Population Growth, and Food Borne Illness – each on a two year rotation

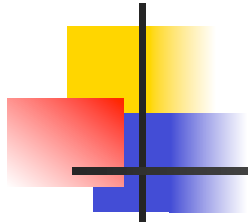
2017 is Foodborne Causes of Illness

BE SURE TO CHECK THE 2017 EVENT RULES FOR EVENT PARAMETERS AND TOPICS FOR EACH COMPETITION LEVEL



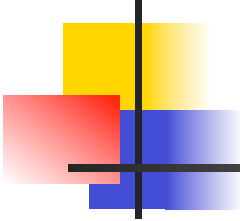
TRAINING MATERIALS

- **Training Power Point** – content overview
- **Training Handout** - content information
- **Sample Tournament** – sample problems with key
- **Event Supervisor Guide** – prep tips, event needs, and scoring tips
- **Internet Resources & Training Materials** – on the Science Olympiad website at www.soinc.org under Event Information
- **A Biology-Earth Science CD, a Disease Detectives CD and the Division B and Division C Test Packets are available from SO store at www.soinc.org**



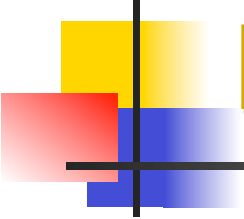
Epidemiology

- **2017 focus is Foodborne Causes of Health Problems**
- **Content**
 - **Definitions** of basic epidemiologic terms
 - **Categories** of disease causing agents
 - **Modes** of disease spread
 - **Triads** of analysis (e.g., person/place/time & agent/host/environment)
 - **Basis for taking action** to control and prevent the spread of disease
- **Process Skills** – hypothesis, observations, inferences, predictions, variable analysis, data analysis, calculations, and conclusions
- **Event Parameters** – be sure to check the rules for resources allowed



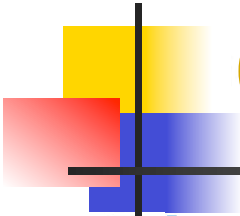
Some Foodborne Causes of Health Problems

- **Bacteria**
- **Viruses**
- **Parasites**
- **Protozoa**
- **Natural toxins**
- **Other pathogenic agents (as Prions)**



Common Foodborne Pathogens

- See the chart “Foodborne Illness: What You Need to Know” provided by FDA
- <http://www.fda.gov/Food/ResourcesForYou/Consumers/ucm103263.htm>



On-line Text Books

Principles of Epidemiology 3rd edition from CDC

http://www.cdc.gov/osels/scientific_edu/SS1978/SS1978.pdf

Epidemiology Basics published by the World Health Organization

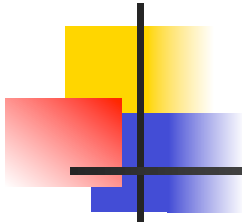
http://whqlibdoc.who.int/publications/2006/9241547073_eng.pdf

Basic-Statistics-and-Epidemiology-a-Practical-Guide

<http://www.scribd.com/doc/7885761/Basic-Statistics-and-Epidemiology-a-Practical-Guide>

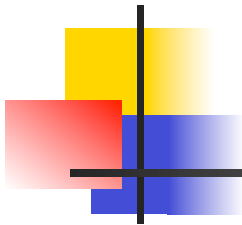
Causes of Foodborne Illness – Bad Bug Book v. 2

<http://www.fda.gov/Food/FoodborneIllnessContaminants/CausesOfIllnessBadBugBook/default.htm>



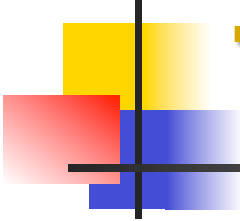
Event Makeup

- **Format and material** of the Division B and C event is similar except that the level of reasoning and math skills should be consistent with the grade level. **Div. C may include some statistics-not more than 10% of competition**
- **Differences** between the two levels should be reflected in both the type of questions asked and the scoring rubrics.



EPIDEMIIOLOGY

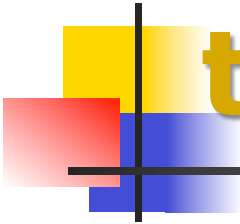
- **Health of populations instead of individuals**
- **Scientific method – organized problem solving**
- **Distribution and determinants of disease in human populations**
- **Prevent and control those diseases**
- **Health-related events:**
 - **chronic diseases**
 - **environmental problems**
 - **behavioral problems**
 - **injuries**
 - **infectious diseases**



Types of skills needed

- Recognize **risk factors** for health problems
- Know the **components of the scientific method** used in investigating a disease outbreak to real-life situations affecting health
- Understand and interpret the **basic concepts of mathematics** (rates & proportions as attack rate, relative risk & odds ratio) used to assess health risks
- Recognize an epidemiological **case definition**
- Know the different **types of study designs** used by epidemiologists and be able to recognize them from written accounts

Scientific Method as related to Disease Detectives

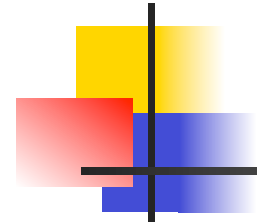


- **Obtain Background Information**
- **Define the Problem**
- **Formulate Hypothesis**
- **Develop a Study to Test the Hypothesis**
- **Collect Data and Observations**
- **Evaluate Results**
- **Determine if Hypothesis is true/modify**
- **Formulate Conclusions**
- **Report Results**

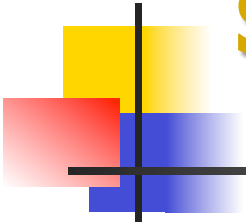
Compare these steps to 10 Steps in Outbreak Investigation

Outbreak Investigation

10 Steps

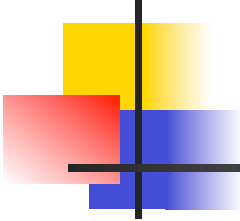


- **Outbreak** – (localized epidemic) – more cases of a particular disease than expected in a given area or among a specialized group of people over a particular period of time.
- **Epidemic** – large numbers of people over a wide geographic area affected.
- **Pandemic** -An epidemic occurring over a very wide area (several countries or continents) and usually affecting a large proportion of the population.
- **Cluster** –an aggregation of cases over a particular period esp. cancer & birth defects closely grouped in time and space regardless of whether the number is more than the expected number. (often the expected number of cases is not known.)
- **Public Health Surveillance** - the systematic collection, analysis, interpretation, and dissemination of health data to gain knowledge of the pattern of disease occurrence in order to control and prevent disease in the community.



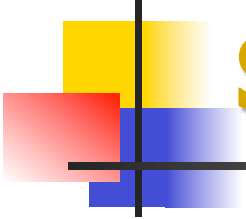
Step 1: Prepare for Field Work

- 1. Research, supplies & equipment** – research the disease or situation and gather needed supplies & equipment to conduct the investigation
- 2. Administrative arrangements** – make official administrative and personal travel arrangements
- 3. Local contacts** - follow protocol



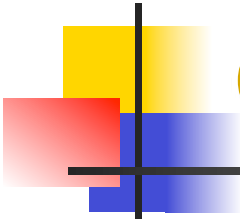
Step 2: Establish the Existence of an Outbreak

- 1. Expected # of cases for area** – use records as health dept., hospital records, death records, physician records, doctor survey to determine expected # for the area in a given time (Flu example)
- 2. Other factors in play** – numbers may exceed normal due to factors such as better reporting, seasonal fluctuations, population changes



Step 3: Verify the Diagnosis

1. **Proper diagnosis** - verify the procedures used to diagnose the problem and check methods used for identifying infectious and toxic chemical agents
2. **Not lab error** – be sure that the increase number of cases are not due to experimental error
3. **Commonality** – interview several persons who became ill to gain insight concerning possible cause, source, and spread of disease or problem



Step 4: Define and Identify Cases

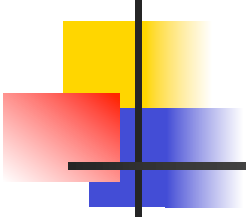
Case definition – establish with the 4 components or standard criteria for determining who has the disease or condition

a. **Clinical information** – about the disease or condition

b. **Characteristics** - of the affected people

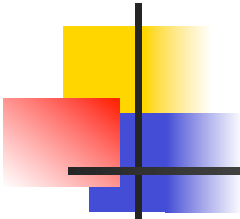
c. **Location or place** - as specific as possible as restaurant, county, or several specific areas

d. **Time sequence** - specific time during which the outbreak or condition occurred



Case Definition for Influenza-like (ILI)

- ***A case of influenza-like illness (ILI) or influenza*** is defined as a person with fever of 37.8°C (100°F) or greater orally or 38.3°C (101°F) rectally PLUS cough during the influenza season (October 1 through May 31).
- **A person with laboratory confirmed influenza** is also considered a case even if the person does not have cough and fever.



Identifying cases

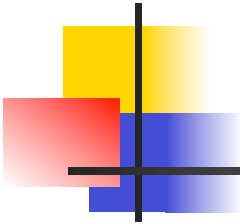
Identification of specific cases – kind & number –
count specific cases

Confirmed – have diagnosis with case definition
plus lab verification

Probable – many factors point to diagnosis but may
lack lab verification

Possible – some factors point to diagnosis

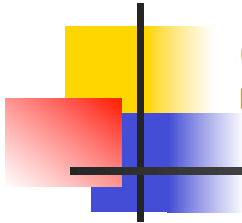
Note: Initial reports may be only a small sampling
of the total problem. Be sure to expand search to
determine the true size and extent of the problem



Line Listing

Line Listing – chart of specific cases including information about each case

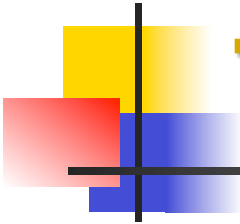
- **Identifying information** - ID or case # - left column + name or initials
- **Clinical information** – diagnosis, symptoms, lab results, hospital – death?
- **Descriptive: time** – date & time of onset + date of report
- **Descriptive: person** – age, sex, occupation, other characteristics
- **Descriptive: place** – street, city or county + specific site
- **Risk factors & possible causes** – specific to situation (disease) and outbreak setting



Sample Line Listing

Sample Line Listing from six case report forms on a wedding reception outbreak

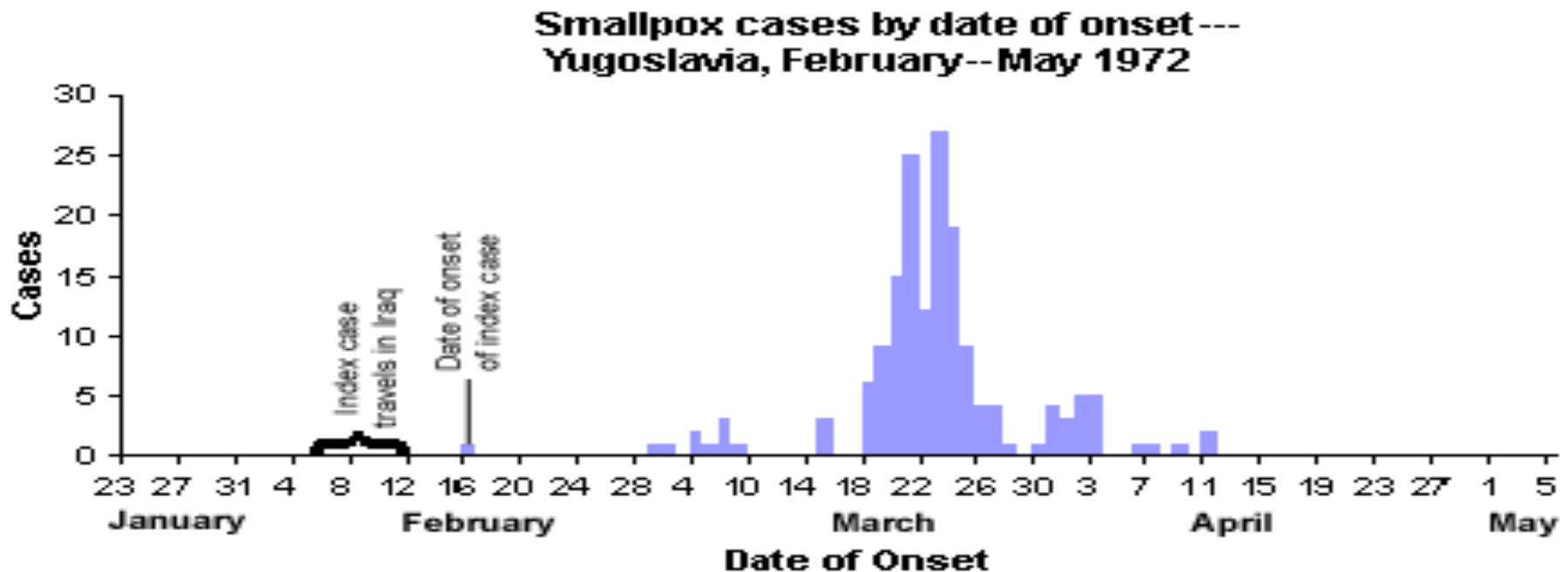
ID #	Initials	Date of Onset	Diagnosis Confirmed	How	Age	Sex	County	Physician	Wedding
1	KR	7/23	probable trichinosis	Not done	29	M	Columbia	Goodman	Yes
2	DM	7/27	trichinosis	Biopsy	33	M	Columbia	Baker	Yes
3	JG	8/14	probable trichinosis	Not done	26	M	Columbia	Gibbs	Yes
4	RD	7/25	trichinosis	Serologia	45	M	King	Webster	Yes
5	NT	8/4	trichinosis	Not done	27	F	Columbia	Stanley	Yes
6	AM	8/11	R/Otrichinosis	Pending	54	F	Clayton	Mason	Yes



Step 5: Describe in terms of Time, Place and Person Triad

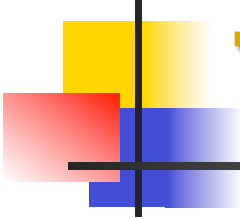
- **TIME** – a histogram showing the course of the disease or outbreak to identify the source of the exposure **Epidemic Curve or Epi curve** (Begin early & update often)
- **PLACE** – geographic extent plus spot map of cases to identify groups specific to a location or environmental factors
- **PERSON** – identify the affected population by type of person or by exposures as age, sex, high risk exposure as with AIDS

EPI Curve (Epidemic Curve)



x axis= units of time equal to $1/4$ to $1/3$ incubation time and **y axis** = # of cases

Note: a single point or source will have only one peak, a plateau will show a continuous common source, several uniform peaks will indicate a propagated outbreak spread from person to person



Types of Descriptive Studies

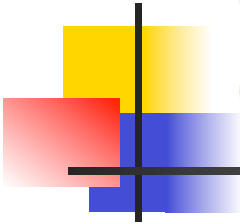
Types of Descriptive Studies – Study the distribution of a problem by cases or outcome, frequency in population, exposure, time pattern or environmental factor (Studies without a control group can be used for descriptive purposes!)

- a. **Case report/case series** – case report = detail report of a single patient from one or more doctors while case series = characteristics of several patients
- b. **Correlative studies** – correlates general characteristics of the population with health problem frequency with several groups during the same period of time

Time series analysis – correlate within the same population a different point in time

Ecologic relations – correlate relative to specific ecologic factors as diet

- c. **Cross sectional** - a survey of a population where participants are selected irrespective of exposure or disease status

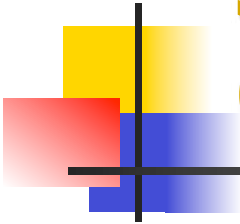


Step 6: Develop Hypothesis (Agent/Host/Environment triad)

1. **Agent /host /environment** = agent capable of causing disease & its source host or persons susceptible to agent + environment allowing them to get together

Infectious Groups: viruses, bacteria, protistans (protozoa), fungi, animals (worms)

2. **Testable** – hypothesis must be in a form that is testable
3. **Current knowledge & background** – it should be based upon current knowledge and be updated or modified as new information is uncovered!!!



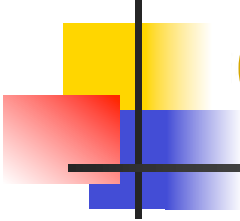
Step 7: Evaluate Hypothesis (Analytical Studies = Control Group)

1. Compare with established fact – these are used when evidence is strong and clear cut
2. **Observational Studies:** (Study determinants of health problems – how & why)

Cohort – Based upon *exposure status* whether or not they have outcome (illness) *works forward from exposure*

Case-Control - Works *backward from effect or illness* to suspected cause.

3. *Must have lab verification to validate hypothesis.*



Cohort Study – Exposure

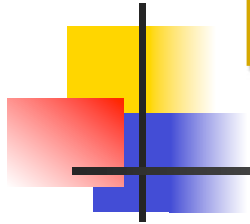
- Both groups have a known exposure and are checked for future outcomes or illness.
- **retrospective**: (historic cohort) starts at exposure in past & moves forward to outcome
- **prospective**: starts a present exposure and moves forward in time to outcome

Sample Cohort Study using 2 X 2 table

- **400 people** attended a special awards dinner
- **Some persons became ill.** The suspected culprit was the **potato salad**. The population at the dinner was then surveyed to determine who became ill.

	Disease Yes	Disease No
Exposed (Ate salad)	150 (a)	30 (b)
Unexposed(no salad)	50 (c)	170 (d)

Calculating Attack Rate & Relative Risk



	Disease Yes	Disease No
Exposed (Ate salad)	150 (a)	30 (b)
Unexposed (no salad)	50 (c)	170 (d)

- **Attack rate** – the rate that a group experienced an outcome or illness = number sick ÷ total in that group (Look for high attack rate in exposed & low rate in unexposed)

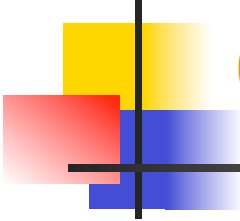
$$\text{exposed} = a \div (a+b) = 150 \div 180 = 80\%$$

$$\text{unexposed} = c \div (c + d) = 50 \div 220 = 20\%$$

- **Relative risk** = $[a \div (a+b)] / [c \div (c+d)] = 80\% \div 20\% = 4$

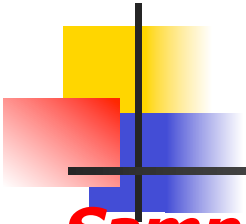
Interpreting Results of Cohort Study

- **Relative risk** estimates the extent of the association between an exposure and a disease. It estimates the likelihood of developing the disease in the exposed group as compared to the unexposed group.
- **A relative risk >1.0** indicates a positive association or an increased risk. This risk increases in strength as the magnitude of the relative risk increases.
- **A relative risk $= 1.0$** indicates that the incidence rates of disease in the exposed group is equal to the incidence rates in unexposed group. Therefore the data does not provide evidence for an association. (What about $RR < 1$?)
- **Relative risk** is cannot be expressed in negative numbers.



Case Control - Illness

- Works *backward from effect or illness* to suspected cause.
- **Control group** is a selected group who has similar characteristics to the sick group but is not ill.
- They are then checked for similar exposures.
- It is often hard to select the control group for this type of study.
- *Odds Ratio* is calculated to evaluate the possible agents & vehicles of transmission



Sample Case-Control Study

Sample:

Several patients were diagnosed with Hepatitis A.

- The local Restaurant A was thought to be the source of the infection.
- 40 case patients and a similar disease free group or control were contacted to determine if they ate at Restaurant A. (copy to board, expectation as an explanation)

2 X 2 table of data

Ate	Case patients	Controls	Total
Yes	a = 30	b = 36	66
No	c = 10	d = 70	80
Total	40	106	146

Calculating Odds Ratio

2 X 2 table of data:

Ate	Case patients	Controls	Total
Yes	a = 30	b = 36	66
No	c = 10	d = 70	80
Total	40	106	146

Odds Ratio =

$$\frac{\text{Odds of exposure in cases}}{\text{Odds of exposure in controls}} = \frac{a/c}{b/d} = \frac{a d}{b c} = \frac{30 \times 70}{36 \times 10} = 5.8$$

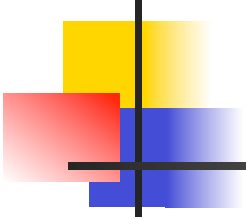
This means that people who ate at Restaurant A were 5.8 times more likely to develop hepatitis A than were people who did not eat there.

a = # of case patients exposed

c = # of case patients unexposed

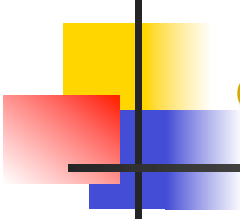
b = # of control exposed

d = # of control unexposed



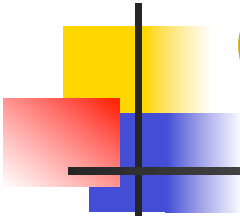
Step 8: Refine Hypothesis and do Additional Studies

1. **No confirmation of hypothesis** - where analytical studies do not confirm hypothesis. May need to look for a new vehicle or mode of transmission
2. **More specific** – May need to be more specific in make up of case patients & controls
3. **Verify with environmental/laboratory studies** - verification with careful control conditions is very important



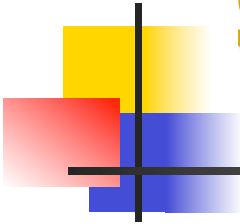
Step 9: Implement Control and Preventative Measures

1. **As soon as source is known** – people are sick or hurting and we need to know: agent & source of agent + susceptibility of host + chain of transmission as soon as possible
2. **Aim at chain of agent-source-host** – break the chain of transmission at any of its 3 points
3. **May interrupt transmission or exposure** – with control of vehicles or patient isolation
4. **May reduce susceptibility** – with immunization, legal issues and/or education



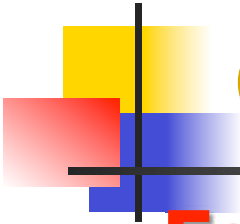
Criteria to Draw Conclusions

1. **Temporality** – cause/exposure must precede effect/outcome
2. **Consistency** – observation of association must be repeatable in different populations at different times
3. **Coherence, 1-1 relationship** – exposure is always associated with outcome/ outcome is always caused by the specific exposure
4. **Strength of association** – relationship is clear and risk estimate is high
5. **Biological plausibility** – biological explanation makes sense
6. **Dose/response (biologic gradient)** – increasing risk is associated with increasing exposure (population)



Step 10: Communicate Findings

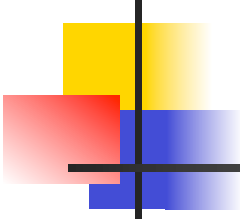
1. **Oral briefing** – inform local health officials or other need-to-know groups as soon as information is available
2. **Written report** – usually done in scientific format for future reference, legal issues, and education



Potential Types of Error in Data Collection - Division C

■ False Relationships

- **Random Error** - the divergence due to chance alone, of an observation on sample from the true population value, leading to lack of precision in measurement of association (height vs temp vs pH example)
- **Bias** - systematic error in an epidemiologic study that results in an incorrect estimation of the association between exposure and health-related event (ocean temp example)



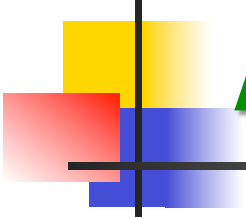
Potential Types of Error in Data Collection – Div. C

- **Non-Causal Relationships**
 - **Confounding** – occurs when the effects of two risk factors are mixed in the occurrence of the health-related event under study - when an extraneous factor is related to both disease and exposure (example of grey hair and CAD)

Statistics for Division C

Descriptive Epidemiology

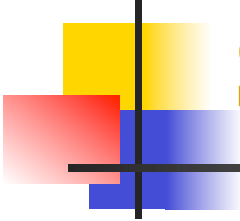
- **Mean**
- **Median**
- **Mode**
- **Variance**
- **Standard deviation**
- **Standard error**
- **Confidence intervals of means**



Statistics for Division C

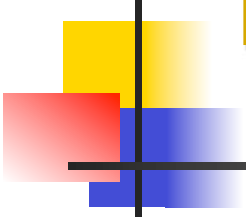
Analytic Epidemiology

- **Z-test**
- **T-test**
- **Paired T-test**
- **Chi-square**
- **McNemar test for paired data**
- **Fischers exact test**
- **Cochran Mantel-Haenszel summary odds ratio**



Division B – Regional/ State

- **modes of transmission**
- **Calculate health-related rates (attack, incidence, prevalence, case fatality)**
- **Calculate a simple relative risk and describe what it means**
- **Interpret epi curves, temporal patterns and other simple graphic presentations of health data**
- **List, discuss and recognize examples of disease causing agents (physical and biological)**
- **Demonstrate an understanding and ability to use terms such as endemic, epidemic and pandemic; population versus sample, association versus cause.**
- **Describe various types of prevention and control strategies (e.g. immunization, behavior change, etc) and situations where they might be used**



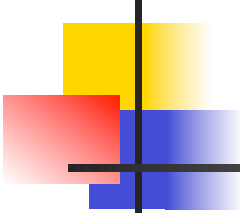
Division B – National

- **Understand how units affect the relative magnitude of a set of rates with different units.**
- **Calculate appropriate measures of risk when given the study design**
- **Complete tables when given all data needed to complete calculations.**
- **Propose a reasonable intervention to a public health problem.**
- **Recognize gaps in information**



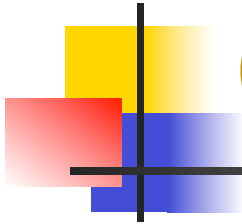
Division C – Regional/ State

- Recognize differences between study designs ,Types of Error, and **do Statistical Analysis (formulas)**
- Calculate measures of risk (e.g. relative risk or odds ratio) when given a description of the study design
- Calculate measures based on data that is not given but that can be readily extracted.
- Recognize how gaps in information influence the ability to extend conclusions to the general population.



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- Recognize unmentioned factors that may influence results.
- Recognize Types of Error and **do Statistical Analysis**
- Convert between rates with different basic units (e.g. incidence per 10000 persons/year to incidence per 100 persons/week).
- Propose a means to evaluate the effectiveness of an intervention or control program.



Questions?

- For comments and questions:
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