Cause: Salmonella

montevideo



Model 1, above, adapted from CDC: "Making Food Safer to Eat: Prevention from Farm to Table infographic." Information sources: CDC and National Center for Emerging and Zoonotic Infectious Diseases (NCEZID).

Directions--Think-Pair-Share: Using the internet or your text as resources or making a guess if necessary, think individually about the answers to questions 1-2, and then compare notes with the person next to you.

1. The organisms that caused illness in all of the cases noted in Model 1 are all types of bacteria. Are these organisms visible to the unaided eye? ______ If not, how do we know that those organisms were responsible for the reported illnesses/deaths? In other words, what kinds of steps do you think went into making the link between specific foods and specific cases of illness? (Hint: Check out the diagram below.)

2. What do we call the branch of science dedicated to the study of the distribution of health-related problems, the factors affecting human health in specific populations, and the means by which human health problems can be controlled?



Directions: Visit the CDC website: <u>http://www.cdc.gov/foodsafety/outbreaks//investigating-outbreaks/</u> and click on "Multistate and Nationwide Foodborne Outbreak Investigations: A Step-By-Step Guide." Next click on "Detecting a Possible Outbreak." If you do not have internet access handy, ask Dr. D. for a hardcopy. As a group, read this section and answers for the following questions.

1. What is a "cluster" and what determines whether the term "cluster" or "outbreak" is used?

2. In 2015, over 100 students from Boston College developed illness due to norovirus exposure after eating at a Chipotle restaurant. Was this an example of a cluster or an outbreak? Why?

3. What is PulseNet and why is it so helpful, especially in light of the speed at which modern food distribution systems work and the speed at which people move around?

Directions: As a group and using whatever resources you choose, consider the information in Model 3 and respond to questions 1-4. Note: The case study components included in Models 3 and 4B are taken directly from training materials made available by the Centers for Disease Control. Only selected portions of the CDC's case study have been included below, and some questions have been added. For further information on the original investigators and other information, see the "Botulism in Argentina" link at: <u>http://www.cdc.gov/epicasestudies/foodborne.html.</u> This case study is based on a real-life outbreak investigation undertaken in Buenos Aires, Argentina, in 1998.

Model 3: ANALYSIS AND INTERPRETATION OF EPIDEMIOLOGIC RESULTS

The following food exposure information was collected through the cohort study. On January 19, the information was tabulated by epidemiologists from the Argentine MOH. (Table 2)

Table 2. Foods eaten by ill and well bus drivers at the home at the terminal bus stop, January 3-7, 1998. (N=21)

Food item	At	e item	Did not eat item	
	III	Well	III	Well
Bologna	1	0	8	12
Hot dog	1	1	8	11
Matambre*	9	2	0	10
Mate**	4	4	5	3
Processed Ham	2	3	7	9
Sauce	7	2	2	10
Salami	1	1	8	11
Solid ham	2	3	7	9

*Matambre is a traditional meat roll in Argentina.

**Mate is green tea.

- 3. Look at the "raw data" (not yet analyzed) in the table above. What aspect of the numbers in the "Ate item" columns makes bologna look suspicious? The person who ate the bologna became ______.
- 4. What aspects of the numbers in the "Did not eat item" columns makes bologna seem much LESS likely to be the culprit in this outbreak? (Hint: How many of those who did NOT eat the bologna became ill anyway?)

1. What is a cohort study?

2. By adding up the total of the numbers in each ROW in the table, can you determine what "N=21" means?

Model 4A: How to interpret TWO important numbers when looking at a table showing relationships between FOODS people ate and the RISK of developing an illness from eating that food. (These tables include data that has been analyzed to try to determine which food may have been the causative agent of an outbreak of foodborne illness.)

1) RELATIVE RISK (RR). From the raw data presented in the previous section, one can calculate what is called the relative risk.

The relative risk reflects the excess risk (of disease) in the exposed group compared with the unexposed group.

Relative=attack rate among persons who ate itemRiskattack rate among persons who did not eat the item

of ill persons who ate item/total # of persons who ate item
of ill persons who did not eat item/total # of persons who did not eat item

How to interpret the RR numbers:

A relative risk of 1.0 means the risk of disease is similar in the exposed and unexposed group and exposure is not associated with disease.

A relative risk (RR) of greater than 1.0 means the risk of disease is greater in the exposed than the unexposed group and the exposure could be a risk factor for the disease.

A relative risk of less than 1.0 means the risk of disease is less in the exposed group than the unexposed group and the exposure could be a protective factor.

2) *p*-value. Tests of statistical significance are used to determine *how likely it is that the observed relative risk could have occurred by chance alone,* if exposure to a given item was not actually related to the disease. This probability is the *p*-value.

A very low *p*-value (less than or equal to 0.05, or 5 in 100 chance) means that the link being shown between a certain food and developing an illness was UNLIKELY due to random chance! This kind of result (with a low p-value) suggests that the association between that food and the risk of developing a certain illness is "statistically significant".

Food item	Ate item			Did not eat item			Relative Risk	p-value
		Well	Attack Rate		Well	Attack Rate		
Bologna	1	0	100%	8	12	40%	2.5	0.43
Hot dog	1	1	50%	8	11	42%	1.2	1.0
Matambre	9	2	82%	0	10	0%	undefined	0.0002
Mate	4	4	50%	5	3	63%	0.8	1.0
Processed Ham	2	3	40%	7	9	44%	0.9	1.0
Sauce	7	2	78%	2	10	17%	4.6	0.009
Salami	1	1	50%	8	11	42%	1.2	1.0
Solid ham	2	3	40%	7	9	44%	0.9	1.0

Model 4B: The calculations for the food items served at the terminal home of the bus route are:

NOTE: The relative risk for matambre is undefined. This is because among persons who did not eat the matambre, no one became ill (i.e., the attack rate is zero among persons not eating matambre.) For the calculation of the relative risk, this would mean the denominator is "0" and division by "0" is undefined.

Directions: Working as a group, consult the table above and the information on the previous page to respond to the following questions:

1. Which of the foods in the table above have a relative risk (RR) that make them candidates as the food responsible for the outbreak?

2. Read the Note to see why is the relative risk for matambre listed as "undefined". Considering this, do you think that this food should be included as one of the foods listed in your response to question 1?

3. Looking at the *p*-values, list which foods can be linked to the outbreak in a manner that is statistically significant (meaning that the link between consuming that item and then getting sick is unlikely to be due to chance)? How did you determine this?

Case study conclusion: After inspection by local food safety officials, the facility producing the matambre was closed. The producer was unable to provide receipts or a distribution list with locations where his products were sold. The producer's matambre was not labeled in any way to indicate the source or date of production, so a recall of any remaining matambre was not deemed feasible. Because of the relatively high incidence and case fatality ratio for botulism in Argentina, the MOH and Centers for Disease Control and Prevention (CDC) collaborated to establish a botulism surveillance and antitoxin release system in Argentina.

Model 5: Types of Epidemic Curves

Directions: Working individually, study the following definitions and graphs. Use this information to answer the question on the screen.

Epidemic: Increase in number of cases of an illness, above the level normally expected in a given population

Outbreak: Same as an epidemic, but in a more limited geographic area

Epidemic patterns: Ways to classify epidemics (or outbreaks), based on how they spread through a population. Examples include the following:

<u>Common Source Epidemic/Outbreak</u>—All affected individuals were exposed to a toxin or infectious agent from the same (common) source.

<u>Point-Source Epidemic/Outbreak</u>—A type of common source epidemic in which all affected individuals are exposed to the same toxin/ infectious agent in a relatively short span of time, so that the number of cases of resulting illness increases suddenly and then decreases, within the range of one incubation period (the length of time between exposure to the toxin/agent and onset of illness symptoms). See Fig. A below.

<u>Continuous Common-Source Epidemic/Outbreak</u>—Another type of common source epidemic, in which affected individuals are exposed to the toxin/infectious agent over a longer period of time (e.g. days/weeks/longer). In these cases, there is a sudden increase in the number of cases, and then a decline, but not within one incubation period (since individuals are being newly exposed over time). See Fig. B below.

<u>Propagated Epidemic/Outbreak</u>—Occurs when the illness can be transmitted from one person to another. In this type of epidemic, there are intermittent peaks in the number of cases of illness after the index (first) case. The cases occur over more than one incubation period. See Fig. C below.



Source: https://www.cdc.gov/training/quicklearns/epimode/

Source: Centers for Disease Control and Prevention. Unpublished data; 1990. Source: Centers for Disease Control and Prevention. Measle Soutbreak-Aberdeen, S.D. MMWR 1971;20:26.

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Linear version of notes from this handout (key points):

- I. Epidemiology: branch of science investigating the incidence and distribution of diseases, as well as factors influencing health/disease, in an effort to implement control measures
- II. Responses to food/waterborne illnesses are complex and include the following steps:
 - A. detection of an outbreak; lab work includes sertotyping, bacterial DNA fingerprinting, and now WGS (whole genome sequencing)
 - B. epidemiological investigation, hypothesis development and testing; analyze any available epidemiological and lab evidence (Note: review the definition of "N" in a study, and the importance of looking at the p-value after data have been analyzed)
 - C. identify source of contamination
 - D. implement control measures
 - E. declare outbreak over