In Part II, you will learn different ways that data can be presented for interpretation. In addition, you will be provided examples of how to interpret real data using summarizing or summary statements and theorizing statements. These skills will be applied when completing Assignment #3. Finally, you will learn about different types of charts/graphs used to present data.

Before data from surveillance can be analyzed, they need to be interpreted. Interpretation is a skill that comes from a basic knowledge of epidemiology and disease transmission as well as from public health practice principles. Part of your assignment for this week (Assignment #3) involves learning how to and then applying that knowledge to choose appropriate summary statements and theorizing statements from selected case examples. The examples we will be using include national notifiable disease reporting from the most current report available, 2012. (Typically, the CDC’s most current Nationally Notifiable Disease Summary report contains data from 2-3 years ago; therefore, in 2014, it contained 2012 data.) (Exception: The pertussis data from this presentation covers 2014).

Here is a graph of pertussis incidence. It lists the number of cases of pertussis on the vertical or “y” axis” and the year on the horizontal or “x” axis. In the reference from which this graph is excerpted, here is what it states: “This graph illustrates the number of pertussis cases reported to CDC from 1922 to 2014. Following the introduction of pertussis vaccines in the 1940s when case counts frequently exceeded 100,000 cases per year, reports declined dramatically to fewer than 10,000 by 1965. During the 1980s pertussis reports began increasing gradually, and by 2013 more than 24,000 cases were reported nationwide.”

Next, let’s make a few summarizing statements about the information from this graph (see the next slide).
On this slide are 3 examples of summarizing statements made from the graph on slide #3. 1) During the time period of 1922-2014, the highest incidence of pertussis, approximately 275,000 cases, was in the mid 1930’s. 2) After the DTP vaccine was introduced in the late 1940’s, the incidence of pertussis declined from approximately 160,000 cases to approximately 70,000 cases in 1950, during the time period of 1922 to 2014. 3) Between the early 1990’s-2014, the highest incidence of pertussis has occurred in 2013.

Please review these 3 statements. In general, each relays some accurate information about what is represented by the graph. Note that in none of these statements, are there any suppositions or discussion items. In summary statements, the information should represent what is able to be detected from the material presented. The information should also be summarized in context of the time period the data represent. For example, to state that the highest number of pertussis cases occurred in the mid 1930’s as a stand alone statement, does not portray the time period during which this is being reported, which is between 1922-2014. These are all examples of correct summarizing statements.

Let’s now view another graph on pertussis. This one shows the number of reported pertussis cases per 100,000 on the “y” axis and the year on the “x” axis. A series of different color lines that run from left to right, represent 5 age groups. This graph covers the time period in the United States from 1990-2014. Between 1990 and 2014, infants aged <1 year, continue to have the highest reported incidence rate of pertussis. That is an example of a summarizing statement. In the time period of 1990-2014, school-aged children 7-10 years old continue to contribute a significant proportion of reported pertussis incidence. This is another example of a summarizing statement.

Theorizing statements are those which make a supposition of why the data appear as they do. Theorizing statements should incorporate information about disease transmission, immunization and what is known about the disease/condition. What is different about a theorizing statement in comparison to a summarizing statement is that with a theorizing statement-the person making the statement is trying to offer an explanation for what is contributing to the data presentation. The theorizing statement could be partially right, all right or wrong. However, the theorizing statements need to be based on facts. For pertussis, one must be familiar with the epidemiology of the disease as well as the vaccine recommendations, which have undergone changes in the past decade. On this slide are 3 examples of theorizing statements from the graph on the previous slide: 1. Perhaps the reason for the largest number of pertussis cases in persons <1 yr. of
age was that these persons were exposed to pertussis before they could be immunized. 2. Perhaps the reason for the large numbers of cases in the 10-17 year age group is from early waning of immunity after Dtap vaccination. 3. The lowest number of cases in those over the age of 20 may due to a reporting anomaly, as clinicians may not be looking for pertussis in persons over that age and thus may miss cases.

It is also important, for purposes of illustration, to give an example of an incorrect theorizing statement. Pertussis is spread by the droplet route of transmission, more specifically, “with discharges from respiratory mucous membranes of infected persons via large droplets”. An incorrect theorizing statement would be, “Perhaps a reason for the lower numbers of cases of pertussis in persons over the age of 20 is that persons in this age group do not eat in group settings and therefore have less chance of food-related pertussis outbreaks.” This is incorrect because pertussis is not transmitted by contaminated food.

A correctly crafted theorizing statement may turn out to NOT be the actual explanation, but it is still based on facts. An incorrectly crafted theorizing statement is NOT based on correct facts about the data.

Now it's your turn to practice what you have learned. The next nine (9) slides are from the last MMWR summary of notifiable diseases. (After this, the CDC has started using a different real time system to collect these data). For each of the graphs/charts, practice composing one summarizing statement and one theorizing statement. For each summary statement, be sure to include information that is visible in the data presented and within context. For the theorizing statement, try to explain, in your own words, what you think the reason(s) is/are for how these data are presented, but based on facts. There will be 5 graphs/charts from the following 9 in Assignment #3. You will be asked to select the statement that either best summarizes or best theorizes from the examples presented. So it is recommended that you note the examples provided in the previous slides and apply the principles to practice on the next 9 example slides. From slide #8 through slide #16, there will be no narration.
Slide 7
No narration on this slide

Slide 8
Additional notes from graph:
* Per 100,000 population.
† Hepatitis A vaccine was first licensed in 1995.
§ Hepatitis B vaccine was first licensed in June 1982.
¶ An anti-hepatitis C virus (HCV) antibody test first became available in May 1990.

Slide 9
No narration on this slide

Slide 10
No narration on this slide

Slide 11
No narration on this slide
Slide 12
No narration on this slide

Slide 13
No narration on this slide

Slide 14
Meningococcal disease. Incidence,* by year – United States, 1982-2012
No narration on this slide

Slide 15
Tuberculosis. Incidence,* by race/ethnicity – United States, 2002-2012
No narration on this slide
Surveillance data are collected for a variety of reasons, as outlined in weeks 1 & 2 of this course. Once data have been collected, data can be displayed in different formats for further inspection as well identification of problem causes. Then strategies or solutions can be proposed. Let’s look at different ways to portray/present data for interpretation and action planning. On this slide, is an example of a fishbone diagram.

A fishbone diagram is another name for the Ishikawa Diagram or Cause and Effect Diagram. It gets its name from the fact that the shape looks a bit like a fish skeleton. A fish bone diagram is a common tool used for a cause and effect analysis, where you try to identify possible causes for a certain problem or event. To construct a fishbone, start with stating the problem in the form of a question, for example ‘Why is the hospital’s urinary tract infection rate so high?’ Framing it as a ‘why’ question will help in brainstorming, as each root cause idea should answer the question. The Infection Prevention & Control team should agree on the statement of the problem and then place this question in a box at the 'head' of the fishbone. The rest of the fishbone then consists of one line drawn across the page, attached to the problem statement, and several lines, or 'bones,' coming out vertically from the main line. These branches are labeled with different categories. The categories you use are up to you to decide. One standard choice consists of the process steps. Using the high infection rate from urinary catheters as an example, the branches might include: selection of the patient (what criteria to use for catheterizing a patient); the procedure for inserting a catheter (is it sterile?); training of those inserting catheters (is it adequate)? One is free to modify the categories as it relates to the selected problem and subject matter as evident from collection of surveillance data. Once the branches are labeled, brainstorm possible causes and attach them to the appropriate branches. For each cause identified, continue to ask 'why does that happen?' and attach that information as another bone of the category branch. This will help get you to the true contributing factors of a problem.

Another way to present data for interpretation is by use of a Pareto diagram, a bar graph used to arrange information in such a way that priorities for process improvement can be established. Purposes of Pareto diagrams include the following: 1) To display the relative importance of data, and 2) To direct efforts to the biggest improvement opportunity by highlighting the vital few in contrast to the useful many. Pareto diagrams are named after Vilfredo Pareto, an Italian sociologist and economist, who invented this method of information presentation toward the end of the 19th century. The chart is similar to the histogram or bar chart, except that the bars are arranged in decreasing order from left to right along the abscissa (or “x” axis). The fundamental idea behind the use of Pareto diagrams for quality improvement is that the first few (as presented on the diagram) contributing causes to a problem usually account for the majority of the result. Thus, targeting these “major causes” for elimination results in the most cost-effective improvement. (Source: http://mot.vuse.vanderbilt.edu/mt322/AnsPareto.htm)

On this slide are two additional examples of Pareto charts. The top left shows, in decreasing order of frequency, the reasons why blood work was not completed. On the bottom right, is a chart used to target the most important interventions for reducing surgical site infections.

On this slide is a table of data categorizing medication errors. Try constructing a Pareto Diagram from these data.
Slide 20

Does your Pareto diagram look like the one on this slide? If not, or if you did not construct one for practice, please view this example illustrating how data are compiled into a Pareto diagram.

Slide 21

Statistical Process Control (SPC) is an approach that helps to monitor and control the output of a process by assessing the stability of the process and the type of variation that is present. SPCs are the application of statistical theory to Quality Control. SPCs show data chronologically and describe the data as either natural variation or unnatural variation. Natural variation indicates that any change in the number of new cases from month-to-month is just part of the system, e.g. the time you come to work every morning probably varies by a few minutes around an average – it varies naturally. But if there was an accident on the road then the time taken to come to work would be significantly longer – this would be unnatural variation indicating that something in the system of bringing you to work has gone awry. SPC charts can aid decisions about whether a process is ‘in-control’ and whether or not an adjustment is necessary. The diagram on this slide shows a typical SPC chart.

Slide 22

On this slide is a sample SPC chart of new cases of ward-acquired methicillin-resistant *Staphylococcus aureus* (MRSA) or *Clostridium difficile* (C.D.)

When constructing any SPC, there are 3 terms with which you need to become familiar: the **Center Line (CL)** is the average number of acquired cases per month; the **Trigger Line (Trigger)**, a warning limit, is there so that results that reach or exceed the Trigger should be investigated for possible problems in infection control; and the **Upper Control Limit (UCL)**, which is the limit of natural variation. All results should be below the UCL – and any result above is considered unnatural variation and out of statistical control.

To read an SPC chart, one must ask 3 questions:
1. Does the **Center Line (CL)** run through the center of the results? (To be stable and in control the CL should run through the center of the results)
2. Is the latest result below the **Trigger** and or the **UCL**? (To be in control the latest result must be below the CL)
3. Is there evidence in the latest 5-8 results of: a) The results being on one side of the CL  b) A trend in one direction (To be in control the results should not be biased on one side)

For the case example chart on this slide, the monthly number of new cases is in (blue) and the three lines of the SPC, the UCL, the Trigger and the CL are color-coded according to the legend on the chart. The UCL defines the limit of natural variation. Any result above the UCL indicates a statistically significant out of control process. A warning limit or Trigger is set at 2 standard deviations above the mean. Triggers are less sensitive and investigations are less likely to identify poor infection control systems - but investigations of Triggers can prevent outbreaks by detecting problems early.

Supplemental Reading #2 provides this case example in depth. There are usually questions on the Certification in Infection Control (CIC) exam on interpreting different types of charts. If you wish to go into more depth on this topic of SPC charts, please review the Supplemental Reading.

Flowcharts map or represent the ordered steps in a process. A flow chart can be used to define and analyze processes; build a step-by-step picture of the process for analysis, discussion, or communication; and define, standardize or find areas for improvement in a process. The major components of a flowchart include start and end points (circles), decision points (diamonds), abstract or detailed description of units of work (rectangles), and an ordering of the components (arrows).

On this slide on the left is a simple example of a flowchart (www.breezetree.com/images/flowchart_sample.gif). Resources: http://www.mindtools.com/pages/article/newTMC_97.htm; http://c2.com/cgi/wiki?FlowChart). On the right is an example of a flowchart for a generic surveillance system. (Source: http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5013a1.htm) . The links to both diagrams are located in the transcripts for this slide.

This concludes the lecture, Part II for Week 6.