Welcome to PHC 6251 Disease Surveillance and Monitoring, fall semester. This week contains two lectures entitled “Core Concepts Regarding Surveillance: Parts I & II”. In these lectures, you will be introduced to core concepts regarding surveillance that will lay the groundwork for the rest of the course.

Greenwald & Layde developed a model for the presentation of the role of surveillance in public health practice. The first step in public health practice is the recognition of a problem. The problem could be an outbreak of an old disease, a recognition of a new disease, or a re-emergence of a pandemic disease. Examples include the recognition of the new AIDS virus in the 1980’s and West Nile Virus in the early 2000’s. Monkeypox in 2004 in the U.S. was an example of recognition of a disease occurring in the U.S. which had never before appeared in the Western hemisphere. Avian influenza has been a pandemic in birds for several years and the concern was that it would become the next influenza pandemic in humans. Intensive surveillance of this disease has been in place on a global scale. However, in 2009, H1N1 novel influenza A emerged as a pandemic and surveillance has been essential in tracking this global pandemic. Ebola outbreaks had occurred in specific sections of West Africa prior to 2014, but then it became the largest Ebola outbreak in history as well as the first Ebola outbreak in West Africa. Most recently, MERS co-V has been recognized as a new infection. Thus, surveillance can be used to identify an upward trend in cases of a known disease, such as rubella, or to recognize a new disease, such as several of those listed on this slide.

The second step in this public health model is the definition of the scope of the problem. The scope entails who is affected, who is at risk, how widespread the disease or condition is, and how far it is capable of spreading. A good example is the emergence of the HIV/AIDS virus. It was first recognized as a condition in men who had sex with men. As more became known about the disease, the risk groups increased as well as knowledge about the modes of transmission. Another example is the collection and analysis of laboratory reports of elevated lead levels in adults, and subsequent follow-up with these adults. Collecting, analyzing and using such laboratory results for purposes of preventing lead poisoning are examples of surveillance and are part of the public health process.
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| 4     | The third step: **determine cause of a disease**<br>This step consists of an epidemiologic study, not surveillance.  
The third step in the public health process is to conduct etiologic research to determine the cause of a disease. It is important to point out that this step usually consists of an epidemiologic study, not surveillance. For example, an epidemiologic study might be conducted to determine the differential exposure of cases of Norovirus as compared to those without the infection. In this instance, this step does not require the on-going collection of information about cases, only about cases that occur during the period under study. |
| 5     | The fourth step: **design intervention to prevent transmission of infectious agent**<br>This is **NOT** surveillance.  
- Once developed, must be tried in experimental situation to see if it is effective  
The fourth step in the public health model is the design of an intervention that will prevent transmission of the infectious agent, exposure to a chemical hazard, etc. This is not surveillance. Once the intervention has been developed, it must be tested in an experimental situation to see if it is effective. Examples of interventions would be immunization to prevent a disease, withdrawal of a contaminated food source from the market, or repairing a ventilation system that has resulted in cases of aspergillosis. Once such an intervention has been developed, it must be tried in an experimental situation to determine its effectiveness. This is also **NOT** an example of surveillance. |
| 6     | **If intervention is successful, targeting of it should be guided by surveillance information that identifies high risk groups**<br>**Case Example:** Smallpox  
If an intervention is successful, determining where to apply it or “targeting” the intervention, should be guided by surveillance information that identifies high risk groups. For an example, let’s look at how eradication of smallpox involved surveillance. |
| 7     | **Global Eradication of Smallpox: Ring Vaccination Strategy**<br>Identify<br>Vaccinate<br>Monitor<br>Case<br>Contacts<br>Contact of Contacts<br>http://www.bt.cdc.gov/agent/smallpox/smallpox-images/smallpox3.htm  
Success in eradication of smallpox was accomplished by conducting intensive surveillance for cases & targeting immunization to contacts of cases. This “ring vaccination” strategy was used to eradicate smallpox on a global scale. This surveillance was intensive and targeted immunization to contacts of cases, and contacts of contacts. Persons exposed to smallpox were at high risk of acquiring smallpox. Therefore, surveillance was targeted to determining where cases had occurred and then determining who the contacts of such cases were, as well as their contacts, to immunize them against smallpox. |
The final step in the public health process is to evaluate the effectiveness of the public health intervention. This is accomplished by assessing the trend in the disease or injury once it becomes a routine component of public health programs. This step requires surveillance. For example, in order to track the use of a new vaccine, surveillance could be used to track the number and demographic characteristics of children who are not immunized. According to Halperin & Baker, “…the model of public health presented here should serve to differentiate surveillance from the whole of public health practice, and to distinguish surveillance from analytic epidemiologic studies.”

Now that we have outlined the steps in the public health model which involve surveillance, it is important to define surveillance. The Centers for Disease Control & Prevention defines public health surveillance as “the ongoing, systematic collection, analysis, & interpretation of health data essential to the planning, implementation, & evaluation of public health practice, closely integrated with the timely dissemination of these data to those who need to know. The final link of the surveillance chain is the application of these data to prevention & control. A surveillance system includes a functional capacity for data collection, analysis & dissemination linked to public health programs”. It is important to mention that beyond collection and analysis of health data, public health surveillance requires dissemination of those data to people who need to know.

We will now outline the essential elements of a surveillance system. The first is that the population and events to be studied are defined as precisely as possible. The next step is that relevant data are collected using systematic methods.

Continuing with the essential elements of a surveillance system, next, data are consolidated or tabulated to facilitate evaluation. The data are then appropriately analyzed and interpreted. The data are then reported, which is important to do in order to bring about change.
Included in core concepts of surveillance are the uses of surveillance. We will outline these uses in the next two slides. First, surveillance can be used to determine the quantitative estimate of the magnitude of a health problem. Next, it can be used to portray the natural history of the disease. Perhaps one of the most important uses of surveillance is to detect epidemics. This often serves as the rationale for the investigation of an outbreak. Surveillance can be used to document the distribution and spread of a health event. Surveillance can be used to facilitate epidemiologic and laboratory research.

Surveillance can also be used to test hypotheses, to evaluate control & prevention methods and for planning purposes. Additional uses of surveillance include monitoring of changes in infectious agents, isolation activities, and finally, to detect changes in health practice. You should be able to describe the uses of surveillance and to provide examples of these uses (so be sure to read the Required Readings).

The first type of surveillance is active surveillance. Active surveillance is routine surveillance where reports are sought dynamically from participants in the surveillance system on a regular basis. An example would be a public health department worker telephoning physicians in the community each month to ask about any new cases of influenza. Active case-finding may be used in active surveillance. Active case finding is the dynamic identification of the occurrence of a disease or health event under surveillance which may involve house-to-house visits to identify cases.

A second type of surveillance is passive surveillance. Passive surveillance is defined as routine surveillance where reports are awaited & no attempt is made to actively seek reports from the participants in the system.
Mandatory surveillance is a type of surveillance where participants must report to the health system. An example is health authorities requiring all public health laboratories to report specified diseases. In such cases this requirement is usually not by virtue of a law but it is linked to their contractual duties.

Notifiable diseases, either by county, state or nationally, are an example of a mandatory system where reporting is required by law.

Serosurveillance is a type of surveillance where specific antibodies are measured in a population or sub-population of individuals. Examples of serosurveillance include measuring whether all new employees of a healthcare facility have antibodies to measles. Measuring antibodies to hepatitis B in dialysis patients is another example of serosurveillance. Finally, measuring residents of one particular African village to determine the prevalence of HIV infection is another example of serosurveillance.

A sentinel health event is a case of unnecessary disease, unnecessary disability or untimely death whose occurrence is a warning signal that the quality of preventive or medical care may need to be improved. Sentinel surveillance is the surveillance of a specified health event in only a sample of the population at risk using a sample of possible reporting sites. When conducting sentinel surveillance, it is important that the sample should be representative of the total population at risk.

Community surveillance occurs when the starting point is a health event occurring in the community. This event is reported by a community worker or actively sought by investigators. This type of surveillance may be particularly useful during an outbreak and where syndromic case definitions can be used. An example would be if a case or cases of a viral hemorrhagic fever such as Ebola virus were occurring in a community. It would be imperative for public health investigators to actively seek out other cases of this condition in the community.
Let’s look at three ways that surveillance can be analyzed: by structure, process and output (or outcome). When analyzing surveillance in terms of structure, one would look at the objectives of the surveillance, the resources used to operate the surveillance system or the organizational procedures (such as inputs to the system) used to conduct the surveillance.

When analyzing surveillance data by process, one could use observation, communication, and confirmation of events. Alternatively, interpretation, presentation and communication of findings to decision-makers can be another parameter used to evaluate the surveillance process. When analyzing surveillance by outcome or output, the product is usually a report. One way to analyze the output of surveillance is to examine how the findings are put to use. This is an extremely important aspect of surveillance.

Let’s look more closely at the difference between outcome vs. process surveillance using needlestick injuries as an example. When small numbers of outcomes present a problem of sample size, then rates of usage or compliance, which might offer a larger sample, could be a more productive application of resources. Needlestick injuries, from a statistical standpoint, represent a relatively small number. (This is NOT to discount the fact that a single injury can be devastating to an individual). Instead of looking at raw numbers of needlestick injuries as the output or outcome when conducting needlestick injury surveillance, process surveillance can be used to measure compliance with established protocols or utilization of specific health-care resources. For example, one might want to examine the process of reporting needlestick injuries to determine if procedures are being followed. Outcome (i.e., infection or disease) measurement has dominated most surveillance systems & healthcare-associated infection surveillance plans. In these cases, reduction in infection rates is the goal. Some outcomes will be so infrequent in occurrence that calculation of infection rates cannot yield interpretable information and this might be when process surveillance can be more useful.

This completes the lecture entitled “Core Surveillance Concepts”, Part I.