Welcome to “Core Surveillance Concepts, Part II.” The course description for PHC 6251 states that it covers “…epidemiologic principles & methods used in development & practice of disease surveillance, prevention & control for use in public health in general-emphasizing hospital infection control in particular.” This requires orientation to not only core surveillance concepts but also to infection prevention and control concepts. As much as possible I have included both hospital & healthcare infection control as well as global health surveillance issues in this course.

Continuing from Part I with core surveillance concepts, let’s first cover the functional levels of disease surveillance. There are three levels from the lowest to the highest: Peripheral, Intermediate, and Central. The first level, the Peripheral level, is the first time an ill person has contact with health services and in this situation, the individual is usually seen by a clinical person. The type of clinical person or setting can vary. It can be in a hospital Emergency Room, a Doctor’s walk in clinic, in the community with a traveling nurse, or in the home. The clinical person can be a Licensed Practical Nurse, a Triage Nurse, a Nurse Practitioner, a Physician’s Assistant, or a Physician. On each one of these levels, there are a set of tasks that are performed.

The first point of contact of an ill person with health services occurs at the peripheral level. Tasks at this level include trying to make a diagnosis; managing the case; if it is reportable disease, reporting that case; as well as some simple tabulation and graphing of data. Some community-based and non-governmental organizations (NGO’s) are at the peripheral level.

The second level is the intermediate level (I.L.). It is at this level where data are collected from the peripheral level. The main function at this level is to perform ongoing analysis of data from the peripheral level to be able to recognize if there are outbreaks, or changes in disease trends. Some diseases require reporting up to a higher level, or making practice changes, immunization, policy, or planning changes. At the intermediate level, personnel who work at that level should be able to help with investigations and interventions in an outbreak situation. Some countries have two levels at the Intermediate level, the District and the Region; it depends on the size of that country and the health services development level.
There are numerous tasks at the intermediate level: case management that cannot be done at the peripheral level; analysis of peripheral data for epidemiological links, trends, or things that need to be targeted for control. At this level there is also a higher level laboratory that provides supportive lab data to help in making the diagnosis in that case. Another task is the investigation of an outbreak. If you remember from Week 1, one of the core concepts of surveillance is to feed the information back to those who need to know. If the peripheral level has sent data to the intermediate level for analysis, the intermediate level needs to feed the information back to the peripheral level. Another task upwards, at this level, is to report data and outbreaks to the next highest or the highest level, which is the central level.

The central level is usually at the national level, where policies are set and resources are allocated. This is often where the highest level of epidemiologic skills are required of personnel. There might be someone on the national level that will be sent out to the intermediate or peripheral level to help with an outbreak. What is unique to this level is that there is collaboration with non-medical sectors. This can include the Department of Agriculture, Veterinary Medicine, Environmental Health and safety agencies. With the monkeypox outbreak in the U.S. in 2004, there had to be collaboration between healthcare, veterinary medicine, and import agencies. This was because it was discovered in prairie dogs, but it was transmitted to some people. How the prairie dogs acquired the disease was from transmission from imported giant Gambian rats and other small rodents from Africa. At the central level, water-borne, food-borne and vector-borne diseases might require collaboration between appropriate agencies for surveillance and control.

Tasks at this level include analyzing data from the other two levels, giving support to the intermediate level (I.L.) for outbreak control and case management, feeding information back to the intermediate level and possibly the peripheral level. A very important task at this level is to report to the WHO as required by international health regulations; if there is a disease that is to be reported by those regulations.

Disease surveillance at the national, state and local levels helps to define populations of people affected by a disease, to determine trends in the occurrence of a disease, and other uses as listed in Part I. When developing national plans for the surveillance of communicable diseases, it is important to have a list of priority diseases. This list needs to be as short as possible, from the national, regional and international perspectives, as diseases can spread rapidly across boundaries.
In order to determine this priority list, there are questions that can be used to guide this process. First, does the disease result in a high disease impact? In other words, does it have a high number of cases (morbidity) or a high death rate (mortality) or both? A second question to answer is, does the disease have a significant epidemic potential (easily acquired or easily spread from person to person?). Here are a few examples. Cholera can be acquired from contaminated food and water sources and from person to person transmission. Meningococcal meningitis can be acquired from close personal contact. Measles is a highly contagious infectious disease. Will the information to be collected lead to significant public health action? If surveillance of a particular disease is collected, what action will be conducted based on its occurrence? If there is none, then this disease or condition should probably not be included in a priority list. A significant public health action could be an immunization campaign or other specific measure to control the disease to be provided by the central level, such as international reporting. Are there specific syndromes, such as viral hemorrhagic fevers, that should be considered for surveillance? Are there specific public health issues, such as antimicrobial sensitivity of some infectious agents, that warrants including them on a list of priority diseases for surveillance?

We will now cover some concepts regarding disease reporting for notifiable infectious diseases. It is important to mention that reporting diseases by themselves does not constitute surveillance. It is the review of the information for trends, determination of interventions, and reporting back to those who need to know, that transforms disease reporting into a surveillance system. Disease reporting is conducted by the U.S. Federal government, as well as city, county, state and country health departments. There are three categories of notifiable disease reports: 1) Information is collected on each individual with the disease/injury, 2) Conditions for which only the total # of patients seen is reported, and, 3) Conditions for which the total # of cases is reported if, & only if, there is an epidemic.

Most states have comprehensive, passive disease surveillance systems, “as required by law in all 50 U.S. states”. For the health department to initiate regular contact & direct it to all possible reporting sources, is neither feasible nor required by any current regulations. It is important that even though reporting of disease is mandated, no one can be forced to do so and enforcement of such reporting is rarely instituted.
Once there is a list of priority diseases for surveillance, how do diseases get reported? In the simplest situation, a physician diagnoses a reportable condition and sends the appropriate form (either hard copy or electronic) to the health department. Once sent to the local health department, the case data are added to the appropriate disease surveillance system.

At the local health department (HD), summaries of reports are regularly reviewed and analyzed by staff. The purpose of these actions is to identify any conditions reported more frequently than expected on the basis of past experience. Information from the local health department is then forwarded to the state health department to be consolidated with reports from other local health departments. Composite data from these reports are examined for trends. Each state department then voluntarily reports these cases to the CDC on a weekly basis.

It is important that completeness and timeliness of case reports should be assessed regularly, including the proportion of reports with each of the following variables: age of case, date of onset of the condition, date the report was completed, and the time between the onset of the condition and the receipt of the case report. If there is a long gap between when the report was received and the case report completed, this might be a surveillance process issue. At the level of the local health department, this information should be analyzed by reporting source, so according to clinicians, hospitals, diagnostic laboratories, and the health jurisdiction. Once the analysis is complete, feedback should be provided, training or information provided to improve any deficiencies that have been noted.

Next, let’s discuss notifiable disease reporting. Notifiable Disease reporting is conducted at the county, state and national levels.
Please read Required Reading #2 by the time you review this material. It provides an overview of how the U.S. list of notifiable diseases originated and how it continues to be updated. At the annual meeting of the State and Territorial Health Officers in 1950, this group authorized a council of state and territorial epidemiologists (CSTE) with the purpose of determining which diseases should be reported to the Public Health Service. The Centers for Disease Control & Prevention assumed the responsibility for both the collection and publication of data on nationally notifiable disease. However, CSTE still continues to make annual recommendations for additions or deletions to this list. You will be interpreting some of these data in future weeks of this course.

The list of notifiable diseases is mandated by Florida Statute 381, requiring any Practitioner licensed in this state to practice medicine, be it osteopathic medicine, chiropractic medicine, naturopathy, or veterinary, or any hospital licensed under sub-part I, or any licensed laboratory, to immediately report diseases of public health significance to the department of health. For example, let’s say a laboratory has a positive syphilis result, the patient is in the hospital and the patient was seen by someone before they went to the hospital. This disease must be reported by the laboratory and if the physician diagnoses the case, that physician must also report it.

Hillsborough County, where the University of South Florida is located, uses the Florida list of reportable diseases. There are different telephone contact numbers for reporting AIDS/HIV, tuberculosis, sexually transmitted diseases (STD) (also known as sexually transmitted infections) (STI), all others and after hours contacts. For AIDS/HIV reporting, faxes cannot be used.

It is very important, in an age of potential bioterrorism and use of biological agents, that there be timely reporting. Situational awareness surveillance or Biosurveillance can be used as an early warning system for potential bioterrorism or pandemic disease situations (such an pandemic influenza).
Up to this point, we have covered some core surveillance concepts. Next, we will focus on several infection control core concepts. We will answer: What is infection control? Who practices infection control? And what are the content areas of the field?

On this slide is a definition of infection control that I have compiled based upon years of experience in this field. Infection Control is the prevention of transmission of infection/disease between patients, employees, & visitors as well as the investigation of such events should they occur. To accomplish this involves the development of policies & procedures, education, surveillance, & a multi-disciplinary effort that is regulated/guided/overseen/monitored by numerous county, state, & federal agencies.

Infection control programs are designed with the goal of protecting patients, healthcare workers, visitors and others in the healthcare environment within a context of cost-effectiveness. A landmark infection control article outlining essential components of infection control programs is listed on this slide for your reference. It is also the article upon which PHC 6314 Infection Control Program Design, is designed.

This diagram illustrates the infection prevention target triad of employees, visitors and patients that you will hear again and again when discussing infection control programs. This triad is accomplished with the use of policies, procedures, agencies, and guidelines but often within the constraints of tight budgets.

We just talked about what infection control is, now let’s talk about who practices it. Most infection control programs have one or more Infection Preventionists (IPs)(formerly called Infection Control Practitioners or ICPs). Another person very important in the program is the Hospital Epidemiologist. Finally a program with this magnitude cannot function without support staff. These roles are covered in more detail in the summer course, PHC 6314 Infection Control Program Design.
Let's look at the general model of disease causation. In it, you can see the classic epidemiologic triad: the environment, the host and the agent. If you have taken an Epidemiology course, you will have heard of this. But we put a little slant on it in the healthcare setting because there are some things you may not think of as host, agent and environment. Let's look at some examples.

In the healthcare setting the **host** can be a patient, who comes in with an infection or develops one while hospitalized. Host can be an employee who comes in with a rash illness or some infectious illness; or a visiting child who is incubating chickenpox or some other contagious disease, or the many other people who visit the hospital: chaplains, volunteers, consultants, etc. All of those can serve as a host for a communicable disease or infection. The **agent** is normally thought of as a disease, such as varicella (chickenpox), for example, which could be brought in from a visiting child. But in the healthcare setting, the agent may take several forms. Microorganisms, such as *Staphylococcus aureus*, which have been resistant to antibiotics, can serve as an agent of infection from one patient to another. If there is a contaminated device that is transferred from patient to patient or a system, such as a dialysis system in which the fluid becomes contaminated, can also serve as an agent of infection. These are examples of different agents in the healthcare setting. Finally, in terms of the **environment**, there are numerous examples in the healthcare setting. The patient's room may harbor *Clostridium difficile* spores. The operating room is a very important environmental area. Let's say you're doing surgical wound surveillance and you notice a cluster of *Staph. aureus* infection post-op in some patients. You do some digging and you find out that all the cases had surgery in the same operating room or all of them were operated on the same day. Those may be clues that there is something in the room that might be contaminated or it might be the staff. For example, we had a cluster of orthopedic infections and it was found that all of the infected patients were operated on in the same room. Upon further investigation, they found some bone wax that was used in orthopedic surgery that was contaminated. So anyone who had surgery in that room that ended up with an infection with that organism could be traced from that situation. Hydrotherapy or whirlpool therapy is frequently used in wound and burn units. It is difficult to disinfect the hydrotherapy tank because there is a drain in it and water can pool. If it is filled up again and hasn't been adequately cleaned, someone can soak in a solution that has organisms in it. So that is a very important environmental area as well. If there is a room that you do a particular procedure in such as a cardiac catheterization or some other procedure, that can serve as an environment where infections be acquired.

Thus, these are all examples of looking at the host, agent and environment in the healthcare setting.
Another important concept is the “Chain of Infection”. The components of the Infectious Disease Process that contribute to transmission of infection are: causative agent, reservoir, portal of exit, mode of transmission, portal of entry, and susceptible host. The causative agent is what actually causes the disease, such as a virus, bacteria, etc. The reservoir is where the agent originated from in the first place. The portal of exit is where the agent escapes from the reservoir and the portal of entry is how it enters the susceptible host. The mode of transmission is the way it can be transferred to the susceptible host. We will go into more detail on the modes of transmission and the susceptible host. The other components are covered in more detail in PHC 6517 “Infectious Disease Prevention Strategies.”

The mode of transmission is the mechanism of transfer of an infectious agent from the reservoir to the susceptible host. The four main categories of modes of transmission are: contact, airborne, common vehicle, and vector-borne. Contact has subcategories: direct, indirect, and droplet. A common vehicle can be active, where the agent replicates in that vehicle, or a passive vehicle where it does not. The final mode of transmission is vector borne (e.g., external transmission, internal transmission, and whether that is a virus that replicates in the host or not). The most important thing to know about vector borne transmission is that in the U.S., it is of minimal importance in the healthcare setting. This is not so in developing countries. We go into much more detail into the modes of transmission in the Spring class.

Most often the susceptible hosts in the healthcare setting are the patients, but remember what we just learned on slide #26 about other potential hosts. The definition of a susceptible host is the person or animal without resistance to a particular agent, so when that agent enters the host through a portal of entry, the host becomes infected. Whether someone becomes infected depends upon a variety of factors. In the healthcare setting, many factors that can contribute to susceptibility to infections: age (the very youngest, particularly low-birth weight, premature infants, and the very old are at the highest risk in terms of age); underlying disease (e.g., diabetes, existing infection, immune-suppression); and immunization status. It also depends on procedures that are done on a patient. Medications can be contaminated by themselves or in the process of when they were made. This can be either outside of the hospital or when they are worked on in the pharmacy. Some medications can lower resistance and cause immune suppression. So medications have 2 different ways that they might contribute to infection. Pregnancy is also a compromised status for some infections. If a person has trauma and has an open area of skin when they come in, that makes them more susceptible. Finally, nutritional status influences host susceptibility. This is a growing field: nutrition and its contribution to disease. All of these factors contribute to whether a host is susceptible to infection or not.
Another important concept to include in infection control core concepts is antimicrobial resistance. This is a serious problem in healthcare facilities. Examples of antimicrobial-resistant organisms include: MRSA (methicillin-resistant Staphylococcus aureus); VRE (vancomycin-resistant Enterococcus), and VRSA (vancomycin-resistant Staphylococcus aureus). Most recently, serious conditions have resulted in patients infected with CRE or carbapenem-resistant Enterobacteriaceae. The issue of antimicrobial resistance is covered in more detail in PHC 6314 Infection Control Program Design.

What contributes to this problem of antimicrobial resistance? First of all, there may be poor prescribing practices, such as if the clinician feels pressured to prescribe an antibiotic even when it is not needed, or prescribes an inappropriate antibiotic. How many of you had had a course of antibiotics, felt better and decided “I’m not going to take the rest.”? Do you know anyone who has done that? When you or someone else does that, it can contribute to resistance. Mutations of microorganisms can occur with new drugs, making these new drugs not effective. It is also a problem when we have a susceptible host in the hospital and we have resistant organisms that infect them. They are already compromised and then they get infected with something like MRSA, it is also a problem because resistant organisms can be transmitted easily. That has to do with concepts of colonization vs. infection, which we'll talk about in a minute. There is also the question of environmental components and their contribution to antimicrobial resistance.

On this slide are three important terms that are often interchanged erroneously: infection, colonization, & contamination. “Infection” means that a host has been entered with an infectious agent and that agent has multiplied in the tissues of that host, resulting in some sort of invasion. An infected person has signs and symptoms, such as fever, redness, pus, or elevated white blood cell count. “Colonization” refers to the presence of organisms in the host with growth and multiplication, but without tissue invasion or damage. A person may have a wound that is colonized with a resistant organism, but without any signs to indicate that. “Contamination”, for the most part, refers to the presence of microorganisms on inanimate objects or in substances. If a room is inadequately cleaned of C. difficile spores, the next patient may become infected if he or she is immune compromised and the components of the chain of infection are all in place. I say “for the most part” because in the area of biodefense, the term “decontamination” is often used to indicate the process of removing agents, such as anthrax, from rescue or emergency medical services personnel.
Colonization is an important concept in a healthcare setting. What you need to know for this and other courses is that a person can transmit infection if they are colonized or infected. In fact, because it may NOT be known that a patient or healthcare worker is colonized with an infectious agent, there may not be the level of care taken to clean hands or inanimate objects between patient care episodes. Contamination of equipment can occur and has been implicated as a source of infection in the literature. However, contamination of equipment is not as efficient in transmitting infection as other modes. But it still underscores the need for good patient care practices, environmental cleaning and sterilization/disinfection processes.

Cohorting in this context is the placement of patients with like diseases or conditions together, when private rooms are not available. Any time hospital staff wish to put patients together, it should be in consultation with Infection Control. One has to consider the epidemiology of the disease or infectious condition, how it is transmitted, and an assessment of the patients with the condition or who might be roomed with the infected patient. For example, a patient with a large draining wound should not be roomed with a patient who is immune suppressed. There is a great deal of assessment that must be done to determine what types of patients can be cohorted, thus consultation with the Infection Preventionist is important.

Handwashing or its new universal term, hand hygiene, is the single most important procedure to prevent infection. It is often the cause, when it is inadequate, of hospital outbreaks. Hand hygiene is an essential infection control core concept, with many new recent advances. Hand hygiene is now the universal term to encompass washing with soap and water, washing with a waterless alcohol hand rub, and surgical scrubbing. There are many recent issues related to hand hygiene. Surgical scrubbing with a brush can damage hands if performed for excessive amounts of time. The use of lotion is now recommended in the CDC Guidelines on Hand Hygiene. Artificial nails can be a place where organisms are present, so their use is discouraged in high-risk settings.
So what does Infection Control have to do with surveillance and why are we covering it here? Infection Control personnel are responsible for a variety of surveillance activities, including but not limited to: 1) reporting notifiable diseases 2) conducting surveillance, be it unit-specific, rotating, or other targeted types 3) analyzing surveillance data (to determine problem areas, successes, etc.) 4) making recommendations based on surveillance data (e.g., change of practice, new procedure) and 5) designing patient care practices and employee policies to decrease transmission of infections.

In summary, we have covered some more core surveillance concepts and introduced core infection prevention and control concepts.

This concludes the lecture material for "Core Surveillance Concepts, Part II".