Welcome to week 10 entitled “Surveillance for Healthcare Workers”. This is part 2 of 2 lectures for this week.

Next we are going to talk about tuberculosis (TB). Approximately 1/3 of the world’s population is infected with TB. In 2013 on a global scale, approximately 9 million people became sick with TB and it is estimated to have killed 1.5 million. 10% of people who are infected with TB bacilli (but who are not infected with HIV) become sick or infectious at some time during their life. People with HIV and TB infection are much more likely to develop TB. (Source: http://www.who.int/mediacentre/factsheets/fs104/en/)

W.H.O. estimates that the largest number of new TB cases in 2013 occurred in Asia, which accounted for 56% of new cases globally. However, sub-Saharan Africa carried the greatest proportion of new cases per population with over 280 cases per 100 000 population in 2013. Over 95% of TB fatalities occur in low and middle income families. (Source: http://www.who.int/mediacentre/factsheets/fs104/en/)

There is some good news. Some countries are experiencing a major decline in cases, while cases are dropping very slowly in others. Brazil and China for example, are among the 22 countries that showed a sustained decline in TB cases over the past 20 years. In the last decade, the TB prevalence in Cambodia fell by almost 50%.

For those of you interested in global surveillance of TB, the W.H.O. has a query tool where you can select indicators and produce TB data by country. Please go to the following site if interested: http://www.who.int/tb/country/data/profiles/en/index.html

The figure on this slide is a combination line graph and bar chart showing the number and rate of newly diagnosed tuberculosis (TB) cases among U.S.-born and foreign-born persons reported in the United States during 2000-2014. The 3,114 TB cases in U.S.-born persons (representing 33.5% of all cases in persons with known national origin) indicated a 6.3% decrease in the number of cases compared with 2013 and a 64% decrease compared with 2000.
In terms of health care workers, there are some data about them and TB. Remember from Part 1, the number of HCWs in the U.S. and globally. Healthcare workers have an average lifetime risk of acquiring TB infection in their occupation, between 30-386 out of 1000 workers exposed. The average lifetime occupational risk of acquiring TB disease is from 3-39 out of 1000 workers exposed.

In 2009, the CDC revised the occupation variable so trending of healthcare workers, for example, before 2009 is no longer valid. Between 2009-2013, 1,751 cases of tuberculosis were reported in the healthcare occupation.

The Centers for Disease Control and Prevention have a data query tool for tuberculosis. It enables one to select certain variables and obtain information through 2013 regarding TB in the United States. Please go to the following link and try a few data queries of interest to you: http://wonder.cdc.gov/tb.html

Several factors have been found time after time to cause or contribute to TB outbreaks. The first is delay in diagnosis: TB may not have been suspected or there was another condition more urgent being assessed, they didn’t test for TB, etc. Another factor is that after it was discovered, there was a delay in either initiating Airborne Precautions of inadequate precautions. TB can be transmitted by airborne droplet nuclei, the smallest particles in a ventilation system, so if it is in the ventilation system in a room that doesn’t have negative air flow, TB may be transmitted to other people in the hospital. Lapses in all practices and precautions when conducting cough inducing and aerosol-generating procedures is another contributing factor. The least frequent component to contribute to TB outbreaks is that people didn’t have adequate respiratory protection. That can happen if people don’t wear adequate respiratory protection when they enter the room of a TB patient.
The OSHA TB exposure control plan, similar to the format of the BBPS, was published in 1997, but withdrawn in 2003. OSHA has something called a “general duty clause”, requiring employers to protect HCWs in the workplace, and that includes protection from TB. In 2008, OSHA published a Respiratory Protection Standard, number 1910.134. This covers types of respiratory protection for several different types of industries—it is not specific to TB. OSHA recommends that healthcare facilities follow the CDC Guidelines for Prevention of TB from 2005. We will be using those guidelines to discuss the hierarchy of controls and surveillance recommendations for TB prevention in HCWs.

The latest CDC Guidelines for the Prevention of TB in Healthcare Facilities are 147 pages. Infection control professionals and occupational health professionals need to be familiar with this whole guideline. Trying to narrow this material down into achievable facts that you are going to retain is very challenging. So for this next section about TB, just listen to the discussion, and I will tell you what to focus on. I would like you to be thinking about the disease, and issues applying to surveillance. Don’t feel pressure to memorize this material. You will only need to memorize it if you are going to take the CIC exam, and then you will need to know the slides that I have selected for this lecture.

Before we get into the guidelines, let’s explain a few terms. BAMT is the Blood Assay for *Mycobacterium tuberculosis*. This is a relatively new way to determine if someone has been infected with TB by testing their blood. The term TST stands for Tuberculin Skin Test and has replaced the old term PPD, which stood for Purified Protein Derivative (also known as the Mantoux test). Latent TB infection is LTBI. BCG stands for Bacillus Calmette-Guerin and is a vaccine given in some countries to prevent TB.

Many foreign-born persons have been BCG-vaccinated. BCG is used in many countries with a high prevalence of TB to prevent childhood tuberculosis meningitis and miliary disease. However, BCG is not generally recommended for use in the United States because of the low risk of infection with *Mycobacterium tuberculosis*, the variable effectiveness of the vaccine against adult pulmonary TB, and the vaccine’s potential interference with tuberculin skin test reactivity. The BCG vaccine should be considered only for very select persons who meet specific criteria and in consultation with a TB expert.
HCWs Included in TB Surveillance Program

- All paid & unpaid persons working in health-care settings with potential exposure to M. tuberculosis through air space shared with infectious TB disease
- Part time, temporary, contract, & full-time HCWs
- All HCWs with duties that involve face-to-face contact with TB patients

CDC makes the following specific recommendations about who should be involved in a TB surveillance program:

- All paid and unpaid persons working in health-care settings with potential exposure to M. tuberculosis through air space shared with persons with infectious TB disease
- Part time, temporary, contract, & full-time HCWs
- All HCWs with duties that involve face-to-face contact with TB patients

It is important to realize that being paid is not a condition of inclusion—there are volunteers, students, clergy that are not paid but they share air space with TB patients, so they need to be included in TB surveillance.

Examples

- Chaplains
- Correctional officers
- Craft/maintenance/repair
- Dieticians/food service
- Housekeeping/janitorial
- Infection control staff
- Laboratory staff
- Maintenance staff
- Morgue staff
- Nurses
- Pharmacists
- Phlebotomists
- Physical & occu. therapy
- Respiratory therapists
- Scientists
- Social workers
- Students
- Volunteers

There are numerous examples of job categories that should be included in a TB surveillance program. On this slide are some examples and you may see ones that make sense, but might question others. For this reason, we will give examples for a few selected job categories. Chaplains need to counsel patients and share air space that way. Craft or repair staff may have to enter a TB isolation room if something needs to be fixed or maintenance needs to be done. Food service staff deliver trays to patient rooms, they go into rooms so that is the way they share air space. Homeless shelter staff could be at a high risk for exposure to TB as they serve a high-risk population: the homeless. Laboratory staff handle infectious TB specimens. Using the morgue staff as another example, if a patient who had TB has an autopsy, the body fluids can be highly infectious. If using a bone saw, that may aerosolize infectious body fluids. Respiratory therapists perform aerosol-generating procedures, which can transmit TB if personnel do not wear appropriate personal protective equipment. Social workers talk to patients and families. Volunteers bring magazines, cookies, flowers, etc. into patient rooms. The CDC Guidelines do not say WHO has to provide the surveillance, just that is has to be done. So for example, with nursing or medical students, the corresponding university may be in charge of conducting such surveillance.
## Slide 11

**Include HCWs with any of the following activities:**

- entering patient rooms/treatment rooms whether or not patient is present
- participating in aerosol-generating or aerosol-producing procedures
- participating in suspected/confirmed MTB specimen processing or
- installing, maintaining, replacing environmental controls in TB disease areas

The guidelines also recommend including HCWS in TB surveillance if they participate in any of the following activities: 1) **entering patient rooms** or treatment rooms whether or not a patient is present, 2) participating in **aerosol-generating or aerosol-producing procedures** (e.g., bronchoscopy, sputum induction, & administration of aerosolized medications), 3) participating in suspected or confirmed *M. tuberculosis* specimen processing, or 4) installing, maintaining, or replacing **environmental controls** in areas in which persons with TB disease are encountered.

## Slide 12

**Why Do We Need Surveillance for TB in HCWs?**

TB screening programs provide critical information for caring for individual HCWs and information that facilitates detection of **MTB** transmission.

Why do we need to do surveillance for TB in health care facilities? The answer is, because TB screening programs provide critical information for caring for individual HCWs and information that facilitates detection of TB transmission.

## Slide 13

**The TB screening program has 4 major components:**

1. baseline testing for **MTB** infection
2. serial testing for **MTB** infection
3. serial screening for symptoms or signs of TB disease
4. TB training & education

The TB screening program from the CDC guidelines recommends 4 surveillance components: 1. baseline testing for **MTB** infection (before the start of employment), 2. serial testing for **MTB** infection (at regular intervals, e.g. once a year), 3. serial screening for symptoms or signs of TB disease (to determine if any HCW has come down with clinical TB), and 4. TB training & education (to educate employees on prevention). We will go through each of these 4 components in the next series of slides.

## Slide 14

**1. Baseline Testing for MTB**

- Recommended for **all newly hired HCWs** regardless of risk classification
- Can be conducted with **TST or BAMT**
- Recommended for those who will receive serial **TB screening**
- Certain settings may not choose to perform baseline **TB testing**

Re: baseline testing, it is recommended for all newly hired HCWs regardless of their risk classification. This testing can be conducted with either tuberculin skin testing or via the blood assay. It is recommended for those who will undergo serial screening at regular intervals. It is also recommended that certain settings may choose **NOT** to perform baseline TB testing, if certain employees are never going to be in contact as defined in the initial slides.
When results of the baseline testing are received, it provides the basis for comparison in the event that a potential or known TB exposure occurs. Tuberculin skin testing (TST) minimizes the possibility that boosting will lead to unwarranted suspicion of transmission of TB with subsequent testing. A two-step skin test can be used to eliminate the booster phenomenon.

What does that mean? Let’s say in the past Employee A was infected with TB, and comes to start work at a hospital. The hospital does a baseline test on that employee, and it is negative. The booster phenomenon would occur, if Employee A gets a negative and then you do the test again one to three weeks later and it is positive. In this example, if done one to three weeks later and it is positive after it has been negative, the interpretation for Employee A is likely someone who has had TB in the past, the skin test boosted or triggered the immune system to remember that and then give a positive result. So this employee has been infected with TB in the past.

Then let’s take Employee B who starts work with no history of TB. The initial skin test is negative and two weeks later is a negative again. The interpretation for Employee B is most likely that they have never had TB. So when an exposure happens, and in the terrible event that Employee B tests positive the next time, you know that is a true conversion. Most health care facilities will do the two step skin test now. This does NOT apply with the blood test. The blood test is only done in one step. For a comprehensive explanation of testing for TB and the booster phenomenon, go to the following link: http://www.cdc.gov/tb/publications/factsheets/testing/skintesting.htm

The second component in a TB surveillance program for HCWs includes serial follow-up of TB screening and testing for MTB infection. This has to be based upon the setting’s risk classification. For example, if a facility has numerous cases of TB, a medium amount of cases, a low amount of cases, or they don’t have cases because they don’t have isolation rooms. It also has to be based on periodic reassessment to determine if that risk changes.
There are also recommendations about follow-up skin testing. The first is: 2-step TST testing should NOT be performed for follow-up testing (only for baseline testing). The next is: Stagger follow-up screening. What does that mean? That means you don't test every person in the hospital the first week in March. Staggered screening opportunities for early recognition. Finally, processing aggregate analysis of TB screening data on a periodic regular basis is important for detecting problems.

On the right is someone with a skin reaction to a TST. On the left is someone measuring the millimetres of induration to determine if it is large enough to be considered a positive skin test. There is a big area of red here, on the right-hand picture. That is not what is to be measured. The induration, only the raised area, matters for interpretation. You can probably see how interpretation can be a problem. That is why it is a good idea to carefully train those placing and reading TSTs.

It is important to provide definitions for what is considered a positive test result for TB infection in a healthcare worker. First, symptoms of disease in the lung, pleura, airways and/or the larynx should be present. Second, the following symptoms could be present: coughing for more than three weeks, loss of appetite, unexplained weight loss, night sweats, bloody sputum (aka hemoptysis), hoarseness, fever, fatigue or chest pain.

All evaluations for HCWs with newly recognized Tb should also include a clinical exam, symptom screen (for those symptoms on the previous slide), a chest x-ray and a collection of sputum specimens. If a diagnosis of TB is made from this evaluation, anti-TB treatment should be initiated immediately. If TB disease is not detected, the HCW should be offered treatment for latent TB infection according to established guidelines.
**Slide 21**

Chest Radiography
- HCW with baseline (+) or newly (+) TST or BAMT
- After baseline, repeat radiographs not needed
- Only when symptomatic
- Serial chest x-rays NOT recommended: when?

There are misconceptions regarding follow-up chest x-rays that need to be dispelled. When a HCW has a baseline positive TST or a newly positive TST or BAMT, he/she should receive one chest x-ray. However, after that, chest x-rays should not be repeated at regular intervals. They should only be done in conjunction with new symptoms that indicate disease. Serial chest x-rays are not recommended for: 1) HCWs with a previously positive test result for TB, 2) in HCWs just because they have once been treated for LTBI, or 3) in asymptomatic HCWs with negative tests for TB infection.

**Slide 22**

Workplace Restrictions
- HCWs with confirmed infectious pulmonary, laryngeal, endobroncheal, or tracheal TB disease, or draining TB skin lesion pose risk to patients, HCWs, & others
- HCWs with extrapulmonary TB disease usually do not workplace exclusion if no involvement of respiratory track
- HCWs receiving treatment for LTBI can return to work immediately

An important component of occupational health and infection control for HCWs is the concept of workplace restrictions. HCWs with confirmed infectious TB that is pulmonary, laryngeal, endobroncheal, or tracheal pose a risk to patients, HCWs and others. This also true of those with a draining TB skin lesion. Such HCWs must be sent off of work with any of these situations. On the other hand, HCWs with extrapulmonary TB (no lung involvement), do NOT need to be excluded from the workplace as long as there is no involvement of the respiratory tract. A HCW with LTBI who is receiving treatment can return to work immediately.

**Slide 23**

These HCWs should not be allowed RTW until:
- 3 consecutive (-) sputum samples collected in 8-24 hour intervals (at least 1 early AM sample)
- Person responded to anti-TB effective treatment
- Non-infectious by MD with knowledge & experienced re: TB

The information on this slide is imperative to know to sit for the CIC exam and is very important to know for this week. The duration of being off work is until the following conditions have been met: 1. There have been 3 consecutive negative smears collected at 8-24 hour intervals and which should include at least one early morning sample, 2. The person has responded to anti-TB effective medicine (if still as ill as when they started, may have a resistant strain of TB), and 3. The HCW is determined to be non-infectious by a physician knowledgeable and experienced in managing TB.

**Slide 24**

Surveillance of Patient TB Cases Indicates Possible Pt.-to-Pt. Transmission
- Healthcare setting should collaborate to conduct investigation
- Where HCWs serially tested, review records or T in # of TST conversions
- Review patient surveillance data & medical records for additional TB cases

In the event that surveillance of TB cases in patients indicates possible patient-to-patient transmission of the disease, there are 3 recommendations: 1. Healthcare setting should collaborate with local/state health departments to conduct an investigation into the source of the infection (other patient, HCW, visitor, family member, etc.). 2. Where HCWs serially tested, review HCW records for in the number of TST conversions. This might signal a clue of when the exposure may have occurred. 3. Review patient surveillance data & medical records for additional TB cases.
### 3. Screening

- HCWs who might **need** to perform job duties while wearing a respirator should be screened by a licensed healthcare professional.
- Include questionnaire for pertinent medical conditions.

The third component of a TB surveillance program is screening. A licensed healthcare professional should screen HCWs who might need to perform job duties while wearing a respirator. The screening should also include questions about pertinent medical conditions that might affect a HCW's ability to wear a respirator.

### 3. Screening

- Classification of potential on-going transmission warrants immediate investigation & corrective steps.
- If transmission has ceased, setting reclassified as medium risk.
- Maintaining classification of medium risk recommended for 1 year.

When there have been TB conversions in test results that have been detected in follow-up testing, then the third component of the surveillance program needs to be enacted. If surveillance indicates that possible ongoing transmission of TB has occurred, this warrants immediate investigation and corrective steps. The facility should remain as a high risk classification during that time. If transmission has ceased, then the setting should be reclassified as medium risk, and this level be maintained for at least one year.

### 4. Training

- HCWs should be provided with annual training on multiple topics:
  - Nature, extent, & hazards of TB disease in healthcare setting
  - Risk assessment process & relation to respirator program
  - Signs & symbols used to demonstrate that respirators are required in an area
  - Examples

The fourth component in a TB surveillance program is training and education. There is annual training on TB that should include the following topics: 1) the nature, extent and hazards of TB disease in a healthcare setting, 2) the risk assessment process and its relation to the respirator program, and 3) signs and symbols used to demonstrate that respirators are required in an area. Some examples of specific ways to meet that training requirement includes covering reasons for using respirators, environmental controls used to prevent the spread and concentration of airborne droplet nuclei (that cause TB) and reasons for selecting a particular respirator for a given hazard.

### Trainees’ Resources

- Resources available as adjunct to respiratory protection program:
  - Opportunities to handle & wear respirator until trainee proficient
  - Educational materials for references
  - Instructions to refer all problems immediately to program administrator

There is also a recommendation that resources be available as an adjunct to a respiratory protection program. Such resources include opportunities to handle and wear a respirator until a trainee is proficient, educational materials for references, and instructions for referring all respirator problems immediately to the respirator program administrator.

At this point, we have covered all that was essential for this class from the 147 pages of TB guidelines.
What you should focus on for this section of the lecture is the hierarchy of controls for protecting healthcare workers from TB. We learned about the controls and used bloodborne pathogen exposure examples in Part 1. Now let’s define and use examples of these controls for tuberculosis. Administrative controls reduce the risk of exposure through an effective infection control program; environmental and engineering controls prevent the spread of and reduce the concentration of droplet nuclei; and respiratory protection provides additional protection in special circumstances.

A facility that does not have isolation rooms or the capacity for airborne precautions may simply send TB patients to another facility. This is a pure form of elimination—the patient is removed. If the facility to which the TB patient is being sent wishes to exchange a non-infectious patient (perhaps if over census), this would constitute substitution. The CDC guidelines describe how many TB cases a facility needs to have a year to warrant the requirement of airborne precautions. An example of surveillance that could be done related to this issue is to look at the number of TB cases admitted to a facility each year, compare it to past years, and if transmission of TB has occurred. An increase in TB cases might warrant a change in the facility’s risk assessment.

On this slide, are two examples of engineering controls for preventing TB exposures. First is negative pressure ventilation. This control allows pulling of air into the room and exhausting it to the outside so that it does not get pushed out into hallways and the rest of the ventilation system. The second is high-efficiency particulate air or HEPA filtration if air cannot be exhausted to the outside. HEPA filtration can capture the small TB particles. An example of a type of surveillance that can be done to monitor effectiveness of engineering controls is to measure the isolation rooms periodically to determine if the rooms are indeed maintaining negative pressure. If not, this must be corrected immediately and the situation should be re-monitored again as a follow-up.
Administrative and work practice controls for tuberculosis need to be incorporated into policies. There should be a strict policy regarding placement of patients with a high index of suspicion into isolation for TB. This can be done without a doctor’s order and in many institutions, the infection control staff or the nurses on the floors can do so if TB is suspected. All patients with suspected TB must be placed in negative pressure isolation rooms using airborne precautions until either TB has been ruled out by another diagnosis, or the same conditions listed for infected HCWs are met. The negative pressure isolation systems need to be monitored. All patients who are suspected to have TB or have a cough of unknown cause have to be masked. You can see the flaws with that, if someone decides not to follow one or more of those recommendations (e.g., too busy or there is an emergency). That’s why it is better to have the upper level controls in the hierarchy for protection.

In the lowest rung of the hierarchy is Personal Protective Equipment (PPE). Examples of PPE for control of TB are N-95 respirators and powered air purifying respirators (PAPRs). N-95 respirators are the required respiratory protection for entering the room with a patient with TB. PAPRs are highly recommended in the guideline, if someone has facial hair, or can’t be fitted with an N-95 respirator. If you can’t create a tight seal, because you have facial hair or some other issue, then you need to wear more involved equipment to ensure protection. Performing skin testing or BAMTs of employees as part of the program is an excellent way to measure effectiveness of personal protective equipment and engineering controls.

Next, let’s use a hand hygiene surveillance example. The Joint Commission (or TJC) mandates that healthcare facilities perform surveillance on compliance with hand hygiene by their employees. How a facility chooses to measure this is not mandated. Let’s say that your facility is scheduled to be inspected in a year. As the IP for the facility, you must come up with some options for conducting this surveillance to the infection control committee and they need to vote on one of the options.
On this slide are some possible options. The first is to periodically (so not all the time), but at some interval, monitor and record adherence to the number of hand hygiene episodes performed by personnel over the number of hand hygiene opportunities. How would that happen? One could make a checklist with these columns: healthcare worker category (nurse, doctor, respiratory therapist, nurses aid, physical therapist, etc.); activity (what was the HCW doing), was this an activity that required hand hygiene (yes or no); and did they wash their hands with soap and water or decontaminate with an alcohol hand-rub? This surveillance could be conducted by unit, by job category, or during a specific time period for all categories of HCWs in a particular area, as examples. Another way to conduct surveillance, would be to monitor the volume of the alcohol based hand rub that has been used per 1000 patient days. Another option, if there is some type of outbreak or cluster of infections, to monitor the adequacy of hand hygiene (using enough soap, washing hands for an adequate time period, using hand rub correctly) at that time. So TJC mandates surveillance for hand hygiene compliance in health care facilities, how it is conducted is up to the facility. But facilities have to conduct some type, so be thinking about how you might do it, and what your numerator would be and what your denominator would be (heads up hint for a final exam question!).

In summary, we have looked at important occupational safety and health concepts and the hierarchy of controls for protecting HCWs. We have applied these to surveillance for bloodborne pathogens, surveillance of TB, and some examples for monitoring compliance with hand hygiene. Make sure that you know the levels of control in the hierarchy, their definitions, and be able to give examples for bloodborne pathogens and for TB. You will next complete the on-line exercise on occupational health hazards to learn many of the potential hazards healthcare workers face in healthcare facilities. Good luck on the exercise.

This concludes the lecture for Week 10 part 2.

By the way, happy Halloween!