

**SLIDE 1=TITLE**

**SLIDE 2**

Hi. I'm Zack Moore, medical Epidemiologist with the Communicable Disease Branch. In this unit, I will be discussing invasive bacterial diseases.

**SLIDE 3**

At the conclusion of this presentation, participants should be able to:

- Recognize the public health significance of invasive bacterial diseases,
- Be able to locate control measure guidance for these diseases, and
- Known which invasive bacteria must be sent to the state lab for serotyping.

**SLIDE 4**

I will first discuss four invasive bacterial diseases that are reportable in North Carolina: Haemophilus influenzae invasive disease; Invasive meningococcal disease; Pneumococcal meningitis; and Group A streptococcal invasive disease, including toxic shock syndrome.

Drug-resistant infections are covered in a separate presentation.

**SLIDE 5**

When talking about invasive disease, it is important to remember that- with some exceptions- only isolation of the organism from a “normally sterile site” is considered invasive.

Invasive infections occur when pathogens get past the body's normal defenses- such as the skin or the lining of the respiratory tract- and invade normally sterile sites like the blood stream or spinal fluid. Other less commonly infected sterile sites include joint fluid, bone, pleural fluid and pericardial fluid.

It is important to note that invasive disease does NOT include positive cultures from sputum, throat, or nasopharyngeal swabs. These bacteria are common in the upper respiratory tract and

they can cause many noninvasive illnesses like ear infections and sinus infections. For group A strep, invasive disease also does NOT include cultures from skin, genital tract, or superficial wounds. Invasive means just that; the organism has invaded into a normally sterile site.

Some results are difficult to interpret because they are not obviously sterile or nonsterile sites. Examples include cultures from bronchioalveolar lavage specimens, pleural fluid, or surgical specimens. In these cases, it is good to get more clinical information and information about how the specimen was collected to help you decide whether the bacteria was really invasive.

## **SLIDE 6**

Three of the pathogens we will discuss- meningococcus, pneumococcus, and haemophilus- have many similarities.

All three organisms can colonize the upper respiratory tract. Colonization means that they can live in or on the body without causing any disease.

All three spread from person to person by respiratory droplets or contact with oral secretions. This means that transmission requires close contact; there is little or no risk of transmission from contaminated environmental surfaces or through the airborne route.

All three of these infections are vaccine-preventable.

Finally, all three bacteria can invade after viral infections. This happens when respiratory viruses disrupt the lining of the airways, allowing the bacteria to invade.

## **SLIDE 7**

The first bacteria I will discuss is Haemophilus influenzae or “H flu”. H flu can cause a variety of clinical syndromes. Invasive diseases include pneumonia, meningitis, epiglottitis and bacteremia. Noninvasive diseases include ear, eye and sinus infections.

H flu bacteria are divided into serotypes a, b, c, d, e, and f based on proteins found in the capsule that surrounds the organism. Strains without a capsule are called nontypeable. Keep in mind that a “nontypeable” result from the state lab does not mean serotyping could not be performed; it means the organism had no capsule.

All serotypes can cause invasive disease. Haemophilus influenza serotype b, or Hib, is the most virulent.

## **SLIDE 8**

Haemophilus influenzae Type b was the leading cause of bacterial meningitis in children <5 before vaccination. Approximately 4–5% of cases were fatal and 20% of infected children had permanent sequelae.

## **SLIDE 9**

This graph from the CDC shows what happened with reported cases of invasive H flu disease in children less than 6 years old after the introduction of the Hib vaccine in the late 1980s. As you can see from the yellow line, the incidence of invasive Hib disease had already decreased more than 95% by 1993.

As stated previously, other types of H flu can cause invasive disease; these are represented by the red line. The incidence of invasive H. flu caused by other serotypes has remained stable.

## **SLIDE 10**

Maintaining high coverage with the Hib vaccine is the most important measuring for preventing invasive H. flu.

Antibiotic prophylaxis is only recommended for type b disease. Even for Hib cases, prophylaxis is only recommended for households with an under-immunized child <4 or an immunocompromised child in the home.

Serotyping results are not usually available when a case is first identified. Since Hib is now rare in the US, we generally do not assume the infection is caused by type b when planning control measures unless the patient is at increased risk. Examples of patients at increased risk might include contacts to known Hib cases, travelers to highly endemic areas, or unvaccinated children.

## **SLIDE 11**

Here are a few tips for reporting H. flu invasive disease to help you avoid common pitfalls.

First, H. flu is not influenza. This is a point of confusion for many patients, especially during flu season.

Remember that all H. flu serotypes are reportable if they are associated with invasive disease, not just type b, and that all H. flu isolates from normally sterile sites must be serotyped according to NC law. This usually means the lab must submit them to the state.

Finally, positive latex agglutination tests from spinal fluid are also reportable as “probable” cases even if there is no positive culture result. Latex agglutination tests only pick up type b and are sometimes used for rapid diagnosis or for patients who received antibiotics before spinal fluid could be obtained.

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Let’s turn our attention now to meningococcal infections.

*Neisseria meningitidis*, also called meningococcus, can cause several clinical syndromes. It is one of the leading causes of bacterial meningitis in young children, and can also cause a blood stream infection known as meningococemia. Both meningococcal meningitis and meningococemia cause significant morbidity and mortality. These conditions can occur as sporadic cases or in outbreaks.

There are many strains or serogroups of *Neisseria meningitidis*. The five serogroups responsible for the vast majority of invasive disease are A, B, C, Y, and W-135. Serogroup A is uncommon in the US.

A vaccine is available that protects against four of the five serogroups: A, C, Y and W-135. Routine vaccination is now recommended for all children 11--18 years of age and for adults who are at increased risk, including college freshmen living in dormitories, military recruits, and people with asplenia or certain other immune problems. The vaccines available in the US do not protect against serogroup B, which is the leading cause of meningococcal disease in infants.

## **SLIDE 13**

One of the frequent signs of meningococemia is a rash, which often begins as petechiae. In severe cases, the patients can develop purpura, as shown in this picture from the Nat’l Foundation of Infectious Diseases website.

## **SLIDE 14**

Antibiotic prophylaxis is the most important step in preventing infections among close contacts of patients with invasive meningococcal infections. Prophylaxis is recommended for HH contacts and others with direct exposures to the patient’s oral secretions. Note that prophylaxis is NOT recommended for casual contacts such as office coworkers, elementary, high school or college classmates, or healthcare workers who were not directly exposed to oral secretions. Detailed recommendations are available in the Red Book.

Timing of prophylaxis should be based on the index patient's infectious period and the time since last exposure. Patients are considered infectious beginning approximately 7 days before onset until 24 hours after starting appropriate antibiotics. Prophylaxis should be given within 24 hours after identification of index patient if possible, and is of limited value if started more than 14 days after the last exposure.

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Invasive meningococcal disease can be reportable even without a positive culture if there were gram negative diplococci- like those shown on the right- on a gram stain from a normally sterile site, or if the patient was clinically diagnosed with purpura fulminans.

Finally, remember that all meningococcal isolates from normally sterile sites must be sent to the state laboratory of public health for serogrouping.

#### **SLIDE 16**

We are now going to talk about *Streptococcus pneumoniae*, which is also known as pneumococcus.

Pneumococcus can cause many clinical syndromes. Invasive pneumococcal diseases include bacteremia, pneumonia, and meningitis.

Pneumococcal infections are most common during the late winter and early spring. Certain groups are at higher risk of invasive pneumococcal disease, including children less than 2 years of age, adults over 65; and people with certain chronic medical conditions.

There are many pneumococcal serotypes, and vaccines are available to protect against those that are most likely to cause invasive disease. Prevnar (or PCV13) is a conjugate vaccine that protects against the thirteen serotypes most commonly associated with severe infections. Routine vaccination with PCV13 is recommended for all children less than 2 years of age and for children 2-5 years of age with high risk medical conditions.

Persons over 65 years of age and adults who have chronic medical conditions like diabetes should receive the pneumococcal polysaccharide vaccine that protects against 23 different serogroups.

#### **SLIDE 17**

This graph shows the dramatic declines in invasive pneumococcal disease in children under 5 following the introduction of the PCV7 in 2000. Rates of disease due to the 7 strains covered by

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the vaccine, shown by the blue line, dropped from around 80 cases per 100,000 children before vaccine to less than 1 case per 100,000 children by 2007.

PCV7 also reduced rates of invasive pneumococcal disease by more than 60% among older children and adults through herd immunity.

### **SLIDE 18**

Only one type of invasive pneumococcal disease is currently reportable in NC, and that is Pneumococcal meningitis. Keep in mind that this is not the same as meningococcal meningitis; there can be some confusion with names of organisms versus names of clinical syndromes, particularly if patients have pneumococcal meningitis, or even meningococcal pneumonia.

Since contacts are not generally at increased risk, antibiotic prophylaxis is rarely- if ever- indicated.

### **SLIDE 19**

For reporting purposes, a confirmed case of pneumococcal meningitis is defined as isolation of *S. pneumoniae* from cerebrospinal fluid.

A probable case is defined as a clinically compatible case with a laboratory-confirmed culture of *S. pneumoniae* from another normally sterile site other than CSF, OR a clinically compatible case with other supportive laboratory findings (such as a positive latex agglutination test from CSF) and no other specific etiology identified.

### **SLIDE 20**

Next I will review Group A strep invasive disease. Group A strep is a very common type of bacteria that often causes strep throat, skin infections, and scarlet fever. It can also cause several types of invasive disease.

The first of these is streptococcal toxic shock syndrome, an acute illness characterized by fever, low blood pressure, rash, peeling skin, and multisystem organ involvement which often includes the liver, kidneys, GI tract, and central nervous system

### **SLIDE 21**

The rash of toxic shock syndrome is often described as a sunburn-like rash as seen in this picture.

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Another clinical finding of toxic shock syndrome is desquamation, or peeling of the of the skin. This peeling usually involves the palms and soles, as well as fingers and toes.

It is important to realize that desquamation, or peeling, is a late finding. This finding may not be present when the initial report is made.

Toxic shock syndrome caused by staph aureus is very similar to streptococcal toxic shock and is also reportable in North Carolina, but that topic is not covered in this presentation.

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Group A strep is also a leading cause necrotizing fasciitis, often referred to as “flesh-eating bacteria” because of the rapid and severe tissue damage it causes.

Some other clinical syndromes include myositis (or muscle infection); bone or joint infections; and pneumonia. Bacteremia can occur in association with superficial skin or wound infections, or with no apparent source.

## **SLIDE 24**

Group A strep is also called *Streptococcus pyogenes* or group A beta hemolytic strep. When investigating and reporting invasive group A strep cases, it’s important to remember that not all strep are group A strep. There are many other strep species that cause human illness, including *Streptococcus pneumoniae* and group B strep.

Antibiotic prophylaxis is not routinely recommended for contacts to invasive group A strep cases. However, it can be considered for elderly HHCs or others who are at increased risk for invasive group A strep. Prophylaxis can also be considered in outbreak settings.

## **SLIDE 25**

Group A strep is an important cause of post-surgical and post-partum infections. These are sometimes linked to transmission from colonized healthcare workers. To prevent healthcare transmission, it’s important to identify these cases by finding out whether patients with invasive group A strep had surgical procedures or delivery within 7 days before the first positive culture. The CDC has published guidance for investigating post-partum and post-surgical cases, and these are available from the Communicable Disease Branch.

Finally, group A strep infections have very high morbidity and mortality in long-term care settings. GAS can spread quickly in these settings due to inadequate hand hygiene or colonized staff members. Specific investigation and control measures for group A strep cases or outbreaks in long-term care settings are available from the Communicable Disease Branch.

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In conclusion, invasive bacterial diseases are an important cause of illness and death in the United States. Although outcomes from these infections have improved with the help of antibiotics and better supportive care, we must continue to be vigilant in our response to these pathogens.

Public health plays an important role in prevention and control of these diseases. Vaccines are available to prevent many of these infections, but other tools such as education of the public and healthcare providers, improved infection control, and antimicrobial prophylaxis when indicated are also important tools.

#### **SLIDE 27**

Additional references are listed here.

- American Academy of Pediatrics. Pickering, LK, ed. *Red Book: 2009 Report of the Committee on Infectious Diseases*. 29th ed. Elk Grove Village, IL: 2012.
- American Public Health Association. Heyman, DL, ed. *Control of Communicable Diseases Manual, 19<sup>th</sup> ed.* Washington, DC: 2008.
- North Carolina Communicable Disease Manual.  
<http://www.epi.state.nc.us/epi/gcdc/manual/toc.html>
- CDC/ Prevention of invasive group A streptococcal disease among household contacts of case patients and among postpartum and postsurgical patients: Recommendations from the Centers of Disease Control and Prevention. *Clin Infect Dis* 2002; 35:950-9.