Influenza
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Dr. Zack Moore

SLIDE 1-TITLE

SLIDE 2

I'm Zack Moore, a medical epidemiologist with the Communicable Disease Branch. This presentation will cover influenza.

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

1. Describe basic epidemiologic features of seasonal and novel/pandemic influenza
2. Locate and interpret current influenza surveillance data
3. Correctly classify and report influenza-associated deaths
4. Identify resources for responding to influenza outbreaks in long-term care settings

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Influenza is a respiratory virus with three main types: A, B and C. Influenza A infects animals and humans and is responsible for both seasonal epidemics and global pandemics. Influenza B primarily infects humans and contributes to seasonal epidemics but not to global pandemics. Influenza C causes a mild respiratory illness and is not associated with epidemics or pandemics.

Influenza is an RNA virus that has eight gene segments, represented by the squiggly lines in this diagram. These genes code for structural and surface proteins. Two of the most important surface proteins are hemagglutinin, represented by the pink spikes, and neuraminidase, represented by the yellow polo mallets. The hemagglutinin binds to receptors in the respiratory tract and the neuraminidase cleaves the receptors allowing new flu virions to be released. Influenza A viruses are named based on the type of hemagglutinin and neuraminidase they produce, such as H1N1 or H3N2.

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Like all viruses, flu viruses are constantly mutating. Flu undergoes two types of genetic changes, known as drift and shift.

Antigenic drift is the continual development of new strains through the gradual accumulation of genetic mutations. These mutations occur much more rapidly in influenza A than in influenza B. This constant antigenic drift is one reason why we have seasonal epidemics each year. The population-level immunity that developed to last year's flu strains might not protect us against the slightly different strains circulating this season. This is also the reason why the flu strains included in the flu vaccine have to be changed every year.

Antigenic shift is a much more radical and rapid genetic change that occurs when a flu virus acquires a new hemagglutinin or a new hemagglutinin and neuraminidase. Antigenic shift is usually due to mixing or reassortment between human and animal influenza viruses, so it occurs in influenza A only. Antigenic shift results in new flu strains and can be the first step in a global pandemic.

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This back-lit picture of respiratory droplets generated by a sneeze demonstrates why respiratory viruses are able to spread so efficiently. Flu can be spread directly through contact with droplets generated by coughing or sneezing, or by contact transmission with virus on the hands or on contaminated surfaces. Airborne transmission on smaller droplets that remain suspended in air is also possible, but this is less likely with flu than with some other viruses like measles or varicella.

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Seasonal flu has major public health and economic impacts.

Each year, influenza infects between 5 and 20% of the US population, resulting in more than 200,000 hospitalizations and an average of 24,000 deaths each year. Certain groups are at higher risk for developing flu-related complications, including the elderly, young children, pregnant women, and people with certain underlying medical conditions. About 90% of flu-associated deaths are in adults 65 years of age and older.

Each year, flu epidemics result in approximately $10 billion in direct medical costs. When lost productivity and other factors are included, it is estimated that flu results in approximately $87 billion total economic burden each year.

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While seasonal flu is of major public health importance, what we worry about even more is the generation of new or "novel" influenza viruses that have the potential to cause global pandemics. As shown in this diagram, novel flu viruses are created when viruses from domestic or wild birds, pigs or humans mix and exchange gene segments.

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Three conditions are required for a flu pandemic to occur. First, a new virus has to arise to which all or most of the population is susceptible. Second, this virus must be capable of sustained person-to-person transmission. It is worth noting that human infections with novel flu viruses are reported every year in the US and abroad, sometimes with limited person-to-person transmission. However, it is only when these viruses are capable of sustained person-to-person transmission that wide geographic spread becomes inevitable.

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Pandemics can cause tremendous devastation. This photograph shows a warehouse full of soldiers infected during the 1918 influenza pandemic, the most severe pandemic of the past century.

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This table shows the impact of other past influenza pandemics, including the 2009 H1N1 pandemic. As you can see, these pandemics have each resulted in more than 12,000 excess deaths and have often had a disproportionate effect on young adults.

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This slide lists currently available options for testing for influenza. Viral culture and PCR are both performed at the NC State Lab.

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Rapid influenza tests are the only point-of-care option for diagnosis and therefore are widely used. However, keep in mind that these tests have low sensitivity. Therefore, a negative rapid influenza diagnostic test does NOT rule out influenza infection and treatment and infection control decisions should NOT be based on negative RIDT results when influenza is circulating.

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Two classes of antiviral medication are approved for treatment of flu. Unfortunately, the adamantanes, also called M2 inhibitors, are not effective against any currently circulating strains. The only treatment options at present are the neuraminidase inhibitors, oseltamivir and zanamivir. These drugs are active against all circulating strains of influenza A and B.

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Antiviral treatment is recommended as early as possible for any patient with confirmed or suspected influenza who

is hospitalized;

has severe, complicated, or progressive illness; or

is at higher risk for influenza complications.

Keep in mind that treatment should never be delayed or withheld due to a negative rapid influenza diagnostic test.

Although antivirals are most effective if started within 48 hours after onset of illness, observational studies suggest that they can reduce mortality and duration of hospitalization even when they are started more than 48 hours after onset of illness.

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Flu vaccines are the best way to prevent influenza infection and are recommended for everyone 6 months of age and older. Vaccination is especially important for:

People who are at high risk of developing serious complications like pneumonia if they get sick

with the flu, and

People who live with or care for others who are high risk of developing serious complications.

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Next, I will describe the major component of flu surveillance.

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Surveillance for influenza will never identify all infections, since many cases are not medically attended and some infections are subclinical, as depicted by the submerged portion of this iceberg.

Surveillance focuses on identifying flu in patients who present to care, including outpatient visits and hospitalizations.

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In order to accomplish this, we rely on three main components.

The first is tracking influenza-like illness, or ILI, usually defined as fever plus either cough or sore throat. In NC, this is monitored through ILINet, a CDC-operated system that collected data every week from a network of volunteer providers in health departments, doctors' offices, and student health centers. We also monitor emergency department visits for influenza-like illness through NC DETECT.

The second main component is virologic surveillance, which involves performing systematic laboratory testing on a sample of patients seen by providers in the ILINet program. This helps us determine what proportion of flu-like illness is actually caused by flu, and which flu viruses are circulating in the state.

The third component involves case-based reporting of any flu-associated deaths or novel influenza infections.

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Influenza-associated deaths have been reportable in NC since 2004 for children and 2009 for adults. A flu-associated death is defined as a clinically compatible illness during which influenza was confirmed by a laboratory or rapid diagnostic test with no period of complete recovery between the positive test and death.

It is important to note that flu does not have to be the primary cause of death for a case to be reported.

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Each of the next four slides will demonstrate how our flu surveillance data are analyzed and presented.

This graph shows the proportion of visits to ILINet providers that were due to influenza-like illness from October-May during 2002-2013. As you can see, the timing and intensity of the flu season is different each year. The peak in North Carolina usually comes in February, but can be much earlier in some seasons, including the 2012-13 season indicated by the red dashed line.

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This graph shows the number of specimens testing positive for flu at the state lab from October 2012 through May 2013. The colored bars represent different flu viruses, and the black line represents the proportion of all specimens that tested positive. As you can see, the predominant virus can change over the course of the season. In this case, influenza A H3N2, represented by the red bars, was the predominant virus during the peak of flu activity. However, influenza B, represented by the green bars, was more common later in the season. This information can be important for providers and for public health, since different flu viruses sometimes affect different groups more severely.

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This graph shows the number of flu-associated deaths reported in NC during the 2012-13 influenza season. As you can see, most of the deaths were among persons 65 years of age or older, which is the pattern seen during most – but not all - years.

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This graph shows flu-associated deaths reported in NC by the month of death. Adults are represented by blue and children by red. As you can see, the number of deaths reported and the age distribution can vary widely from one season to another.

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These graphs and other flu surveillance information are published each week at www.flu.nc.gov Flu activity is also broken down by region in the weekly reports. I encourage you to check this site for updates during flu season and share this information with providers in your communities.

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Next, I will briefly discuss control measures for influenza. Since influenza outbreaks long-term care facilities can cause significant illness and death, I will focus on control measures for this setting.

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For public health purposes, an outbreak of influenza in a LTC facility is defined as at least one laboratory or rapid test positive case plus respiratory illness in other residents on the same unit.

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If an outbreak of flu is identified in a LTC facility, the four main control measures listed here should be implemented.

First, the facility staff or the health department should conduct daily active surveillance and maintain a line list that includes symptom onset dates.

Standard and droplet precautions should be used for all ill residents and antiviral treatment should be offered to all ill residents.

Finally, antiviral chemoprophylaxis should be provided to all non-ill residents* regardless of vaccine status. Antiviral chemoprophylaxis might also be required for staff in some cases.

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Other control measures to be considered in long-term care outbreaks are listed here. Not all of these control measures are appropriate for every situation, so I encourage you to contact the communicable disease branch epidemiologist on call with any questions.

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To summarize, influenza remains a major cause of morbidity and mortality.

Annual vaccination is the best way to prevent flu.

Finally, remember to look for influenza surveillance data and updated control measures at www.flu.nc.gov Thanks.