

**Global Public Health Issues**  
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**SLIDE 1**

Hello, I am Dr. Megan Davies, the state Epidemiologist and Chief of the Epidemiology Section for the North Carolina Division of Public Health. I welcome you to this first lecture of this course and thank you for taking the time to increase your knowledge and improve your disease investigation skills. This lecture will introduce you to Global Public Health Issues, but more importantly, I hope to convey the importance of your contribution to the global understanding of diseases that impact our communities and our families. As you will see, any place in the world can be the center of a communicable disease epidemic.

**SLIDE 2**

At the end of this presentation, I hope that you will be able to name the three greatest global public health communicable disease threats, know the importance of travel history when investigating reports of communicable disease, and identify two reasons why chemoprophylaxis for malaria may fail.

**SLIDE 3**

The focus of this presentation will be the 3 greatest infectious disease global public health threats — HIV/AIDS, Tuberculosis (TB), and Malaria. According to the World Health Organization, these three infectious diseases are the top three killers worldwide. But before delving into these important topics, I want to briefly address a few global health issues that have also captured the public's attention and ours.

**SLIDE 4**

Malaria and TB are old foes, and HIV is still relatively new, but we also face new and emerging infections, like the SARS pandemic of 2002-2003, and the influenza A: H1N1 Pandemic of 2009. The threat of biological warfare and use of biological agents as weapons of mass destruction makes once eradicated diseases like smallpox, a dreaded threat once more. Severe Acute Respiratory Syndrome or SARS was first recognized in February 2003, when a deadly infection spread quickly within a Hong Kong hotel and rapidly within Hong Kong hospitals as a nosocomial infection. Widespread transmission followed with spread to other countries. The infection had a case fatality rate of 10%. North Carolina had one of only eight laboratory-confirmed cases reported in the United States. SARS was the first pandemic of the 21st century and was caused by a new coronavirus, most likely originating from an animal reservoir (zoonotic infection). Most of us served in the public health response to pandemic influenza A: H1N1 in 2009 and 2010. Because the influenza virus is constantly undergoing genetic changes, we may well all be called upon to respond to the next influenza pandemic. The risk of a bioterrorist attack was proven real in October, 2001, when anthrax spores were deliberately sent through the US Postal Service, sickening 22 people, 5 of whom died. While the prospect of another deliberate biologic attack is unsettling, the surest way to detect and respond to a deliberately caused outbreak is by strengthening the systems

used for detecting and responding to natural outbreaks, as the epidemiological and laboratory principles are fundamentally the same. So, by investing your time in this course to increase your knowledge and skills in communicable disease investigation and control, you are preparing for the next unexpected threat.

### **SLIDE 5**

The key drivers of global infectious diseases are economic. In the map shown here, I want you to pay attention to the distribution of health care dollars around the world. To no one's surprise, there is great disparity among countries on the percentage of dollars spent on health care. You will see as we look at the world-wide distribution of global infectious disease, that morbidity follows the same mapping. I could have shown a map of gross national product, or some other, more general economic indicator, and it would reflect the same reality. In fact, looking at healthcare spending gives a slightly distorted view, since the country that spends the most money on healthcare, the USA, does not have the best health indicators performance (e.g. in infant death rates and life expectancy) in the world. The best results occur in other developed nations such as Canada, western Europe, and Japan, where somewhat less money is spent. However, the main thrust of this slide is to show the poorest areas of the world, which will appear to stand out again when we look at morbidity of HIV, TB, and malaria.

### **SLIDE 6**

The human immunodeficiency virus (HIV) is a retrovirus that infects cells of the immune system, destroying or impairing their function. As the infection progresses, the immune system becomes weaker, and the person becomes more susceptible to infections. The most advanced stage of HIV infection is acquired immunodeficiency syndrome (AIDS). It can take 10-15 years for an HIV-infected person to develop AIDS; antiretroviral drugs can slow the process greatly, and also decrease the amount of virus present in a person's blood. HIV is transmitted through unprotected sexual intercourse, transfusion of contaminated blood, sharing of contaminated needles, and between a mother and her infant during pregnancy, childbirth and breastfeeding. HIV/AIDS has many faces, but this photograph is the one that "Brought AIDS Home" in the United States. In a recent photo journal article by LIFE magazine, we learn that "In November, 1990, LIFE magazine published a photograph of a young man, David Kirby — his body wasted by AIDS, his gaze locked on something beyond this world — surrounded by anguished family members as he took his last breaths. The haunting image of Kirby's passing, taken by a journalism grad student named Therese Frare, became the one photograph most identified with the HIV/AIDS epidemic that, by then, had seen as many as 12 million people infected. David Kirby was an AIDS activist born and raised in a small town in Ohio. When he learned in the late 1980s that he had contracted HIV, he was living in California and was estranged from his family. He got in touch with his parents and asked if he could come home; he wanted, he said, to die with his family around him. The Kirbys welcomed their son back."

## **SLIDE 7**

This photograph taken in 2006, captures one face of HIV and AIDS in Africa today. These are AIDS orphans in the Biwi/Mchesi area of Lilongwe, Malawi. In addition to the terrible personal tragedies that this picture represents, it also captures why AIDS is also considered a threat to global security. High rates of HIV infection in many countries in sub-Saharan Africa threaten whole societal structures and national economies. HIV/AIDS remains one of the world's most significant public health challenges, particularly in low and middle-income countries. Thanks to recent advances in access to antiretroviral therapy (ART), HIV-positive people now live longer and healthier lives. At the end of 2009, 5.2 million people in low and middle-income countries received ART. However, approximately 10 million people in need of ART still have no access to treatment.

## **SLIDE 8**

Here the disease burden of HIV/AIDS around the world is shown. The distribution shows the high prevalence of disease in Sub-Saharan Africa, but also now in central Asia. For 2008, 33.4 million people are believed to be living with HIV/AIDS in the world. More than 2 million children are now living with HIV/AIDS, according to 2008 figures. Most of the children live in sub-Saharan Africa and were infected by their HIV-positive mothers during pregnancy, childbirth or breastfeeding. Almost 1,200 children become newly infected with HIV each day. The number of children receiving ART increased from about 75,000 in 2005 to 355,000 in 2009. HIV/AIDS is the world's leading infectious killer claiming, to date, more than 27 million lives. An estimated 2 million people die every year from HIV/AIDS.

## **SLIDE 9**

This is a similar view of HIV/AIDS around the world showing the number of newly infected adults and children. Clearly, intervention efforts are not having sufficient impact on disease transmission.

## **SLIDE 10**

This graph demonstrates the trend in HIV/AIDS over the course of the epidemic in the United States. The yellow line marking the incidence of AIDS shows the impact of the revised case definition in 1993. The marked decline in age-related deaths (shown on the blue line) in 1995, is the result of the introduction of highly active anti-retroviral therapy (HAART). The prevalence (shown here as an orange line steadily rising) of AIDS continues to increase because HAART has changed a deadly disease into a chronic disease. HIV/AIDS has and will continue to be one of the greatest public health threats in the United States and globally. We must continually challenge ourselves to better understand and respond to the drivers of this pandemic, including sexuality, gender relations, and healthcare inequities. Now I'd like to turn to another infectious disease that has huge global impact...tuberculosis.

## **SLIDE 11**

Tuberculosis, or TB, is an infectious bacterial disease caused by *Mycobacterium tuberculosis*, which most commonly affects the lungs. It is transmitted from person to

person via droplets from the throat and lungs of people with the active respiratory disease. In healthy people, infection with *Mycobacterium tuberculosis* often causes no symptoms, since the person's immune system acts to "wall off" the bacteria. The symptoms of active TB of the lung are coughing, sometimes with sputum or blood, chest pains, weakness, weight loss, fever and night sweats. Tuberculosis is treatable with a prolonged course of antibiotics. The NC Museum of History in its timeline *Health and Healing in NC*, teaches us that "In the United States, from the late 1800s until the 1950s, the favored treatment for one of the world's deadliest diseases was simply resting—and leaving home for five, 10 or 20 years to do it. Tuberculosis was the second leading cause of death in the United States at the turn of the century, just behind pneumonia. Before the development of antibiotics, no one could cure this contagious bacterial infection. But since it usually affected the lungs, scientists thought the illness might subside if the lungs were kept as inactive as possible. While many patients convalesced at home, those who could afford to, went to institutions called *sanatoriums* for special bedside nursing care. The mountain climate of western North Carolina was considered ideal for TB patients. And no town in the South had more sanatoriums than Asheville. Unfortunately, these retreats were very expensive, and only wealthy patients could afford them. In 1908, the State Board of Health opened North Carolina's first public sanatorium in Hoke County, offering much less costly treatment. Other counties followed. However, African Americans were refused treatment until 1923, when the Hoke County facility built a separate, segregated building. Sanatoriums emphasized a regimented daily schedule that included long periods of bed rest. Because fresh air was believed to help fight tuberculosis, patients spent much of their time outside. They slept with their windows open or on screened porches, even when temperatures dipped below zero and fresh air came mixed with sleet and rain. Today, opinion is divided over whether the rest cure really helped."

## **SLIDE 12**

In spite of the advent of antibiotic therapy in the 1950's, tuberculosis infections remain a devastating, global public health threat. More than two billion people — one third of the world's total population — are infected with TB bacilli, the microbes that cause TB. One in every 10 of those people will become sick with active TB in his or her lifetime. People living with HIV are at a much greater risk of progressing to active infection. This slide shows the estimated TB incidence rates worldwide for 2007. There were 9.27 million new TB cases in 2007, of which 80% were in just 22 countries. The Centers for Disease Control and Prevention has initiatives in Africa, the former Soviet Union, Central, and South America, which have all had a positive impact on the disease. Thus, progress has been made worldwide in decreasing the incidence, but there is still an enormous amount of work to be done. This map shows that over one half of the world's countries have an incidence of over 100 cases per 100,000 population. A total of 1.77 million people died from TB in 2007 (including almost half a million people with HIV), equal to about 4,800 deaths a day. TB is a disease of poverty, affecting mostly young adults in their most productive years. The vast majority of TB deaths are in the developing world, with more than half occurring in Asia. Multi drug-resistant tuberculosis (MDR TB) presents a new challenge to TB prevention and control. There were an estimated 511,000 new MDR-TB cases in 2007 with three countries accounting for 56% of all

cases globally — China, India and the Russian Federation. Even more alarming, extensively drug resistant TB (XDR-TB) occurs when resistance to second-line drugs develops. It is extremely difficult to treat and cases have been confirmed in more than 50 countries. Inadequate health systems and the resulting failures of TB program management, especially poor supervision of patient's treatment regimens, disruptions in drug supplies, and poor clinical management, can all prevent patients completing courses of treatment leading to drug resistance.

### **SLIDE 13**

The global failure to control tuberculosis has a direct impact on you as a communicable disease nurse in your county. This slide shows that as we succeed in decreasing new cases of tuberculosis in the United States, we are seeing a higher proportion of new TB cases occurring among foreign-born persons in the US. Remember, more than two billion people in the world are infected with TB bacilli and one in every 10 of these people will become sick with active TB in his or her lifetime. So, some people may come to the United States in apparent good health, with an undiagnosed latent TB infection that will activate if the person's immune system becomes less effective (e.g. from aging or as a result of starting chemotherapy). So it is very important to check, not only recent travel history when investigating TB cases, but also if your patient lived in another country many years ago.

### **SLIDE 14**

In this graph from CDC, we see the percentages of foreign-born cases by country. Note that cases from Mexico and "Other" account for two thirds of all foreign-born cases. Many of the countries grouped in "Other" include other Latin American countries. TB is a worldwide pandemic. Among the 15 countries with the highest estimated TB incidence rates, 13 are in Africa, while half of all new cases are in six Asian countries (Bangladesh, China, India, Indonesia, Pakistan and the Philippines). So over time, we could expect to see more TB cases in people who come to the United States from these parts of the world.

### **SLIDE 15**

Within the United States, the national case rate continues to decline, even though the decline has leveled off in recent years. We continue to see significant health disparities for TB in the southeast, including North Carolina, especially in the African-American population.

### **SLIDE 16**

This map shows the counties with the most TB cases in North Carolina. If not treated, each person with active TB can infect on average 10 to 15 people a year. That is why each and every active TB case in this state is followed up so intensively for treatment and contact investigation. The local health department CD nurses are on the frontline of TB control in North Carolina.

### **SLIDE 17**

Malaria is a life-threatening parasitic disease transmitted by mosquitoes. It was once thought that the disease came from the fetid marshes, hence the name “mal aria” (bad air). In 1880, scientists discovered the real cause of malaria, a one cell parasite called plasmodium. Later they discovered that the parasite is transmitted person-to-person through the bite of a female Anopheles mosquito, which feeds on blood from mammals. In the human body, the parasites multiply in the liver and then infect red blood cells. Symptoms of malaria include fever, headache, and vomiting, and usually appear between 10 and 15 days after the mosquito bite. If not treated, malaria can quickly become life-threatening by disrupting the blood supply to vital organs. In many parts of the world, the parasites have developed resistance to a number of malaria medicines. Key interventions to control malaria include prompt and effective treatment with artemisinin-based combination therapies, use of insecticidal nets by people at risk, and indoor, residual spraying with insecticide to control the vector mosquitoes. In Africa, malaria accounts for one in five of all childhood deaths.

### **SLIDE 18**

This map shows the global distribution of malaria. The disease was once more widespread, but it was successfully eliminated from many countries with temperate climates during the 20th century. Today malaria is found throughout the tropical and sub-tropical regions of the world. Approximately 40% of the world’s population is at risk of malaria. Most of these people live in the world’s poorest countries. It causes more than 300 million acute illnesses and at least one million deaths annually.

### **SLIDE 19**

Epidemics are ongoing in much of Africa. Malaria parasites are developing unacceptable levels of resistance to one drug after another and many insecticides are no longer useful against mosquitoes transmitting the disease. A vaccine is still years away from becoming a reality. Until that time, effective low-cost strategies are available for treatment, prevention and control. The *Roll Back Malaria Global Partnership* is vigorously promoting these measures in Africa. The interventions include insecticide-treated bed nets, intermittent preventive treatment in pregnancy, and anti-malarial drug combination therapy.

### **SLIDE 20**

When you investigate a case of malaria in your county, it is critical to document a thorough travel history, and if the patient was prescribed medications for prophylaxis. The two major reasons that anti-malarial chemoprophylaxis fails are 1) the parasite infecting the patient is resistant to the medication prescribed, and 2) the patient did not take the medication as instructed. If a patient became infected, despite correctly taking anti-malarial prophylaxis appropriate for the area where he or she traveled, your information will be important in detecting the emergence of new patterns of resistance that can ultimately lead to changes in prophylaxis and treatment recommendations. If your patient was prescribed appropriate prophylaxis but failed to take it, understanding the barriers to taking the medication could be important to designing patient education materials or different approaches to malaria prevention.

## **SLIDE 21**

Shown here is an extremely useful reference book for private physicians and clinics that provide immunization and guidance for travelers internationally. It is available online at [www.cdc.gov](http://www.cdc.gov).

## **SLIDE 22**

Finally, I would like to talk a few minutes about what you do and why it is so important, even vital, to our nation's health and to world health. As a local health department communicable disease nurse, you form an essential part of the worldwide network of public health workers striving to prevent and control infectious diseases. Just as you depend on colleagues in other counties, states, and countries to do their jobs well and thoroughly, each of these colleagues worldwide depends on you. Today's highly mobile, interdependent and interconnected world provides many opportunities for the rapid spread of infectious diseases. Infectious diseases are now spreading geographically much faster than at any time in history. An estimated 2.1 billion airline passengers traveled in 2006; an outbreak or epidemic in any one part of the world is only a few hours away from becoming an imminent threat in your community. Infectious diseases are not only spreading faster, they appear to be emerging more quickly than ever before. Since the 1970s, newly emerging diseases have been identified at the rate of one or more per year. There are now nearly 40 diseases that were unknown a generation ago. In addition, during the last five years, WHO has verified more than 1,100 epidemic events worldwide. What were North Carolina communicable disease nurses doing during the SARS Epidemic of 2003? How did North Carolina communicable disease nurses respond to the Influenza Pandemic of 2009-2010?

## **SLIDE 23**

Let me give you examples of how NC communicable diseases nurses made a difference. In 2003, we had the one case of SARS in North Carolina occur in Orange County. Orange County communicable disease nurses interviewed that patient, placed that patient under isolation, counseled that patient's family on quarantine, and monitored that patient with twice daily telephone calls throughout his isolation period. The CD nurses at the Orange County Health Department also followed healthcare workers in the doctor's practice that treated that patient before the diagnosis was made. These nurses were critical to containing SARS to one patient in Orange County and one patient in North Carolina during that pandemic. In 2009, when the pandemic H1N1 strain emerged, early cases were detected in Carteret and Craven counties. The communicable disease nurses in those counties vigorously investigated each new case and determined if those cases were linked to each other, or had independently been exposed while traveling. Their investigation was critical to determining how infectious this pandemic strain was and what actions we needed to take, not only in North Carolina, but in the United States and worldwide, to contain it. So, I thank those nurses and I thank you and again, welcome you to the North Carolina public health course. Thank you.

## **SLIDE 24**

### References