Welcome to the lecture for Unit 11 entitled “Antimicrobial Resistance and Antibiotic Stewardship”. This is a presentation developed by the Centers for Disease Control and Prevention (CDC), as part of their “Get Smart for Healthcare” program to reduce antimicrobial resistance and implement antimicrobial stewardship programs in hospitals and other healthcare facilities. It is entitled: “Know when Antibiotics Work”.

On this slide are 4 reasons why in-patient antibiotic use needs to improve. Antibiotics are misused in hospitals.
- Antibiotic misuse adversely impacts patients and society.
- Improving antibiotic use improves patient outcomes and saves money.
- And finally, improving antibiotic use is a public health imperative.

In the combined Infectious Disease Society of America or “IDSA” and the Society for Healthcare Epidemiology in America (SHEA) Guidelines on Antimicrobial Stewardship Programs, there is a quote that states: “It has been recognized for several decades that up to 50% of antimicrobial use is inappropriate”.

On this slide is a list of the variety of ways that antibiotics are misused. They are given when they are not needed, continued when they are no longer necessary, or given at the wrong dose. Often broad spectrum agents are used when more specific agents can be used to treat very susceptible bacteria. Finally, sometimes the wrong antibiotic is given to treat an infection.

It is important to note that antibiotic exposure is the single most important risk factor for the development of *Clostridium-difficile* associated disease (also known as CDAD). Up to 85% of patients with CDAD have antibiotic exposure in the 28 days before infection.
Emergence of the epidemic strain of *C. difficile* has intensified the risks associated with antibiotic exposure.

In fact, the epidemic strain of *C. difficile* is associated with increased risk of morbidity and mortality.

On this graph, the # of *Clostridium difficile* infections (or CDI) per 100,000 discharges is plotted on the left and the annual mortality rate per million population on the right. The center contains the years 1993 through 2005. It shows that the incidence and mortality of CDI are increasing in the United States.

This graph shows the estimated burden of healthcare-associated CDI in U.S. Hospitals. Note the facts presented by the 3 bullet points on this slide:
- Hospital-acquired, hospital-onset: 165,000 cases, $1.3 billion in excess costs, and 9,000 deaths annually
- Hospital-acquired, post-discharge (up to 4 weeks): 50,000 cases, $0.3 billion in excess costs, and 3,000 deaths annually
- Nursing home-onset: 263,000 cases, $2.2 billion in excess costs, and 16,500 deaths annually

The epidemic strain of *C. difficile* is resistant to fluoroquinolone antibiotics, which confers a selective advantage.
A patient who receives an antibiotic has an increased chance of either becoming colonized or infected with a resistant organism.

In addition, increasing the use of antibiotics increases the prevalence of resistant bacteria in hospitals.

This graph illustrates how the use of vancomycin is associated with increased resistance, resulting in Vancomycin-resistant Enterococci or VRE.

This graph illustrates how the use rate of carbapenem increases the percentage of imipenem resistant *Pseudomonas aeruginosa*.

It is important to note that antibiotic resistance increases mortality.

This graph illustrates mortality associated with carbapenem resistant (CR) vs. carbapenem sensitive (CS) *Klebsiella pneumoniae* (designated by KP).
This slide compares the mortality of persons who had methicillin-sensitive *Staphylococcus aureus* (MSSA) vs. methicillin-resistant *Staphylococcus aureus* (MRSA). In the first study, those with MRSA bacteremia (or blood infection) were 1.93 times more likely to have mortality than those with MSSA bacteremia. In another study, the mortality of MRSA was higher than MSSA, with a relative risk of 1.7 for MRSA.

In 2008, there were 142,000 visits to emergency departments for adverse events attributed to antibiotics.

National estimates for in-patient adverse events are not available, but there are many reports of serious adverse events (aside from *C. difficile* infection) from in-patient antibiotic use.

Improving antibiotic use reduces *C. difficile* infections.

This graph illustrates how restricting the use of fluoroquinolone can reduce rates of *C. difficile* infection.

Improving antibiotic use reduces resistance.
In a report from the American Journal of Respiratory Critical Care Medicine, use of ciprofloxacin (aka cipro) was compared between using it for 10-21 days versus 3 days. The length of stay in the Intensive Care Unit (ICU) and the incidence of antibiotic resistance and/or superinfection, was lower in the group that received cipro for 3 days.

On this graph, there was a statistically significant increase in the susceptibility of *Pseudomonas aeruginosa* after the implementation of antibiotic restrictions. This was true for the 5 antibiotics tested.

On this graph, improving antibiotic use resulted in decreased cases of resistant *Enterobacteriaceae*.

Improving antibiotic use improves infection cure rates.

On this slide, the use of usual practice (UP) was compared to an Antibiotic Management Program (AMP) to determine the effect on clinical outcomes. There were more cures and less failures with the AMP.

Improving antibiotic use saves money. In the same guidelines mentioned in slide #3, it is stated that “Comprehensive programs have consistently demonstrated a decrease in antimicrobial use with annual savings of $200,000 - $900,000".
<table>
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<tr>
<th>Slide 29</th>
<th>This and the next 3 slides outline why improving antibiotic use is a public health imperative. The first reason is that antibiotics are the only drug where use in one patient can impact the effectiveness in another. Next, if everyone does not use antibiotics well, we will all suffer the consequences.</th>
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<tr>
<td>Slide 30</td>
<td>Antibiotics are a shared resource, (and becoming a scarce resource). Using antibiotics properly is analogous to developing and maintaining good roads.</td>
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<td>Slide 31</td>
<td>Available data demonstrate that we are not doing a good job of using antibiotics in in-patient settings. Several studies show that a substantial percentage (up to 50%) of in-patient antibiotic use is either unnecessary or inappropriate.</td>
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<td>Slide 32</td>
<td>Bringing new antibiotics into our current environment is akin to buying a new car because you hit a pot hole, but doing nothing to fix the road. Fixing the &quot;antibiotic use road&quot; is part of the mission of public health.</td>
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<td>Slide 33</td>
<td>The mission of the program “Get Smart for Healthcare: Know When Antibiotics Work” is to optimize the use of antimicrobial agents in in-patient healthcare settings.</td>
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| Slide 34 | CDC’s “Get Smart For Healthcare” program has 3 goals:  
- Improve patient safety through better treatment of infections.  
- Reduce the emergence of anti-microbial resistant pathogens and *Clostridium difficile*.  
- Heighten awareness of the challenges posed by antimicrobial resistance in healthcare and encourage better use of antimicrobials as one solution. |
The source for the complete 42-slide presentation is: http://www.cdc.gov/gets Smart for Healthcare slides.

This completes the lecture for Unit 11. There is no part 2 lecture in this unit.