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News Story: Antibiotic Resistance

A CULTURE OF RESISTANCE

Fighting Superbugs on the Ground and in the Air

By Karen Mitchell

Steps from Capitol Hill, the 2015 World Anti-Microbial Resistance Congress takes place Monday and Tuesday at the Washington Court Hotel in Washington, D.C. The conference is a gathering of industry, government officials, academics, health care service providers and pharmaceutical executives.

Officials from the White House Office of Science and Technology Policy, the Food and Drug Administration, the United States Department of Health & Human Services as well as the National Institute of Allergy and Infectious Disease are scheduled to talk about the White House National Action Plan for Combating Antibiotic-Resistant Bacteria, the economic threat of microbial resistance, rapid diagnostic tests to flag infections as well as other components in the ongoing fight against antibiotic resistance.

Today, over 23,000 United States citizens die annually and 2 million are sickened every year

from antibiotic resistant infections, the Centers for Disease Control and Prevention writes on its website. Some of the ways people may become sick from a resistant infection involve resistant bacteria traveling from person to person, from animal to person, from food by ingestion to person or from contaminated material like a bed sheet or a surgical clamp to person. Bacteria may become resistant to antibiotics when they are routinely exposed to a cornucopia of infection fighting drugs for varying lengths of time.

To help curb the development of resistance through a prophylactically maintained food supply, the White House Action plan states by 2018, medically important antibiotics cannot be used on animals for human consumption. In addition, veterinarians located on-site at animal production facilities will be tasked with regulating the on-site use of antibiotics to ensure the drugs are used on animals for life and health preserving measures only.

Judith McGeary is the Executive Director of the Farm and Ranch Freedom Alliance in Cameron, Texas. In an email interview, McGeary wrote, "It is vital that farmers have reasonable access to antibiotics to treat illnesses and injuries. But the use of antibiotics simply to enable animals to be crowded tightly together in massive facilities, or to put on weight more quickly, benefits no one except the companies that have created this consolidated, industrial system of agriculture."

This past summer, the fight against antibiotic resistance took an unexpected turn when scientists discovered potentially hazardous, antibiotic resistant bacteria may be in the air and traveling long distances across the Texas Panhandle and South Plains, according to a study

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published in the May issue of Environmental Health Perspectives.

Lubbock, Texas, a city located about 350 miles west of Dallas, may be ground zero for a previously unknown, airborne threat in the battle against antibiotic resistant bacteria, according to the study. The specter of airborne resistant bacteria in the United States may be a game changer in a century-old fight against infection. But, in an email interview, the United States Environmental Protection Agency and the Texas Commission for Environmental Quality – an environmental watchdog and regulatory body local to Lubbock– both said they do not plan to investigate the study results, nor scour the air above Texas for resistant microbial material. While breathable, airborne resistant bacteria may one day prove to be a reason for grave concern, an existing, non-airborne, resistance threat in the U.S. triggered a landmark, global response by the White House this summer.

In June, the White House launched a $1.2 billion "National Action Plan for Combating Antibiotic-Resistant Bacteria," the White House Office of the Press Secretary reports. Removing antibiotics from animal feed and products for human consumption is incorporated into the strategy. Multiple stakeholders from health care, food production, retail, education and other industries have partnered with the White House in the national effort to eradicate antibiotic resistant bacteria. The 2012 Generating Antibiotic Incentives Now or GAIN Act laid the groundwork for the current arsenal of weapons being launched in the battle against antibiotic resistance. Fast-tracking novel antibiotics and shortened U.S. Food and Drug Administration review periods were among the incentives offered to pharmaceutical companies willing to carry the baton a little further.

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How the White House Action Plan Works

The White House National Action Plan for Combating Antibiotic-Resistant Bacteria is a guide with a specific, five year timeline. Working with food and retail industries, multiple government agencies, pharmaceutical companies, scientists and special interest groups, the White House hopes to prepare for potential battles with resistant bacteria, armed with an arsenal of tailored tools including new antibiotic drugs and improved therapeutic methods.

One tool would be a rapid diagnostic test identifying whether a patient is infected with a bacteria or viruses in under 30 minutes instead of several hours to multiple days. This step could prevent physicians from prescribing antibiotics blindly, an identified area of antibiotic misuse.

Like a lock and key, antibiotics are designed to eliminate specific bacteria. Prescribing the wrong key can potentially break the lock, creating antibiotic resistance.

A second, proposed rapid test would identify in minutes any bacteria on the CDC list of most hazardous, resistant bugs. This second, rapid test could behave like a Terrorist Watch List for the CDC top 18 resistant infections.

Eileen Palmer is a registered nurse in the Cardiac Telemetry and Stroke Unit at Sentara Martha Jefferson Hospital in Charlottesville, Virginia. She has experience interacting with some of the top 18 resistant infections including *Clostridium difficile*, Methicillin-resistant *Staphylococcus aureus*, Vancomycin-resistant enterococcus and drug resistant tuberculosis.

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"There's a newer, more resistant one I've seen a couple of times. It's resistant to nearly every known antibiotic: CRE and ESBL. The ESBL scares the hell out of me," Palmer said.

Carbapenem-Resistent Enterobacteriacea bacteria, or CRE is described as an urgent threat on the CDC website. "Almost half of hospital patients who get bloodstream infections from CRE bacteria die from the infection," the CDC writes on its website.

Extended-spectrum β-lactamase, ESBL, partners with bacteria to produce resistance to some of the strongest antibiotics available in the U.S. arsenal. The CDC considers ESBL a serious threat with an incidence rate that will worsen over time without careful public health monitoring. Medical treatment tops over $40,000 per year per infection, according to the CDC.

The History of Resistance

The United States government has been a significant part of the effort to combat antibiotic resistance at least since the 1940s, according to the American Chemical Society or ACS website. Concerned about the treatment of British and American casualties during World War II, the British and U.S. governments, scientists, educational institutions and pharmaceutical companies including Merck, Inc. and Pfizer moved quickly and forged plans to research and mass produce the "miracle drug" penicillin, discovered by Alexander Fleming in 1928, ACS writes on its website. The plan worked. Infections including Strep (streptococcal), Staph (staphylococcal) and gonorrhea (gonococcal) were successfully treated. Illnesses like urinary tract infections,

pneumonia, blood and skin infections, surgical and wound infections on the battlefield, and syphilis were also successfully combated, according to the ACS.

Today, the tide of the microbial battle has turned. Antibiotic resistant bacteria including strains of Staph, Strep, gonorrhea, pneumonia, urinary tract infections-- the family of infections Fleming's work helped to contain-- are now a part of the 18 member short list of the most dangerous, antibiotic resistant microorganisms in the U.S. Drug resistant Neisseria gonorrhea is one of the most difficult resistant infections to contain. Six of the 18 families of infection were among the first to be treated after Fleming discovered penicillin.

Seventeen years after his discovery, Fleming warned resistant bacteria may become a problem, Consumer Reports writes on its website. Today, almost a century after Fleming discovered penicillin; the magnitude of the resistance problem has emerged and beckoned an unprecedented global response.

"I think health care will go back to the time prior to antibiotics if we don't fund more research and more drugs to fight these superbugs we currently have," Eileen Palmer, RN said in an email interview.

Dr. Eli Klein, an assistant professor in the Department of Emergency Medicine at Johns Hopkins University has a potential solution that may help curb America's binge on antibiotics. As a fellow at the Center for Disease Dynamics, Economics and Policy in Washington, D.C., Dr. Klein studies the transmission of MRSA within community and hospital populations.

In a phone interview, Dr. Klein explains, "Antibiotics are a precious and increasingly scarce natural resource. The question is whether you believe it's a natural resource like oil with a finite

amount or is it like fisheries or timber, which is like a renewable resource." Klein suggests applying natural resource economic theory to antibiotic resistance may spark new ideas on how to forge ahead.

Novel treatments on the Horizon

The White House National Action Plan includes exploring new treatment options like phage therapy. The National Institute of Allergy and Infectious Disease is also researching bacteriophages as a possible solution to the epidemic of resistant infections occurring in the U.S.

Bacteriophages are viruses that have the ability to infect, occupy or destroy bacteria, including resistant infections. To work therapeutically, specific bacteriophages must be cultured and tailored for the precise strain of resistant bacteria it's designed to destroy, according to a study in the journal Bacteriophage. The virus naturally targets specific bacteria without risk of developing resistance, the study authors report. But the down side to phage therapy is it can be difficult to mass produce easily and certain toxins within phages may have a negative effect on some patients, the study authors state.

While the phage has been used to fight resistance overseas, it's a relatively new therapeutic tool within the U.S. The White House and the NIAID aren't the only ones looking to the bacteriophage for possible solutions to the resistance problem. Texas A&M University, the Bill and Melinda Gates Foundation and the Walter Reed Army Institute of Research Facility participated in a recent conference on bacteriophages hosted by the NIAID.

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In Prevention, Fort Worth, Texas mom Laura Roberts, claims bacteriophage therapy saved her life. Roberts says she became infected with three strains of MRSA - Methicillin-resistant Staphylococcus, in 2005, when a sinus infection developed resistant bacteria, Prevention reports. Roberts fought infection after infection for seven years, but MRSA outpaced her body's defense system, her organs began to fail and physicians at the Mayo Clinic gave Roberts three months to live. Roberts sought bacteriophage therapy overseas, Prevention states on its website.

Today, 10 years later, Roberts is home in Fort Worth, Texas. She credits her complete recovery to three weeks of bacteriophage treatment at the Phage Therapy Center in Tbilisi, Georgia, Prevention reports.

The Battleground

Bacteriophages may become a new weapon in the U.S. arsenal against antibiotic drug resistance. This battle has yet to be fought. But it's only part of an age-old battle between human hosts and the bacteria that infect them. The fronts these battles are fought on-- air attacks or ground wars-- may continue to evolve just as resistant bacteria continue to evolve. Modern medicine is giving us tools to fight bacteria but modern life is creating conditions that make the fight more challenging. Cooperation, on an individual, national and biological scale, may unlock clues to reversing the tide of antibiotic resistance once and for all.

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