

Drug-Resistant Staph Infections in Europe Could Mark Start of New Epidemic

By Robin Lloyd | October 16, 2011

FLAGSTAFF, Arizona—A relatively new type of drug-resistant *Staphylococcus aureus* could represent the world's next bacterial epidemic, an environmental health expert said here today at a conference for science writers.

The superbug, called **methicillin-resistant *Staphylococcus aureus* strain 398, or MRSA ST398**, was first identified in an infant in the Netherlands in 1994 and traced back to her family's pigs. Now, researchers are starting to see more serious infections and some of the cases reveal no direct link to livestock, said Lance B. Price, director of the Center for Microbiomics and Human Health at The Translational Genomics Research Institute (TGen), in Flagstaff.

"The rate of human [ST398] infections is going up in Denmark and the Netherlands," Price said. "We are just looking at the beginning of an epidemic." Price made his comments during a presentation at the 49th annual New Horizons in Science meeting, organized by the Council for the Advancement of Science Writing.

The mechanism for transmission in these newer ST398 cases currently is unknown. Researchers are considering various explanations including human-to-human exposure, contaminated meat or changes in the organism that make it spread more easily, Price said. Already, ST398 was recently found in about half of the pigs and farmers tested in Iowa.

ST398 probably started out as a human-associated strain that was treatable with methicillin, a recent analysis by Price and his colleagues has revealed. Animal husbandry practices subsequently allowed the **strain to spread into livestock**. Meat production worldwide involves the **use of life-saving human-class antibiotics as a preventive measure or production tool to keep animals healthy**. However, the **bacterial die-off then exercises a selection pressure on the remaining smaller population of bacteria, giving rise to antibiotic-resistant strains**. With ST398, that probably led to drug-resistant strains of the bug, which were **then passed back to humans via contact with livestock**.

"It's a pretty sad cycle really," Price said.

Staph aureus infections can cause skin and soft tissue infections, respiratory tract infections like pneumonia, bacteremia (the presence of bacteria in the blood) and endocarditis (inflammation of the inner heart). **Until the use of antibiotics in the developed world became widespread in the 1940s, these infections were often fatal**. A rise in antibiotic-resistant bacteria in the past two decades means the door is open to a return to a dire medical scenario that prevailed nearly a century ago. In fact, even now, **methicillin-resistant *Staph aureus* kills more people in the U.S. than HIV**, Price said.

Industrial-scale livestock **farming practices are often the culprit in the proliferation of antibiotic-resistant strains of bacteria.** There are 9 billion livestock animals in the U.S. (mostly broiler chickens) and 29 million pounds of active antibiotics are administered to food animals in this country each year. The animals are raised in crowded and perhaps filthy settings. The result is a profitable meat industry that makes this food affordable for much of the nation's population (at a significant, long-term environmental cost when scaled up to current levels) but also **one of the most effective systems for the evolution and transmission of antibiotic-resistant strains of bacteria that an engineer could devise,** Price said. These strains persist on animal carcasses and then are passed on to humans via the meat we purchase and eat.

The typical "gold standard" for distinguishing bacterial strains is called multi-locus sequence typing, but strains of ST398 all look identical via this approach. Whole-genome sequencing has allowed researchers such as Price and his mentor Paul Keim, a Northern Arizona University microbiologist who is also director of the Pathogen Genomics Division at TGen, to obtain much higher-resolution but still low-cost "fingerprints" of strains of all kinds of microbes in the past 10 years, including anthrax and cholera, to tell them apart.

For ST398, Price and his team sequenced all 2.9 million bases a total of 50 times in 88 isolates from all over the world. By looking for small variations in the strains, called single-nucleotide polymorphisms, the researchers were able to create a phylogenetic tree to see which strains were most ancestral and which were less so, or more "derived." This analysis, which revealed that ST398 originated in humans, could assist in future efforts to manage a more serious outbreak in what some researchers are calling the "post-antibiotic era."

Earlier this year, Price and his colleagues published a finding in *Clinical Infectious Diseases* of a nationwide study of meat in grocery stores and **found that nearly half of all U.S. chicken, beef and pork samples were contaminated with *Staph aureus* and more than half of those bacteria were resistant to three classes of antibiotics.** Nearly three-quarters of the turkey samples were found to be contaminated. Very few of us have direct contact with antibiotic-treated animals (most U.S. livestock undergoes this treatment), but almost all of us, even vegetarians, come into contact with bacteria via meat, Price said. Cooking kills most *Staph aureus* but food handling and cross-contamination can still allow the bug to infect us.

"We have to do something about this," Price said, adding that antibiotic resistance in various bacteria, not just *Staph aureus*, is one of the **greatest threats to public health that we face today.**

Price also presented the following quiz to the 150 or so writers and others in the room during his presentation (answers are below):

1. True or false: People are becoming increasingly resistant to antibiotics.

2. True or False: Most antibiotics are used to treat sick animals in the U.S.

3. True or False: Antibiotics are injected into poultry eggs in the U.S.

Answers: (1) false; (2) false; (3) true. For (1), people aren't becoming more resistant; the fact is that humans are infected with antibiotic-resistant bacteria which can lead to longer sickness and treatment failure if the appropriate medicine is not administered in the brief window of time during which treatment can succeed. For (3), machines today inject antibiotics into billions of eggs every year, not for direct consumption but for hatcheries where they grow into chickens.