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Clinical Microbiology 2020: Modern medicine faces challenges in antibiotic resistance - Reza Nassiri - Michigan State University

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Antimicrobial resistance is a major challenge in modern medicine which impairs the effectiveness of therapies in infectious diseases, cancer, and a health risk for agricultural products. Antibiotic resistance globally impacts the health of millions in both developed and developing nations and is associated with massive financial burden on society, especially in healthcare sectors. The World Health Organization (WHO) considers antimicrobial resistance as one the major public health threats.

Recent evidence suggests global consumption of antibiotics has increased nearly 40% in the last decade. The incredible rapid antibiotic resistance which is happening worldwide is not only a significant threat to the practice of recent medicine, but equally important, a threat to global public health. While the causes of antibiotic resistance are complex, certainly human behaviour play a big role within the spread of antibiotic resistant genes. In addition to the human behaviour, the drivers of resistance include agriculture sector, animal husbandry, household, and industry – these factors contribute significantly to the spread of the resistant genes within the ecosystem. Such resistant mechanisms are continuously emerging globally, which threatens our ability to treat common infections, leading to increased death, disability, and costs.

The CDC and WHO surveillance data shows that the resistance in E. coli is usually and consistently the very best for antibacterial agents in both human and medicine. Within communities, resistant bacteria circulate from person to person or from animals and environment to person, or vice versa. With more than 1 billion people travelling each year, bacteria are becoming more mobile. The bacterial resistance can kill 700,000 worldwide each year and it has been estimated to kill 10 million by 2050. The WHO estimates that 78 million people in a year gets Gonorrhea - there is a widespread resistance to the first-line medicine ciprofloxacin as well as increasing resistance to azithromycin.

The emergence of resistance to last-resort treatments known as extended-spectrum cephalosporins (ESCs) is now eminent. The five riskiest superbugs are globally recognized as (1) the original one: Staphylococcus Aureus (MRSA), (2) the hospital lurkers: Clostridium Difficile and Acinetobacter, (3) the food borne pathogens: Escherichia coli and Salmonella, (4) the sexually-transmitted infections: Gonorrhea and Chlamydia, and (5) TB. India is an example of encountering the deadly bacterial resistance.

The discovery of the New Delhi metallo-beta-lactamase-1 (NDM-1) which disables almost all antibiotics directed against it was turning point in the rapid emergence of blaNDM-1 gene which was first identified in 2008 in people who had travelled in India or sought medical care in South Asia. The gene for NDM-1 travels on a plasmid, an extra-chromosomal loop of DNA that can be traded freely among bacteria. So far, it has been found a variety of bacterial species that carry NDM-1 particularly in the gut bacteria, can cause serious infections in vulnerable hospital patients in India, South Asia, South Africa, and the UK.

There are two major routes of spread for the bacteria: hospital and the community. In emergency clinic diseases, microscopic organisms conveying NDM-1 move from individual to individual when patients who have gotten numerous anti-infection agents, create looseness of the bowels and hints of defecation debase surfaces, gear, and medicinal services laborers' hands. In community infections, the bacteria carrying the enzyme passes from person to person when traces of feces contaminate municipal water supplies – and with a large percentage of the population lacking any access to sanitation. In addition, tourists can pick up antibiotic-resistance genes in just 2-3 days.

In the animal husbandry and agricultural sectors of China, the demand for the antibiotics to reach almost 12,000 tons per year. The high prevalence of the mrc-1 gene in E. coli samples both in animals and raw meat, with the number of positive-testing samples are increasing each year in China. On average, more than 20 percent of bacteria in the animal samples and 15 percent of the raw meat samples carried the mrc-1 gene. Numerous European countries have reported the existence of mrc-1 gene in the isolates from human, isolates from animals used for food, isolates from food, and isolated from the environment.

In summary, because of the One Health nature of antibiotic resistance, cross-disciplinary interaction is highly vital to control and prevent the global spread of antibiotic resistance. Therefore, there is an urgent need between research universities and industry aimed at developing novel antimicrobial agents to save the practice of modern medicine and to implement effective public health strategies minimizing the global burden of antibiotic resistance.

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