ARxCH
Annual Review of Changes in Healthcare

Agricultural Antibiotics and Their Impact on Human Health

Edwin Ruppert, PharmD Candidate 2018[1]
Jason Guy, PharmD[1]
[1]*University of Findlay College of Pharmacy*

One of the more revolutionary discoveries in modern medicine within the last century was the serendipitous discovery of penicillin by Alexander Fleming in 1928. Since then, several more antibiotic drug classes have been discovered and synthesized by researchers to specifically target different pathogens by their unique characteristics; +/- gram stain, aerobic, non-aerobic, etc. Unfortunately, the selection of inappropriate antibiotics and poor antibiotic stewardship have led to an increase in antibiotic resistant pathogens. The US Center for Disease Control and Prevention (CDC) report estimates approximately 2 million illnesses and 23,000 deaths annually are directly attributable to antibiotic resistant pathogens.[1] The CDC has cited antibiotic resistant pathogens as a top threat to global health and has testified before US Congress in 2010 with the FDA and USDA that there is a definite association between the use of antibiotics in food animal production and the antibiotic-resistance crisis in humans.[2]

An article by Aitken et al, has reviewed available evidence regarding the use of antibiotics in agriculture and their impact on human health.[3] In the United States, approximately 80% of all antibiotics consumed are for agricultural purposes and sold over the counter without any veterinary oversight.[3] Antibiotics have been used in agricultural livestock since the 1950's when it was discovered that their addition into feed significantly accelerated animal growth rates.[3] Additionally, antibiotic use in livestock has been used for purposes of feed efficiency and disease prevention.[3] The increased use of antibiotics in agriculture has led to the selection of resistant bacterial species among the livestock; analogous to their inappropriate and overuse in humans. The prevalence of resistant bacteria in agricultural livestock holds important safety implications for public health as transmission mechanisms of resistant bacteria from agriculture livestock to humans have been well documented and studied.[4-7]

The most straightforward transmission mechanism is direct transmission from farm animals to farmers and other animal handlers.[4] Epidemiological studies have found resistant antibacterial patterns in farms and farmworkers but not spread out to the community at large.[4] Environmental contamination has been studied to be another mode of transmission. Environmental sampling from large industrial farms has discovered a prevalence

of resistant pathogens in waste laden soil and ambient air surrounding the farm and community at large.[5] Additionally, spillover from contaminated wastewater has been attributed to resistant pathogen containing soil samples in studies.[6] Lastly, some evidence has been documented of transmission by the consumption of undercooked animal products that contain resistant pathogens.[7] There may be other transmission mechanisms that have not yet been elucidated or discovered, but nonetheless the available evidence of transmission to humans should be of concern to public health.

With the availability of data supporting the impact of antibiotics in agriculture on human health, regulations aimed at decreasing the amount of antibiotics used in agriculture have begun to be developed and implemented.[3] It should be noted that antibiotic use in agriculture is only one piece of the puzzle; antibacterial stewardship efforts for increasing appropriate use in humans should continue to be sought. It is important for health care providers and policy makers to understand these associations to inform discussion, policies and other actions aimed at combating the antibiotic resistance epidemic.

References

1. U.S. Centers for Disease Control and Prevention. Antibiotic resistance threats in the United States, 2013. 2014.
2. Antibiotic resistance and the use of antibiotics in animal agriculture. Subcommittee on Health of the Committee on Energy and Commerce. One Hudredth Eleven Congress, second session. US Government Pringting Office. 2010.
3. Aitken SL, Dilworth TJ, Heil EL, et al. Agricultural applications for antimicrobials: an official position statement of the society of infectious disease pharmacists. Pharmacotherapy. 2016;36(4):422-32.
4. Stobberingh E, van den Bogaard A, London N, et al. Enterococci with glycopeptide resistance in turkeys, turkey farmers, turkey slaughterers, and (sub)urban residents in the south of The Netherlands: evidence for transmission of vancomycin resistance from animals to humans? Antimicrob Agents Chemother 1999; 9:2215–21.
5. Oppliger A, Moreillon P, Charriere N, et al. Antimicrobial resistance of Staphylococcus aureus strains acquired by pig farmers from pigs. Appl Environ Microbiol. 2012; 22:8010–4.
6. Casey JA, Curriero FC, Cosgrove SE, et al. High-density livestock operations, crop field application of manure, and risk of community-associated methicillin-resistant Staphylococcus aureus infection in Pennsylvania. JAMA Intern Med. 2013; 21:1980–90.
7. Gupta A, Fontana J, Crowe C, et al. Emergence of multidrugresistant Salmonella enterica serotype Newport infections resistant to expanded-spectrum cephalosporins in the United States. J Infect Dis. 2003; 11:1707–16.