Antibiotic Resistance in Livestock

Farm to Fork - Antibiotic Resistance in Agriculture

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Introduction

Since the antibiotic era, antibiotics have been used in poultry and livestock. In order to meet the demand of the world's growing population, farms increased in animal density and observed a need to administer antibiotics in agriculture. More than 70 percent of medically important antibiotics are sold to food producing farms (WHO, 2018).This most likely has contributed to the increased prevalence of antibiotic-resistant bacteria. Bacteria resistant to antibiotics could resist the effects of medication that once could successfully treat it. In this essay, we will explore possible reasons for agricultural use of antibiotics, its impact on human health and recommendations in managing antibiotic resistance in livestock.

Antibiotics are commonly used in livestock farms for four main purposes: (1) therapeutic use to treat sick animals; (2) metaphylaxis, or disease control to treat a group of animals for a short-term when some of animals present with clinical illnesses; (3) prophylactic use to prevent infections for animals that are at risk of becoming sick, such as during transport or weaning; and (4) growth promotion to improve feed utilization and production (McEwen and Fedorka-Cray, 2002; Viola and DeVincent, 2006). The first three types of usage of antibiotics in food animals have been approved by the Food and Drug Administration (FDA). However, the use for growth promotion is the most controversial (Viola & DeVincent, 2006).

The growth-enhancing antibiotics are given to animals at low, sub-therapeutic doses which helps livestock put on body mass. Since the discovery of antibiotics, antibiotics have been found to result in growth advantages beyond benefits provided by prophylactic use. In the 1950s, fishermen discovered that trout near Lederle Laboratories in New York State had a great increase in size. Similarly, chickens prescribed with vitamin B12 as a form of crude *Streptomyces aureofaciens* fermentations were found to grow at a significantly higher rate than those fed with purified vitamin B12. It was further deduced that the crude fermentations contained chlortetracycline antibiotics (Stokstad & Jukes, 1950). Scientists claimed that more than 90% of antibiotics can promote weight gain.

Growth promotional antibiotics allow agribusinesses to maximise economic benefit. It reduces Feed Conversion Efficiency (FCE), the amount of feed chickens needed to consume to make market weight. With growth-promoting antibiotics, chicken will gain a half pound of body weight for every pound of feed. The observed weight gain is due to the "resource-allocation theory" which only a small amount of resources could be shared between maintaining immunity and building muscle mass. As such, more energy is allocated to growth, achieving maximum economic yields. Further, the

Netherthorpe committee (Netherthorpe Committee, 1962) testified this practice posed no risk to humans.

However, scholars and health authorities disagree with antibiotic use for growth promotion. Starr and Reynolds (1951) discovered antibiotic resistance in coliform bacteria after turkeys were given a diet containing streptomycin. The Swann committee concluded that the prescription of antibiotics with the intention of promoting growth constitutes a danger to human and animal health (Swann et., 1969). In 1997, the World Health Organization (WHO) announced that it was strongly against the use of antibiotics for growth promotion and stating that this use of antibiotics is especially favourable to select for resistant bacteria (WHO, 1997).

From Farm to Fork

At present, 31 out of the 41 antibiotics approved by the FDA to be applied in food animals possess medical importance to human health (WHO, 2018). Resistant genes are transmitted from animals to humans via foodborne route or contaminated surfaces. Foodborne transmission of bacteria is the most common means (Mathew, Cissell & Liamthong, 2007). Alternatively, resistant bacteria also exists in the environment, such as during the improper disposal of animal manure into water bodies, or as an input in the soil for plants (See Figure 1).

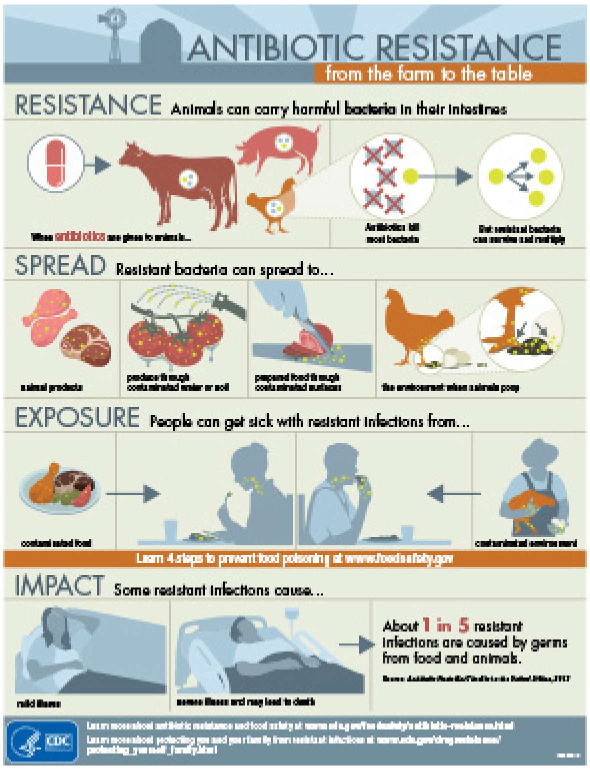

Figure 1

Natural selection favours bacteria with mutations that withstand the prescription of antibiotics. Resistant bacteria survives and proliferates resistant genes through plasmids, possibly to unrelated types of bacteria, resulting in the spread of antibiotic-resistant genes in the human body (See Figure 2).

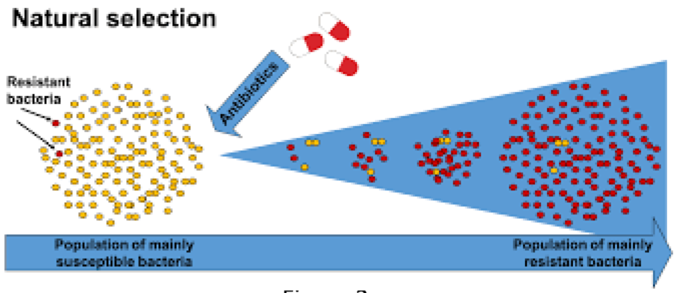

Figure 2

Antibiotic Resistance increases the risk of infection from resistant bacteria and make it more difficult to treat effectively. *Salmonella* resistance claims an approximated 10 more deaths in the US each year and caused 30,000 more infections. It raises the risks of blood-stream infections or even death within 90 days. The resistance of *Campylobacter* to quinolone antibiotics also compromises 10,000 treatments of Americans per year, delaying the treatment of brain and heart infections (McKenna, 2017).

Though the non-therapeutic and growth promoting uses of antibiotics are commonly attributed to resistance prevalence, other factors may play a role in the selection for resistant bacteria. Animal stressors could raise selection of antibiotic resistance, even if antibiotics are not applied. E. coli has shown increased resistance to antibiotics after weaning in swine, regardless of antibiotic use (Mathew et al., 2001). Dose and duration of antibiotic application and bacterial energetics may affect selection for antibiotic resistance, and these elements may be drug-specific. In order to effectively control antibiotic resistance in livestock production, the factors have to be examined to determine the underlying causes in antibiotic resistance from agricultural use (Mathew et al., 2007).

In summary, antibiotic resistance may vary based on assessed risks and benefits, antibiotic type and bacteria of concern. Thus, federal agencies need to have a selective perspective in their surveillance programmes of antibiotic resistance.

Recommendations

The issue of antibiotic resistance in livestock is multifaceted which requires efforts from various stakeholders, agencies and individuals, in particular, the government, restaurant chains corporations, agricultural businesses and consumers.

Governments must regulate antibiotic use by limiting medicines most important for human health. This includes the implementation of deterrents such as antibiotic taxation (Hall, 2018). This could prevent farmers from administering feeds containing medically-crucial antibiotics to livestock and thereby reduce proliferation of genes resistant to medically-important antibiotics. Furthermore, governments could provide monetary subsidies for agribusiness companies to reward corporations who follow specific standards of food security practices in terms of antibiotic use. This measure may accelerate change and resolve the urgent need of reducing antibiotic use in food animals through a top-down approach. It is important that policymakers lay down strict rules governing antibiotic use to promote fewer usage of non-therapeutic antibiotics.

Restaurant chains could cater increased transparency for the customers, such as information about the meat source--whether animals are raised naturally, whether growth-promoting antibiotics were used in the farming process, etc., which informs the purchasing decisions of the market. They could choose to sell or purchase solely antibiotic-free meat products or meats that meet a determined standard of antibiotic use. By raising the demand for antibiotic-free meats, the supply of antibiotic-bred animal meat could be immensely reduced. By catering antibiotic-free products, health-conscious consumers are given more options to choose from and gradually, we may see a paradigm shift in the food we eat, which would be brought about by restaurant companies.

Agribusiness companies should also provide and promote alternative methods to prevent infections to reduce the amount of antibiotics needed. This would encompass raising standards for infection prevention and control with better farming management practices as well as infrastructure. For example, setting up stable design conditions favouring high animal welfare and low antibiotic-use practices of animal husbandry. Businesses should utilise more robust breeds of animals and make better use of vaccinations. Minor tweaks in animal husbandry such as better cleaning and ventilation, and later weaning could compensate for the lack of routine antibiotics in their farms. When more control is exercised by agribusinesses, less antibiotics would be distributed for prophylaxis and metaphylaxis which will lead to a decrease in overall antibiotic use in agriculture.

As consumers, we should practise good food hygiene. For example, washing our hands before preparing meat, and after contact with animals, animal environments or faecal matter. During cooking, we must prevent animal products from contaminating other food and cook meat, poultry and eggs thoroughly. Lastly, we should not drink raw milk.

Conclusion

Professor Dame Sally Davies, Chief Medical Officer for England, warns, “If we don’t take action now, we face a dreadful post-antibiotic apocalypse.” (Pickover, 2017). However, if we each make a small change, millions of lives would be saved from antibiotic-resistant infections.

Given the detrimental impacts which antibiotic use in livestock has brought to antibiotic resistance, it is our responsibility to take measures within our capacity to curb the non-therapeutic use of antibiotics in agriculture. Through the combined efforts of different groups of people, I believe that we will work towards a promising, antibiotic-free agricultural scene.

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