

POLICY BRIEF

The Growing Antimicrobial Resistance from Agricultural Practices

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KEY MESSAGES

- Wide scale antimicrobial usage in animal farming accelerates antimicrobial resistant (AMR) bacteria which is spread on to the human population that consume the products and the environment into which livestock farming wastes are released.
- Repeated use of antibiotic pesticides in plant farming enriches the generation of AMR bacteria which is passed on to animals and humans that eat the produce.
- Use of antibiotics in aquaculture pollutes the waters and generates AMR which affects all living things in the aquatic habitat and even beyond.
- Soil is a natural reservoir for AMR bacteria and may pass them on to crops that grow in it and water that stems from it.
- The environment continues to get polluted with antimicrobial elements due to human activities especially agriculture and there is need to reduce the growing trend.

Context

Emerging evidence suggests the prevalence of AMR in agriculture especially in animal farming, crop farming and the soil in general. This has been due to improper use and overuse of antimicrobials to improve farming. Antimicrobial usage (AMU) in various agricultural practices has presented AMR elements (such as resistant bacteria [RB], antibiotic residues [AR] and antibiotic resistance genes [ARG]) which are able to move along plants, animals and the soil thereby creating an AMR problem through their selection and transfer within the microbial environment (Vidaver, 2002) (Thanner et al., 2016)(Heuer & Smalla, 2007). While high income countries are able to monitor and control usage of antibiotics in agriculture, the situation is different in low and medium income countries (LMIC) with indications that AMU will continue to rise in the next decades as the LMICs strive to meet growing demand for food (Van Boeckel et al., 2015). AMR bacteria in agriculture is rising and finding its way to the larger environment, animals and humans through water and the food supply.

Wide scale antimicrobial usage in animal farming accelerates AMR bacteria which is spread on to the human population that consume the products and the environment into which livestock farming wastes are released

Easy access to antimicrobials all over the world (Laxminarayan et al., 2013) and their wide usage for disease prevention and control as well as growth promotion in animal production (Tang et al., 2017), coupled by weak regulations to restrict inappropriate usage, especially in LMICs (Okeke et al., 1999) have favoured AMR emergence in livestock farming. For example, evidence from Cambodia suggests that non-rational antimicrobial use in pig farming has contributed

to a higher prevalence of AR in the livestock. Special observations were noted in animals that were given growth promoting antibiotics, preventive antibiotics and where the whole herd were treated with antibiotics in the event of disease outbreak (Ström et al., 2018). Further, there has been detection of high level AR in chicken meat (Nonga et al., 2009) and cow milk (Karimuribo et al., 2006) in Tanzania. It has also been noted that improper disposal of large quantities of waste produced in intensive livestock farming systems increase the risk of transfer of AMR genes to bacteria in the environment (Pei Ying Hong, Anthony Yannarell, n.d.). These tell that the population has been ingesting antibiotics through consumption of livestock products and has also been exposed to various bacteria through livestock farming, therefore point to a lot of various bacteria accumulating and circulating in humans and the environment which would become difficult to treat posing an AMR problem.

Repeated use of antibiotic pesticides in plant farming enriches the generation of AMR bacteria which is passed on to animals and humans that eat the produce

Despite evidence that RB and AR from the soil may find their way into plants through water transport and passive absorption (Hu et al., 2010), studies indicate that the probability of transfer of resistance to humans from plants is very minimal (Stockwell & Duffy, 2012). Nevertheless, evidence from a review of plant diseases suggests that antibiotic resistance in plant-disease causing bacteria is a problem especially in plants that have been subjected to antibiotics for many years (Sundin & Wang, 2018). However, the USEPA (2006) advises that applying antibiotics on to plants enriches prevalent AR by creating AMR pathogens through selection and this still poses a danger to human health (US EPA, n.d.). In addition, observations show that AMR genes in plants are able to transfer: from plants back to bacteria, within other bacteria in the environment and to animals when they eat the produce (Vidaver, 2002). Thus the selection and transfer of AMR genes in crop farming still present an AMR bacteria problem to the environment, animals and humans.

Use of antibiotics in aquaculture pollutes the waters and generates AMR bacteria which affects all in the aquatic habitat and beyond.

Aquatic farming already faces a problem arising from having no specialist antibiotics and therefore it borrows from other veterinary medicine products which perform

similar roles to control infectious diseases (Wall et al., n.d.). Further, the antibiotics are applied into the habitat (water) which makes it very complicated as they affect other aquatic creatures indiscriminately. Wall et al add that after taking in the antibiotics, fish excretes between 70-80 percent of them thereby polluting the waters with antimicrobial residues. The antibiotics brought into the aquatic environment contribute to the multiplication of AR and RB and their further selection and transfer. In cases where aquaculture has been integrated with poultry farming and rice growing in recycling farming, otherwise known as vegetation, aquaculture, and cage (VAC) in LMICs, there is even higher rate of antibiotic use and exchange (S. Fletcher, 2015). For instance, in Tanzania and Pakistan, it was observed that poultry releases a lot of resistant bacteria into the fish farms enhancing further resistance (Shah et al., 2012). Further, in some cases, to extend the shelf life of fish products, antibiotics are illegally added into the ice or dip solutions for preservation. All these facilitate the selection and transfer of AR and RB leading to the AMR problem in the environment as they transfer through water and food supply.

Soil is a natural reservoir for antimicrobial resistant bacteria and may pass them on to crops that grow in it and water that stems from it

Studies have indicated that soil is a natural antimicrobial resistant bacteria (ARB) reservoir and therefore contains a range of AMR determinants (D'Costa et al., 2006). Research has also proven that manure is a hot spot for ARG and therefore introduces the ARG into the soil when applied to improve it in crop farming (Binh et al., 2008). Special cases are observed in animal waste manure where a lot of ARs are released through excretion due to poor antibiotic adsorption in the animal guts (Sarmah et al., 2006). These plus the use of antimicrobial agents (AMA) in the soil accelerate the selection and transfer of naturally prevalent ARG in the soil and that which is brought in by manure application. The trend has been observed in a number of countries across the world where manure application as a soil conditioner is very common (S. M. Fletcher et al., 2012)(Adelowo et al., 2014). These new ARGs may contribute to RB and AR which may find their way into plants through water transport and passive absorption (Hu et al., 2010) and may contaminate the freshwater supply through seepage (Adelowo et al., 2014).

As a result, AMR bacteria continues to spread to animals and humans that get in contact with the

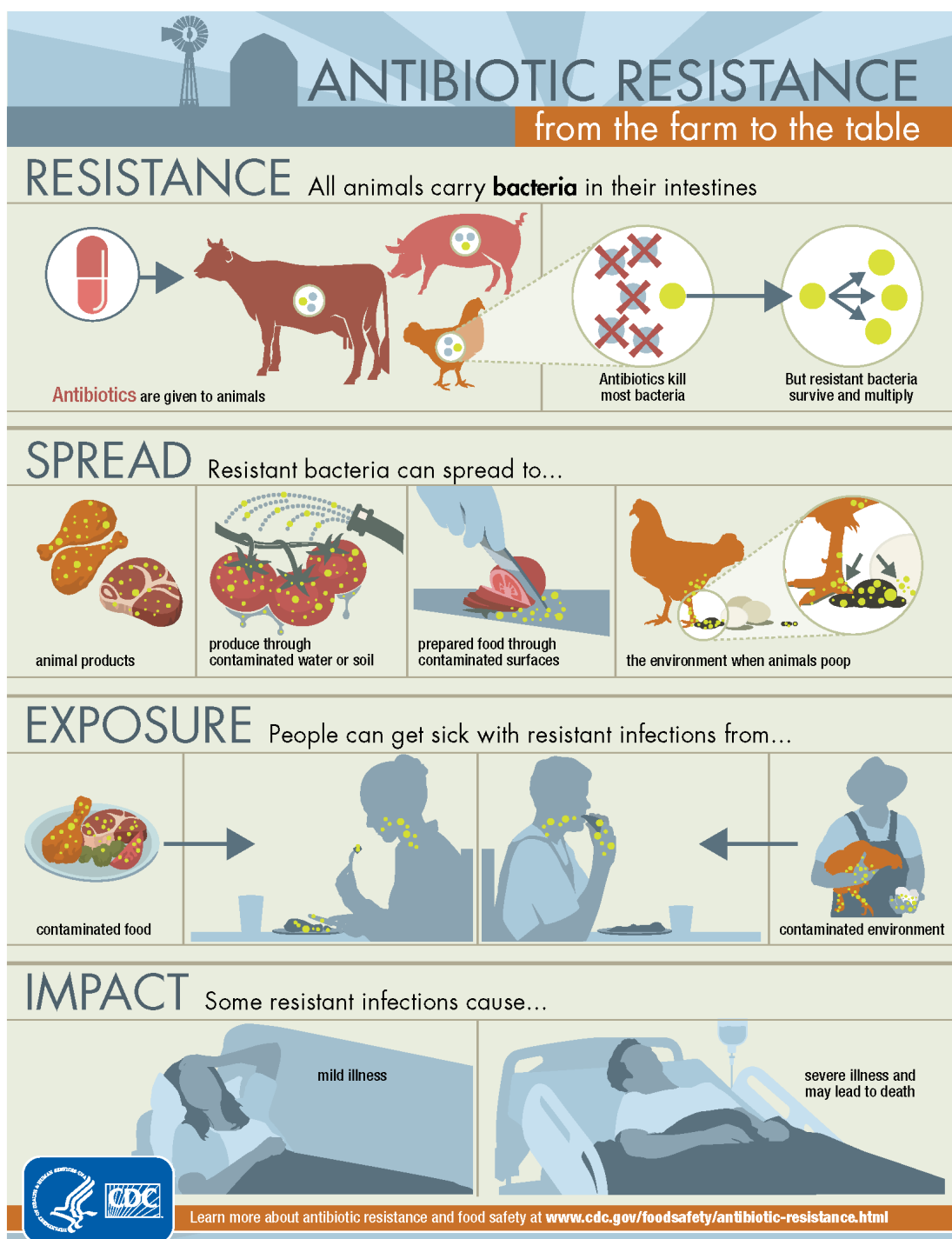
agricultural contaminated waters and consume the produce from these soils.

The environment continues to get polluted with antimicrobial elements due to human activities especially agriculture and there is need to reduce the growing trend.

All this evidence shows that while naturally agricultural practices present the environment with RB, AR and RG, the situation is being accelerated by human activities to improve farming. These include use of antibiotics in aquaculture and livestock farming, application

of manure into the soil and use of antimicrobials as pesticides in crop farming. These practices are contaminating the water and soil thereby increasing and continuing the formation, establishment and spread of AMR bacteria in the environment risking infection in human and animal populations. This is already affecting millions of people globally leading to around 700,000 deaths in a year. If not put under control, it would make most modern medicine irrelevant resulting in high deaths and increased periods of sicknesses from diseases that were once curable.

Figure: Antibiotic Resistance, Food, and Food Animals



Source: <https://www.cdc.gov/media/pdf/dpk/dpk-antibiotics-week/antibiotic-resistance-farm-to-table.pdf>

