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Should we be concerned about low concentrations of antibiotics in our water supply?

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Development of resistance to antimicrobials has been well-documented for some bacteria (Levy 1997; Salyers and Amabile-Cuevas 1997). Of particular concern is resistance to antibacterial drugs of clinical importance. Amidst worries that the ability to treat bacterial infections might soon return to the "pre-antibiotic era," researchers are now seeking alternative therapies and prevention measures, as well as developing new classes of antimicrobials for use in human and animal medicine. To help solve the complex problem of reducing resistance, it is useful to identify activities that are major contributors to the emergence of resistance. The alteration or elimination of these activities could then slow the loss of antibiotic efficacy.

Antibiotic use is the major selection pressure influencing changes in antibiotic resistance. It must be emphasized, however, that resistant bacteria can also be resistant for reasons entirely independent of the use of antibiotics. Bacterial pathogens that are typically considered "food-borne" can be introduced onto agricultural premises from human sources, such as human wastewater plants (Kinde et al. 1996). The discharge of wastewater from animal agricultural facilities (Aminov et al. 2002; Chee-Sanford et al. 2001), human sewage treatment plants (Kinde et al. 1997; Kinde et al. 1996), hospitals (Guardabassi et al. 1998; Reinthaler et al. 2003) and pharmaceutical plants (Guardabassi et al. 1998) has been associated with increased levels of zoonotic pathogens as well as increasingly resistant and virulent organisms. Antibiotics are often discharged from these sites. Once in the environment these antibiotics can act as a selection pressure, further influencing the acquisition of resistance genes (Kummerer 2003; Kummerer and Henninger 2003). All of these possibilities must be considered in order to identify the causes of resistance and to subsequently estimate the amount of risk attributable to animal antibiotic use.

One question that emerges is "What is the biological significance of the low concentrations of antibiotics found in the water supply?" The impacts that these levels might have on the selection of antibiotic resistant bacteria is uncertain. Some studies have found a correlation between increased concentrations of antibiotics and higher levels of antibiotic resistant bacteria and antibiotic resistance genes. However, in a recent study conducted by our laboratory, low levels of chlortetracycline did not appear to select for resistance (Muñoz-Aguayo et al. 2007). The results of our work on tylosin were not as clear, as will be discussed.

Because the pressures that can select for antibiotic resistance in the environment have considerable spatial and temporal heterogeneity, studies that want to investigate the emergence and spread of antibiotic resistance in water must be carefully designed. In conclusion, there are many factors that can affect antibiotic resistance in the water supply. An ecosystem-based approach to antibiotic resistance is the only way in which the myriad of selection pressures and other determinants can be taken into account (Singer et al. 2006).

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