Risk-Risk Assessment of Antibiotic Use in Food Animals

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Concern is not risk

Based on the latest microbiological science and increased surveillance data, the hazard of antimicrobial resistance (AMR) bacteria is creating a valid concern. A hazard is some agent (e.g. microbial or chemical) that may cause harm to a living entity (FDA 2004; FAO 2003; FDA 2003). Many hazardous materials can be found in the average household (FEMA 2010). However they do not pose much risk because the amount and duration of exposure is usually minimized by various risk management steps.

The use of antibiotics in the production of food animals is thought to contribute significantly to the presence of the hazard, AMR bacteria. AMR bacteria can be found on most farms using antibiotics (Sengelov 2003; Furtula 2010; Chander 2008) or in flies (Graham 2009), or in ground water (Sapkota 2007) around some farms. However, the presence of a hazard or concern does not necessarily constitute a risk (Singley 2004.). A valid risk assessment will include a measurable definition of risk. Risk must include two features; exposure (or likelihood of event) and consequence should the event occur or exposure be "significant" (Eason 2011; Society for Toxicology 2011). Risk assessment (RA) is an important policy tool that aids in decision making about many potential hazards. For example, to address concerns about the risk of nuclear energy, the NRC stated "Probabilistic risk assessment should be used to reduce unnecessary conservatism associated with current regulatory requirements …" (NRC 1995). Risk assessment should also include evaluation of multiple management or mitigation options for reducing risk. Evaluation of these options provides decision makers more ways to solve a problem than simply banning a hazard. Risk management options for on farm antibiotic use are multiple and varied.

Demonstrated risk is extremely low

The US Food and Drug Administration's (FDA) and other international bodies have outlined risk assessment methods for the hazard of AMR bacteria (FDA 2003; CAC 1999; Vose 2001) The proposed methodologies infer that for antibiotic use in food animals to pose a human health risk, an extended chain of causal events must occur. FDA stated that the foodborne route is the chain of events of most concern (FDA 2003). AMR risk assessments should include factors such as:

1) probability that resistant bacteria are present in the target animal as a result of drug use
2) probability for humans to ingest bacteria in question from the relevant food commodity, and
3) probability that human exposure to resistant bacteria results in an adverse health consequence (FDA 2003).

Basic microbial-antimicrobial science would suggest that these assessments must be conducted on a case-by-case (bug-drug) basis. A number of qualitative risk assessments have been done for the regulatory approval of specific animal drug uses. Those few made public report a qualitative, albeit somewhat non informative "low to moderate risk" (VMAC 2004; VMAC 2006) However, quantitative RAs published to date, have reported a "negligible" (less than 1 in 1 million) risk of adverse human treatment outcomes (Table 1). Note, these studies do not report a zero risk of on-farm antimicrobial use, which some may argue is justification to prohibit their use. Prohibition is one of many management options.

Are there public health benefits of food animal antibiotic use?

Generally society does not knowingly accept additional risk in the absence of some benefit. For example, the cancer risk of chlorinated water is not insignificant (WHO 2004). However, risk-risk analysis of the alternative shows waterborne bacterial illness risk is much greater (Ashbolt 2004). Risk-risk or risk-benefit analysis involves the comparison of the current situation compared to the imposition of some alternative risk management strategy. In the AMR debate, this step is often overlooked. However, if the long-term goal of any policy change is to improve overall public health, measured say in total illness days before and after the change, then this

type of risk-risk analysis is essential. Therefore, the public health risk of unhealthy or marginally healthy food animals entering the food chain needs to be evaluated.

The first premise of meat inspection law requires the harvest of only healthy animals (USDA 2010). Antemortem inspection by veterinary inspectors will remove clinically ill animals. However, subclinically ill animals may still enter the harvest process, increasing foodborne risk. Studies in poultry have shown that even small marginal changes in bird health at harvest will impact carcass contamination and subsequent public health risk (Cox 2005; Russell 2003; Singer *et al*. 2007). The nationwide public health impacts of these animal health changes can be large.

The rationale for this impact is that animals with residual effects of illness, may be more difficult to eviscerate, resulting in intestinal leakage (Russell 2003). Additionally, these animals may require more handling and trimming of lesions increasing cross-contamination. Lastly, animals with subclinical illness are more likely to carry pathogens such as *Salmonella*. In the first of two pork studies, Hurd *et al.* (2008) showed that increased rates of adhesions will result in increased carcass contamination with *Campylobacter* and *Enterococcus spp.* In the second study, it was shown that a carcass with adhesions (requiring removal of the pleural and peritoneal linings after evisceration) was 90% more likely to be contaminated with *Salmonella spp*. (Hurd *et al*. 2011). In combination, these studies suggest the public health risk of unhealthy animals may be greater than antibiotic resistance concerns.

Further studies are needed on these risk-risk or risk-benefit relationships. Risk assessment and other systems analysis tools are needed to develop policy which addresses these risk-risk tradeoffs and world food sustainability needs. These tools also allow detailed analysis of various risk management or mitigation strategies.