Remarks Addressing Airborne Feedyard Dust and Antimicrobial Resistance

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"qPCR techniques only reveal the presence of bacteria, not their viability. That doesn't translate to transference to the environment and beyond. Really what we're concerned about is, what is the risk of the transmission of these products into the environment relative to human health?"
--Sam Ives, DVM, PhD in an interview published in Environmental Health Perspectives (April 1, 2015) [1]

As professional scientists and researchers with significant experience studying antimicrobial resistant bacteria and their related potential transmission, we are deeply concerned with several erroneous conclusions being drawn from a recently published paper. [2] Any speculation concerning biological risk is not supported by the research.

The major concern with a recent study covering airborne particulate matter (PM) from cattle feeding facilities lies not within the research but with the conclusions drawn and much more with the distorted misrepresentations of those data that have been spread through the media. We will address this by briefly discussing three major points in the research and hopefully eliminate some of the confusion surrounding this issue. Those points are: 1) bacterial viability; 2) likelihood of bacterial repopulation; and 3) concentration of antimicrobials.

In this paper, many inferences are presented as conclusions when in reality they are actually untested hypotheses. Contrary to much of the media representation of this research, the data do not indicate that there are any viable bacteria present in their samples. The likelihood of non-viable bacterial genes transforming into other living bacteria is of very low probability. The antimicrobial concentrations used in this study are not grounded in appropriate air and soil volume concentrations and do not accurately represent the dispersion and dilution of these agents in the environment.

First, these data do not indicate whether or not there are any living bacteria present; therefore, there can be no existence or discussion of a "superbug." A "superbug" is a non-scientific term used to represent those pathogenic bacteria that harbor multiple drug resistant elements. Such a bacterium is identified and characterized at the level of the individual intact organism, most often through a process known as "culture and susceptibility" testing. While the presence of viable bacterial isolates is inferred in the authors' conclusions, absolutely no evidence of this is presented in the paper. It is possible that some viable organisms remain in dust particles, but the resistance profile of such an organism cannot simply be inferred from the genes detected in the dust. Bacteria that are non-viable (not alive; and more likely desiccated with catastrophic damage to cellular membrane integrity) simply cannot "occupy new niches." The authors' conclusion remains nothing more than an untested hypothesis. What was found, however, were the DNA of these bacteria. Dust contains a percentage of fecal material from domestic and wild animals in which living bacteria once were present. As these fecal bacteria became dust over time, the integrity of the cells was lost. We know from forensic studies that DNA fragments can remain long after a living being has died; thus, the researchers were still able to identify the genetic sequences of these non-viable bacteria in the dust.

Second, the DNA from these non-viable cells pose no direct risk to human health. The likelihood of DNA from these non-viable bacteria cells repopulating in other living bacteria and causing potential harm to human health would require an advanced scientific process known as transformation. This is highly improbable in the absence of ideal conditions and rarely occurs among well-known bacteria such

as *E. coli*. DNA from non-viable organisms does not simply re-constitute in the presence of water. To repeat, most fecal bacteria of concern do not transform foreign bacteria or DNA very well; meaning, if there are free-floating DNA in the environment, *E. coli* and S*almonella* are unlikely to acquire those DNA and thus become resistant. The bottom line is, if this dust somehow made it into a nasal passage or came into contact with water, DNA would not simply reconstitute and become living bacteria.

Finally, the study also indicates that detected antimicrobials were tightly bound to PM, allowing them to transport easily and remain active for long periods of time. Describing the activity of the drug in the dust or in the environment once deposited is purely conjecture without appropriate additional research. When the dust particle carrying the bound drug returns to the ground, the concentration would be much lower simply due to dilution in the environment (soil) or in any liquid solution such as water.[3] Further, by the very nature of the collection process, the researchers are concentrating the PM at a much higher level than would be encountered in nature. The models employed by the authors suggest that the dust would be dispersed over a very large area, and thus would be very dilute; it should be noted that the concentrations were expressed in ng/g without any discussion of cubic meters of air from which the gram of PM was collected. Therefore, the concentrations achieved in the environment would be much less, and as stated above, very tightly bound (making them not immediately available for interaction with bacteria), and will undergo degradation in the environment. When the broad dispersal of the PM is considered, it remains important to consider just how diluted the antimicrobials have become in the environment; unfortunately, representing the result in PM gram quantities and ignoring their dispersion and dilution in air makes for a more dramatic conclusion.

There are many unanswered questions that require additional research – which we are actively involved in exploring and will continue to provide to the larger body of science.

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[1]*Seltenrich AD et al., 2015. Dust Emissions from Cattle Feed Yards: A Source of Antibiotic Resistance? Environ Health Perspect 123-A96; http://ehp.niehs.nih.gov/123-A96/*

[2]*McEachran AD et al., 2015. Antibiotics, bacteria, and antibiotic resistance genes: aerial transport from cattle feed yards via particulate matter. Environ Health Perspect 123:337–343; http://dx.doi.org/10.1289/ehp.1408555*

[3]*There are varying reports of tetracycline stability in the environment. For example, chlortetracycline and oxytetracycline have been demonstrated to undergo complete degradation in swine wastewater within 20 days; this correlates with observations that oxytetracycline degrades in broth bacterial cultures with a half-life of approximately 18 hours.*