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EDITORIAL

Toxicology and "One Health": Opportunities for Multidisciplinary Collaborations

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The *Journal of Medical Toxicology* (JMT) is dedicated to the advancement of the science and practice of medical toxicology, including diagnosis, management, and prevention of poisoning and other adverse health effects resulting from medications, chemicals, occupational and environmental substances and biological hazards. It is interesting to note the close similarity between the objectives of this journal and those of veterinary toxicology. Veterinary toxicology is a specialty of medicine which deals with the study, diagnosis, treatment and prevention of effects of natural and man-made chemicals, forms of energy, and gasses in animals. Toxicology squarely fits into the "One Health" concept which is defined as "a collaborative effort of multiple health science professions, together with their related disciplines and institutions—working locally, nationally, and globally—to attain optimal health for people, domestic animals, wildlife, plants, and our environment" [1].

Recently, this journal published a timely commentary entitled "Toxicology, Environment and the One Health Concept" [2]. In her article, Danielle Buttke discussed how some of the major historical environmental health disasters such as Minamata disease of the late 1950s and the great London fog of 1952 highlighted the interconnections between human and animal health. In those environmental disasters, toxicosis was first manifested in animals. She also used the Michigan PBB exposure in livestock to show that animal and human health is also interconnected through the food chain.

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My work as a clinical and diagnostic veterinary toxicologist provides me with an opportunity to deal with issues involving toxicant exposure to both animal and humans. It always strikes me the amazing similarities in clinical responses between people and small animals (dogs and cats) in particular, when exposed to the same toxicant. For example, the toxicosis of acetaminophen poisoning, a common problem in dogs, mirrors that of humans. In both species, the liver is the primary target organ. The similarities in clinical responses, diagnostic tests, and therapeutic approaches underscore the importance of sharing knowledge among medical and veterinary toxicologists.

There is also an interesting link between human medicine and veterinary toxicology. Human medications have in recent years overshadowed pesticides as the most common cause of poisoning in pets [3]. Leading the pack are medications used for treatment of depression, sleeping aids, anti-anxiety and attention deficit hyperactivity disorder. Clinical signs of intoxications in pets from ingesting these drugs are strikingly similar to those in humans. Animals gain access to these "toxicants" because of a shared common environment with their owners. Household pesticides such as insecticides and rodenticides, cleaners and disinfectants, etc., are the second most common causes of poisoning in pets. Lead poisoning is a concern and is still diagnosed in pets living in older homes or those that spend time at workplaces. When a diagnosis of lead poisoning is made, channels of communication are desired to safeguard the health of both humans and animals both at home and in occupational settings. Medical and veterinary professionals have a shared responsibility of educating the public about the dangers of common pet toxicants in order to reduce or eliminate animal poisoning from these toxicants. Regardless, both professions can learn from each other by sharing information

and collaborating on diagnostic and treatment options for these toxicants.

Intensive animal production systems for food producing animals such as pigs, poultry and cattle have presented new toxicological concerns for animals, animal caretakers and farmers [3–5]. Toxic hazards on farms are of common concern for both medical and veterinary toxicologists, but this topic has received little attention. Intensive farming environments likely have implications for human health, including human respiratory diseases (e.g., asthma), and possibly neurodegenerative diseases [6]. Intensive animal agricultural systems are a source of toxic sewer sulfide gases, nitrogen dioxide, carbon monoxide and ammonia, among others. As such, "agricultural toxicology" is a fertile area of collaboration in the spirit of one health to provide optimal health for people, food producing animals, and the environment.

Food safety is one important area for "One Health" collaborations which is well recognized by the medical community. Unfortunately, emphasis on food safety has historically overwhelmingly been placed on food-borne pathogens with little attention given to food-borne toxicants. In her article in this journal, Buttke [2] discussed the fact that both animals and people share common sources of food. Corn, for example, is a shared food ingredient and can be a source of aflatoxin poisoning for both people and animals if contaminated. The recent melamine poisoning of pets in North America and children in China has highlighted the need for joint investigations of poisoning outbreaks by both medical and veterinary toxicologists to safeguard human and animal health. In the melamine poisoning outbreaks, nephrotoxicity was observed in pets in 2007 and subsequently in Chinese infants and children in 2008. The veterinary incident foretold the melamine outbreak in Chinese children. It is also worth noting that the common thread in the melamine poisoning was that the affected populations (pets and babies) feed predominantly or exclusively on one type of diet. Thus, pets can be surrogates for babies.

One Health also calls for interdisciplinary collaborations at the local, regional, and global level. We should seek out global collaborative opportunities, particularly in developing countries. Chemical food contamination is a major issue in developing countries. In an effort to combat external parasites which carry and transmit endemic pathogens in livestock in those regions, pesticides are widely used, sometimes inappropriately, providing opportunities for residues in animal food products. Also, antimicrobials are sometimes used without regard to stipulated withdrawal times. Lack of infrastructure limits residue monitoring and enforcement of regulatory guidelines in these countries. Major health outcomes that have been linked to drug residue exposure include allergenicity, teratogenesis, carcinogenesis, and systemic effects like tremors and palpitations triggered by clenbuterol drug residues in meat [7]. Therefore, developing countries provide unique opportunities for One Health collaborations for toxicologists.

The subject of animals as sentinels of environmental and ecosystem health has been discussed by the toxicology community for over 30 years. This is another perfect area for One Health collaborations. Animals, because of their unique anatomy, physiology, and habitats, are more sensitive than humans to environmental toxicants. Deaths of canaries in mines alerted humans to the presence of dangerous levels of toxic gases such as carbon monoxide in mines [8]. "Crazy cats" in the Minamata bay area foretold Minamata disease in humans. Bald eagle population declines in the Midwest USA in the 1970s and 1980s pointed to severe pollution issues, which threatened the health of the ecosystem in the region. The contaminants (DDT and PCBs) were also found in the human food chain. The entire ecosystem, including people, was affected by the pollution. Therefore, embracing One Health by toxicologists will collectively contribute to a healthier mankind, animals, and the environment.

Finally, the definition of One Health invokes interdisciplinary collaborations. Let us not forget that toxicants can and do predispose both animals and people not only to infections, but also to malnutrition. We should reach out to experts in infectious diseases, immunologists, nutritionists, oncologists, and epidemiologists, among others. The link between aflatoxicosis and hepatitis B infections in Africa is a good example [9]. Through One Health research, we can explore potential links between exposure to toxicants and human infectious diseases such as tuberculosis, malaria, HIV/AIDS, and with respiratory diseases like asthma. In veterinary medicine, the link to animal diseases of economic importance such as respiratory and reproductive diseases encountered in intensive confinement animal production systems such as porcine reproduction and respiratory syndrome (PRRS) require interdisciplinary collaborative research. Such multidisciplinary collaborations are largely lacking at present and provide opportunities for scientific breakthrough.

In summary, JMT is a unique journal providing a good forum for exchange of knowledge between medical and veterinary toxicologists. This exchange should be encouraged and nurtured. It is my hope that this forum will spark collaborations between toxicologists and other professionals around the world for better animal, human, and environmental health.

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