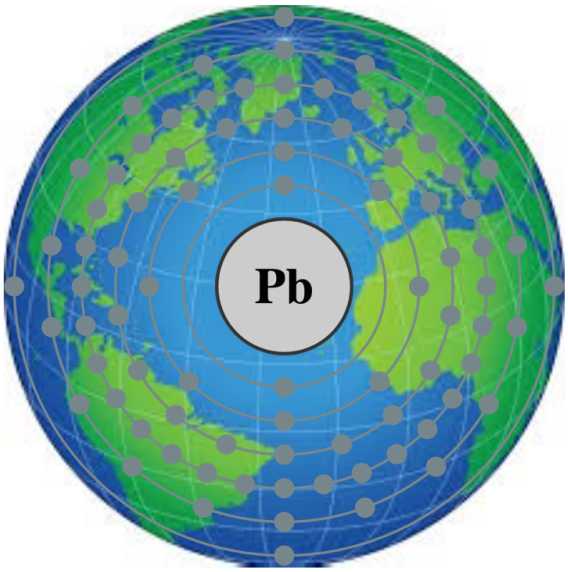

LEAD POISONING:
FROM THE BACKYARD TO A COMMUNITY

A One Health Case Study

Prepared for the AAVMC

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SUMMARY

Synopsis

Lead is a cumulative toxicant which can contaminate our environment from a variety of activities such as mining, smelting and recycling, as well as, from leaded products such as certain paints and gasoline. Worldwide over 143,000 deaths are attributed to lead exposure each year. Most of these deaths are of children. Within the United States, it is estimated that over 4 million households with children contain high levels of lead. Lead poisoning should be completely preventable, but both the burden of lead in developing regions and the ubiquity of the element makes control difficult. This study will look compare two scenarios of lead exposure and ask you to think about how a One Health approach to control could potentially save many lives. This case is based on two real scenarios.

Activity Outline (3 Hours Total)

1. Part One: Lead in the Backyard Shed (30 mins research time and 15 mins discussion)
    1. Scenario
    2. Questions for Discussion
    3. Followup
    4. Questions for Discussion
    5. Conclusion
2. Part Two: Lead in the Community Watershed (30 mins research time and 15 mins discussion)
    1. Scenario
    2. Questions for Discussion
    3. Followup
    4. Questions for Discussion
    5. Conclusion
3. Conclusion (1 hour discussion)
    1. Lead as a One Health Problem
    2. Animals as Sentinels

Goals/Learning Objectives

1. Understand the risks, signs, treatment and control of lead exposure.
2. Compare and contrast lead exposure for a few individuals vs. an entire community, as well as, when animals are involved.
3. Learn about the global impact lead has on humans, animals and our environment.
4. Understand and predict scenarios where animals can act as important sentinels for human health and the environment.

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About the Authors

Stephen Cole, VMD, MS: Dr. Cole is currently the Clinical and Molecular Microbiology Fellow in the University of Pennsylvania's Small Animal Diagnostic Services (Department of Pathobiology). He graduated from Penn's School of Veterinary Medicine in 2015 with his VMD. He earned both his BS and MS degrees from the College of William and Mary (Williamsburg, VA) in biology with a focus on Microbiology. He is a founding member of the One Health Club at PennVet.

Peter Rabinowitz, MD, MPH: Dr. Rabinowitz is an Associate Professor of Environmental and Occupational Health Sciences and Associate Professor of Global Health at the University of Washington. He directs the Center for One Health Research which focuses on zoonotic infectious diseases at the human-animal interface, animals as "sentinels" of environmental health hazards, and clinical collaboration between human health care providers and veterinarians in a species-spanning approach. He completed his MD at the University of Washington and MPH at Yale University. He completed a residency in Family Medicine at UCSF and fellowships in General Preventive Medicine and Occupational and Environmental Medicine at the Yale School of Medicine.

Shelley Rankin, PhD: Dr. Rankin is Associate Professor (CE) of Microbiology at the University of Pennsylvania's School of Veterinary Medicine. She currently serves as the Head of Diagnostic Services and Section Chief of Microbiology for the Ryan Small Animal Hospital. She formally served as the Section Chief for Large Animal Microbiology at the Pennsylvania Animal Diagnostic Laboratory Service (PADLS). She received her BSc in Microbiology and PhD in Molecular Epidemiology from the University of Glasgow.

PART 1- LEAD IN THE BACKYARD

Scenario

You are a poultry veterinarian that works as a diagnostician for a busy state laboratory. Your main training has been in the health of commercial chickens, turkeys and ducks, but you often perform necropsies for local community members when deaths occur in their backyard flocks and game birds, as well as, wildlife. Today, you are presented with 3 racing pigeons (*Columba livia*) that were found dead this morning. To the owner's knowledge the birds were perfectly healthy leading up to today, although she does not take care of them primarily. The pigeons belong to her 12-year-old daughter who races them. Other then the birds being in thin body condition, the necropsy is unremarkable.

Questions for Discussion

(1) What additional questions do you have for the owner?

(2) What broad categories of disease must be considered in the case of multiple sudden deaths within a group of animals?

(3) When considering which infectious diseases to test for which ones would you consider important in the following categories:

A. Zoonotic diseases:

B. Reportable diseases:

C. Common Diseases:

(4) What organs should be collected for toxicology testing? Any different organs for infectious disease testing?

(5) While additional tests are pending, what precautions should the owners take while caring for the rest of the brood?

Follow-Up

Tests for all tested infectious diseases are negative and just as you start to think about what additional tests you should consider, you receive the toxicology results stating that tissues contained abnormally high levels of lead.

Questions for Discussion

1. What would "normal" lead levels be in a bird? In a person?

2. What are potential sources of lead? What kind of testing could you recommend?

3. What recommendations would you make to the owner regarding her family's health?

4. What recommendations would you make regarding the remaining birds?

Conclusion

The owner of the pigeon calls back the next week to let you know that the lead tests were negative for the entire family. They have decided to build new housing for the remaining animals (no more have died) and us a professional service to properly dispose of the shed.

PART 2- LEAD IN THE COMMUNITY

Scenario

In 2010, hundreds of children were stricken with a nebulous disease in two villages within the Zamfara state of northern Nigeria. The ill were reported to have headaches, vomiting, abdominal pain and seizures. At the top of the differentials' list were, of course, infectious diseases and toxicants. Toxicology testing, performed by the CDC, revealed high levels of lead in the blood of children from both villages, as well as high levels in the households of these children.

Questions for Discussion

(1) In what ways are individuals exposed to lead? In your pre-reading what risk factors were associated with lead poisoning?

(2) What are "classic" symptoms of lead poisoning in children? Are they different for adults?

Children:

Adults:

(3) Explain, simply, the pathogenesis of lead toxicity.

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(4) Briefly, how are those exposed to lead treated? What is the most important component of therapy? What differences exist when treating animals?

(5) Develop a brief *public health communication* to disseminate information to community members. It should include :the nature and extent of the crisis and the measures taken to control it;the identified hazard and its characterization, the sources of contamination and when and how to seek medical attention or other assistance as warranted; how to prevent further spread of the problem; and safety strategies. Visit the FAO's risk communication (developed for food safety but could be applied here) website for good strategies: http://www.fao.org/docrep/005/x1271e/X1271E05.htm

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Follow-Up

One member of the team, Dr. Lora Davis (an epidemiologist and an Animal-Human Interface officer for the CDC at the time) began to wonder in the health of animals in the area had been affected. Discussions, surveys and locals. Further investigations showed that their was a general impression that there was a decrease in local duck populations. The majority of sampled duck's blood levels were above 65 ug/dL. Some studies implied that ducks are thought to be more sensitive to lead and show levels more quickly then other animals, such as sheep and goats.

(1) How do the signs of lead toxicity vary in animals compared to people?

(2) What sort of surveillance could be implemented now that lead has been identified as a problem in wildlife as well?

(3) What potential impacts could high levels of lead in duck populations have on the rest of the ecosystem?

(4) What risks, regarding wildlife and their habitat, should be expressed to community members? Again, how would you communicate this? Refine your communication to inform people on the duck epidemic.

Conclusion

More than 400 children died from lead exposure during this outbreak. Since 2010 significant efforts have been made to provide affected children with chelation therapy. Many responded well to treatment. Removal of contaminated soil continued throughout 2014. Local authorities have begun to clamp down on illegal mining activities, which were thought to potentially exacerbate the problem. It was also recognized that significant clues, with regards to the disappearance of a large number of water fowl were missed early on in the outbreak, and potentially could have saved a significant amount of funding and a significant number of lives.

CONCLUSION

Lead as a One Health Problem

(1) Broadly state why lead poisoning is a One Health Issue?

(2) Elevated lead levels are often reportable to local and state public health departments. In some locales, ALL lead blood tests must be reported. The CDC extracts much of its lead poisoning data from these programs. Veterinarians, however, are not required to report lead levels in their patients to public health departments. Should veterinarians or veterinary laboratories be required to report high lead levels to Depts. of Public Health?

(3) During the Nigerian outbreak significant communication existed between human and animal health officials since they were both part of a structured outbreak team. However, in the first scenario, the communication occurred mainly between the veterinarian and the family physician via the client/patient. How could the veterinarian or physician improve inter-professional communication?

Animals as Sentinels

(1) What other diseases have you heard of or imagine that animals could be sentinels of?

(2) Are some types of diseases easier to monitor animals for? Which are more difficult? Why?

(3) What are key ways to utilize animals as sentinels to improve the health of humans and the environment?