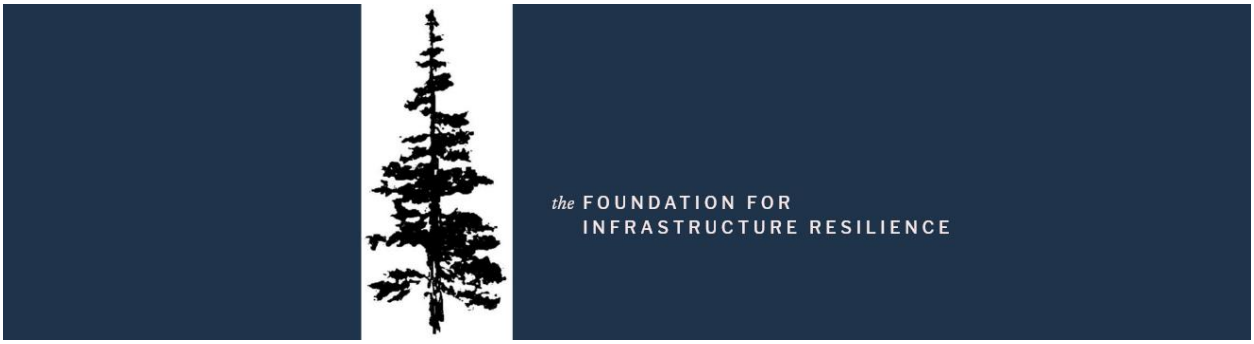

Potential Zoonotic Incursions into the US and the Use of Wastewater Testing to Identify Them

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Executive Summary

The risk of zoonotic disease incursions into the US is growing. Wildlife trade is one of the most complex commercial exchanges and may equal the weapons trade in complexity. The USA must participate in international efforts to regulate international wildlife trade and become an integral part of law enforcement management information systems. Wastewater surveillance may be helpful in indicating the prevalence of some of these zoonotic organisms.

Zoonotic diseases are infections that are spread between people and animals.

Problem Statement

Increasing food animal use and large importations of live wildlife into the US make us vulnerable to zoonotic outbreaks. Urbanization, destruction of natural habitats and sale and trade of high-risk illegal wildlife increasingly puts people at risk of diseases jumping from species to species.[1] One-fourth of all human death is from infectious disease and 60% of

[1] World Health Organization, Zoonoses, July 29,2020, https://www.who.int/news-room/fact-sheets/detail/zoonoses

infectious disease is zoonotic.[2] Seventy percent of zoonotic diseases are from wildlife.[3] China is the leading exporter of legal and illegal wildlife and animals are often not adequately health tested before importation.[4] Backyard farms, roadside zoos and feral hogs may also contribute to the zoonotic disease problem. Intensive biosecurity may be the easiest way to control diseases in our US animal populations.

We need to tighten the enforcement of regulations, implement new ones, and have a comprehensive strategy to address threats according to a recent Harvard Law study.[5] Several questions remain:

- How should we treat the 84 live animal markets in New York City? These markets have been shown to have a high rate of viral spread in the air and on surfaces.
- What should we do about the "pocket" exotic animals which come into the US as part of the worldwide $20 billion exotic pet trade? The exotic pet market in North America and Europe was estimated at USD 1.3 billion in 2023.[6] Much of the up-close observations of these animals must be done by the US Customs and Border Protection (CBP).[7] [8]
- Can we improve the US animal industries? Animal industries in the US may pose a serious risk of pandemics as we process 10 billion head of livestock a year. The US is one of the largest producers of pigs and poultry and both can be carriers of influenza virus. In 2023, "more than 58 million chickens, turkeys and other birds had died in the nation's worst outbreak ever."[9] The uncontrolled wild bird population is making H5N1 management very difficult. Any novel reassortment of H5N1 clades will make this a true challenge. Vaccination of chickens, livestock and people require superb surveillance to prove the critical areas of vaccine effectiveness and protection levels. We have seen few humans with clinical signs of H5N1 with no person-to-person transmission and it is considered to be a low pathogenic avian influenza in cattle, so depopulation of cattle herds is not necessary. Airborne transmission is usually limited to 50 feet but air

[2] Analyzing the Changes in Certain Infectious and Parasitic Diseases in Urban Population of India by Using Medical Certification of Cause of Death Data, Indian J Community Med 2021 Mar 1;(1) 20-23, https://pmc.ncbi.nlm.nih.gov/articles/PMC8117879/

[3] Nelson, C. , 2008, Personal Communication from Purdue University Graduate Veterinary Homeland Security Program Zoonotic Diseases in Bovine, Equine, Porcine

[4] PubMed KM Smith et al, Eco health 2017 Mar Summarizing US Wildlife Trade with an Eye Toward Assessing the Risk of Infectious Disease Introduction, https://pubmed.ncbi.nlm.nih.gov/28176029/

[5] Zoonotic Disease Threats in the US Uncovered in Comprehensive New Report Harvard University Animal Law and Policy Program, https://animal.law.harvard.edu/news-article/animal-markets-and-zoonotic-disease/

[6] North America and Europe Exotic Companion Animal Market Size, Share and Trends Analysis, Grand View Research 2023 report GVR-4-68040-390-8, https://www.grandviewresearch.com/industry-analysis/north-america-europe-exotic-companion-animal-market-report

[7] Personal Communications, Customs and Border Protection personnel

[8] USCBP, Bringing Pets and Wildlife into the United States, https://www.cbp.gov/border-security/protecting-agriculture/bringing-pets-and-wildlife-united-states

[9] Reuters "The ongoing bird flu outbreak in the US", https://www.reuters.com/world/us/ongoing-bird-flu-outbreak-united-states-2024-07-22/

layering, air pockets and dust in aerosols could make potential distance of spread up to 1 mile.[10]

- Is waste milk lagoon disposal and lagoon aeration creating a potential mixing vat crisis (A lagoon mixing vat, also known as an aerated lagoon, is a shallow basin that uses aerators to mix wastewater and add oxygen to it. The mixing and oxygenation process is called lagoon aeration, and it's a common wastewater treatment method for small communities.[11])?

Recent work by Dr. Jay Garland at the EPA has shown that many of these zoonotic diseases can be identified in wastewater, effluent flows and surface water.[12] We should especially pay attention to hospital effluents and any wastewater that is reprocessed into drinking water. Wastewater, effluent flows, and surface water surveillance could provide an early warning system for emerging zoonotic threats, including antimicrobial resistant organisms which may originate from agriculture, the natural environment, wildlife and human activity. This type of surveillance was used during the Covid 19 pandemic.[13] New budgets should be set aside to take a look at the problem of emerging and re-emerging diseases in the US.

Given the increased risk of exposure to zoonotic infections, particularly in high-risk environments like livestock farms, there is a growing need for targeted surveillance of livestock workers and veterinarians. Recent testing has shown that 7% of livestock workers in the US have antibodies to H5N1 despite showing no symptoms. This raises important questions about the potential for subclinical infection and the need for further investigation into the exposure risks for these workers. We should have more testing of livestock workers and veterinarians because of a greater risk of being exposed to zoonotic infections.

In addition, the US is home to a range of bacterial zoonotic diseases from existing organisms with pandemic potential and some of the most frightening bacterial zoonotic diseases like Lyme disease, Southern erythema migrans, Bartonella, Tularemia and Ehrlichia are already here in the US with proven vectors. We have locally acquired Dengue in California via a proven viable vector. The emergence of diseases like these and the viable vectors we have for tick-borne and mosquito-borne diseases highlight the need for comprehensive surveillance and preparedness strategies.

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[10] Personal Communication Dr, Cris Young Professor of Practice at Auburn University Birmingham Infragard "Bird Flu: Double Threat to Humans and Food Supply" November 12, 2024

[11] Dokuz Eylul Universitesi, https://web.deu.edu.tr/atiksu/ana52/ani4044-13.html#:~:text=Aerated%20lagoons%20are%20common%20in,for%20other%20mechanical%20treatment%20systems.

[12] EPA, Science Inventory: Jay Garland, https://cfpub.epa.gov/si/si_public_search_results.cfm?personID=116197&role=Any

[13] Wiesner-Friedman, C., N. Brinkman, E. Wheaton, M. Nagarkar, C. Hart, S. Keely, E. Varughese, J. Garland, P. Klaver, C. Turner, J. Barton, M. Serre, AND M. Jahne. Characterizing Spatial Information Loss for Wastewater Surveillance Using crAssphage: Effect of Decay, Temperature, and Population Mobility. Environmental Science and Tech., https://cfpub.epa.gov/si/si_public_record_report.cfm?dirEntryId=362632&Lab=CESER&personid=116197&role=Any

The Centers for Disease Control and Prevention (CDC) classifies infectious diseases (including zoonotic disease) into categories based on their potential for use as agents of bioterrorism. Category A includes Anthrax, Plague, Smallpox, Tularemia, Ebola, Marburg and Lassa viruses while Category B includes Brucellosis, Salmonella, E coli, Shigella, Psittacosis, Q fever and Staphylococcus enterotoxin B. Surveillance of wastewater systems, particularly hospital effluent, may provide critical data for tracking and controlling the spread of some of these agents.

Summary

The risk of zoonotic disease incursions into the US is growing, driven by factors such as increased animal trade, urbanization, and wildlife habitat destruction. To address these threats, it is crucial to tighten regulation enforcement surrounding wildlife imports, strengthen biosecurity measures in animal industries, and enhance surveillance in high-risk areas such as live animal markets and livestock farms. Wastewater surveillance may be helpful in indicating the prevalence of some of these zoonotic organisms.

About the author: Cheryl F. Nelson DVM has over 44 years in the veterinary profession and is a subject matter expert for InfraGard Food and Agriculture Sector. She has a specialty interest in zoonotic disease and hazards.