4. Inglesby TV, Henderson DA, Bartlett JG, Ascher MS, Eitzen E, Friedlander AM, et al.; Working Group on Civilian Biodefense. Anthrax as a biological weapon: medical and public health management. JAMA. 1999;281:1735–45. https://doi.org/10.1001/jama.281.18.1735
5. Xu J, Bai X, Zhang X, Yuan B, Lin L, Guo Y, et al. Development and application of DETECTR-based rapid detection for pathogenic *Bacillus anthracis*. Anal Chim Acta. 2023; 1247:340891. https://doi.org/10.1016/j.aca.2023.340891
6. Bruce SA, Schiraldi NJ, Kamath PL, Easterday WR, Turner WC. A classification framework for *Bacillus anthracis* defined by global genomic structure. Evol Appl. 2020;13:935–44. https://doi.org/10.1111/eva.12911
7. Sahl JW, Pearson T, Okinaka R, Schupp JM, Gillece JD, Heaton H, et al. A *Bacillus anthracis* genome sequence from the Sverdlovsk 1979 autopsy specimens. MBio. 2016;7:2–10. https://doi.org/10.1128/mBio.01501-16
8. Fell NH. Brief summary of new information about Japanese BW activities. 1947; Location: 290/03/19/02, RG#175, ENTRY#67A4900, Box 196. National Archives and Records Administration, Washington DC, USA.
9. Report of "A" [Anthrax]. 1949; Location: 2910, RG#IWG reference collection. National Archives and Records Administration, Washington DC, USA.
10. Report of "G" [Glanders]. 1949; Location: 2910, RG#IWG reference collection. National Archives and Records Administration, Washington DC, USA.

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Canine Multidrug-Resistant *Pseudomonas aeruginosa* Cases Linked to Human Artificial Tears–Related Outbreak

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We report 2 canine cases of carbapenemase-producing *Pseudomonas aeruginosa* within a United States veterinary hospital associated with a human outbreak linked to over-the-counter artificial tears. We investigated veterinary hospital transmission. Veterinary antimicrobial resistance surveillance and infection prevention and control enhancements are needed to reduce transmission of carbapenemase-producing organisms.

Carbapenem antimicrobial drugs are reserved for highly resistant gram-negative bacterial infections. Carbapenemase enzymes, which hydrolyze and inactivate carbapenems, are commonly encoded on mobile genetic elements that can spread among bacterial genera and species and amplify resistance. Therefore, carbapenemase-producing organisms (CPOs) are a major public health concern (*1*). Although less commonly documented compared with humans, CPOs have been identified in companion animals and suspected transmission reported between humans and animals (*2*–*4*).

In March and June 2023, New Jersey Department of Health (NJDOH) was notified of carbapenemase-producing *Pseudomonas aeruginosa* (CP-PsA) isolated from 2 separately owned pet dogs treated at the same New Jersey, USA, small animal specialty veterinary hospital. The isolates were closely genetically related to the multistate cluster of Verona integron-mediated metallo-β-lactamase (VIM)–producing and Guiana-extended spectrum-β-lactamase (GES)–producing carbapenem-resistant *P. aeruginosa* (VIM-GES-CRPA) isolated from multiple human clinical cultures and associated with contaminated over-the-counter artificial tears products (*5*,*6*). The combination of VIM-80 and GES-9 in a single organism had not been identified in the United States before that outbreak. By May 2023, that outbreak was associated with 81 human cases and 4 deaths in 18 states; no other animal cases were reported.

NJDOH interviewed the dog owners, reviewed veterinary medical and hospital purchase records, and conducted an onsite infection prevention and control (IPC) assessment 1 month after the second case identification. The investigation was reviewed by Centers for Disease Control and Prevention (CDC) and conducted consistent with federal law and CDC policy.

The first canine case was identified in March 2023 in a spayed female Labrador retriever 7 years of age that had a 3-month history of cough. VIM-GES-CRPA was isolated from a bronchoalveolar lavage specimen. The second canine case was identified in June 2023 in a neutered male cocker spaniel 6 years of age with a chronic history of otitis externa and keratoconjunctivitis sicca; VIM-GES-CP-PsA was isolated from

Table. Clinical characteristics and genetic relatedness of *Pseudomonas aeruginosa* infections in canines during outbreak in humans linked to artificial tears*

Case no.	Sample collection month, 2023	Isolate location	Isolate no.	BioSample ID†	SNP difference from human outbreak strain
Dog 1	March	Bronchial alveolar lavage	13494-23	SAMN33902373	2
Dog 2	June	External ear canal	30793-23	SAMN35751022	5

*ID, identification; SNP, single nucleotide polymorphism.
†National Center for Biotechnology Information (https://www.ncbi.nlm.nih.gov).

the external ear canal along with methicillin-resistant *Staphylococcus pseudintermedius*. Clinical specimens were submitted to the clinical microbiology laboratory of the PennVet Diagnostic Laboratory, University of Pennsylvania (Philadelphia, PA, USA), for culture and antimicrobial susceptibility testing (AST).

AST was performed using AST-GN98 cards on Vitek 2 (bioMérieux, https://www.biomerieux.com), according to manufacturer instructions. Isolates tested were resistant to aminoglycosides amikacin and gentamicin, fluoroquinolones enrofloxacin and marbofloxacin, and ceftazidime. Isolate 13494-23 was resistant to imipenem. Although isolate 30793-23 was susceptible (MIC 2 μg/mL), ceftazidime resistance still prompted PCR by Carba-R (Cepheid, https://www.cepheid.com) for carbapenemase genes. Phenotypically susceptible isolates producing carbapenemases are a well-described phenomenon and prompt further investigation (*7*). Short-read whole-genome sequencing was performed using Nextera Library Prep chemistry and HiSeq 2500 (Illumina, https://www.illumina.com) platform and uploaded to National Center for Biotechnology Information (https://www.ncbi.nlm.nih.gov) prokaryotic genomic annotation pipeline for deposit in the pathogen detection database (*8*). The isolates were 2 and 5 single-nucleotide polymorphism differences from the closest related human isolate (Table)

Neither dog owners nor household members reported outbreak-associated ophthalmic product exposures since March 2022, but the second dog had received different over-the-counter artificial tears. The veterinary hospital did not stock the outbreak-associated products. Both dogs had received recent antimicrobial drug treatment. The first dog lived with 3 other dogs; the second dog was the only household pet. No dogs, owners, or household members had travel history (domestic or international) or healthcare setting exposures. Epidemiologic links between the 2 canine cases included treatment in the veterinary facility's surgical preparation and recovery areas for both dogs and ophthalmology department visits by either the affected dog or another animal in the same household. The NJDOH onsite visit identified IPC gaps in hand hygiene, personal protective equipment use, and equipment and environmental cleaning and disinfection. Surgical scrub and instrument sink drains, shared equipment, and ophthalmic product cultures did not grow the outbreak strain. NJDOH provided IPC resources and recommendations to the facility and owners.

CPO identification in dogs linked to a human outbreak but with an unknown transmission route necessitates consideration of the role of companion animals and veterinary hospitals in transmitting and acting as reservoirs for CPOs and underscores the need for veterinary public health action. To clarify veterinary-associated CPO transmission and enhance CPO identification, veterinarians should request diagnostic laboratories perform carbapenem susceptibility testing for gram-negative bacteria resistant to third-generation cephalosporins (e.g., ceftazidime), if clinical history suggests CPO infection risk, and, upon carbapenem-resistant organism identification, request resistance mechanism confirmation. CPO infection risk can include recent antimicrobial use, international travel, hospitalization, raw food diet, close contact with humans or animals carrying CPOs, or exposure to contaminated products (*9*,*10*). Veterinarians and pet owners are encouraged to maintain awareness of outbreaks in persons associated with products used in multiple species, such as through Food and Drug Administration medical product recall notifications.

In conclusion, identifying CPOs in companion animals associated with a human outbreak serves as an urgent call to veterinarians to identify and prevent CPO transmission. Veterinarians should request carbapenem susceptibility testing when appropriate, veterinarians and pet owners should maintain awareness of CPO outbreaks, and veterinary hospitals should establish and implement IPC protocols. By following those recommendations, veterinarians can identify and prevent CPO transmission to protect animal and human health.

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References

1. Centers for Disease Control and Prevention. 2019 Antibiotic resistance threats report [cited 2023 Dec 6]. https://www.cdc.gov/antimicrobial-resistance/data-research/threats
2. Hyun JE, Chung TH, Hwang CY. Identification of VIM-2 metallo-β-lactamase-producing *Pseudomonas aeruginosa* isolated from dogs with pyoderma and otitis in Korea. Vet Dermatol. 2018;29:186–e68. https://doi.org/10.1111/vde.12534
3. Fernandes MR, Sellera FP, Moura Q, Carvalho MPN, Rosato PN, Cerdeira L, et al. Zooanthroponotic transmission of drug-resistant *Pseudomonas aeruginosa*, Brazil. Emerg Infect Dis. 2018;24:1160–2. https://doi.org/10.3201/eid2406.180335
4. Wang Y, Wang X, Schwarz S, Zhang R, Lei L, Liu X, et al. IMP-45-producing multidrug-resistant *Pseudomonas aeruginosa* of canine origin. J Antimicrob Chemother. 2014;69:2579–81. https://doi.org/10.1093/jac/dku133
5. US Food and Drug Administration. FDA warns consumers not to purchase or use EzriCare Artificial Tears due to potential contamination [updated 8/25/2023] [cited 2023 Dec 6]. https://www.fda.gov/drugs/drug-safety-and-availability/fda-warns-consumers-not-purchase-or-use-ezricare-artificial-tears-due-potential-contamination
6. Grossman MK, Rankin DA, Maloney M, Stanton RA, Gable P, Stevens VA, et al.; Multistate Pseudomonas Outbreak Investigation Group. Extensively drug-resistant *Pseudomonas aeruginosa* outbreak associated with artificial tears. Clin Infect Dis. 2024;79:6–14. https://doi.org/10.1093/cid/ciae052
7. Livermore DM, Andrews JM, Hawkey PM, Ho PL, Keness Y, Doi Y, et al. Are susceptibility tests enough, or should laboratories still seek ESBLs and carbapenemases directly? J Antimicrob Chemother. 2012;67:1569–77. https://doi.org/10.1093/jac/dks088
8. Tatusova T, DiCuccio M, Badretdin A, Chetvernin V, Nawrocki EP, Zaslavsky L, et al. NCBI prokaryotic genome annotation pipeline. Nucleic Acids Res. 2016;44:6614–24. https://doi.org/10.1093/nar/gkw569
9. Dazio V, Nigg A, Schmidt JS, Brilhante M, Mauri N, Kuster SP, et al. Acquisition and carriage of multidrug-resistant organisms in dogs and cats presented to small animal practices and clinics in Switzerland. J Vet Intern Med. 2021;35:970–9. https://doi.org/10.1111/jvim.16038
10. van den Bunt G, Fluit AC, Spaninks MP, Timmerman AJ, Geurts Y, Kant A, et al. Faecal carriage, risk factors, acquisition and persistence of ESBL-producing Enterobacteriaceae in dogs and cats and co-carriage with humans belonging to the same household. J Antimicrob Chemother. 2020;75:342–50. https://doi.org/10.1093/jac/dkz462

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Zoonotic Potential of Chronic Wasting Disease after Adaptation in Intermediate Species

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Chronic wasting disease (CWD) is an emerging disease in Europe. We report an increase in interspecies transmission capacity and zoonotic potential of a moose CWD isolate from Europe after passage in an ovine prion protein–expressing host. Those results indicated some CWD prions could acquire enhanced zoonotic properties following adaptation in an intermediate species.

Chronic wasting disease (CWD) is a highly contagious prion disease affecting members of the Cervidae family. CWD is widely spread across North America, where it endangers the survival of free-ranging cervid populations. In Europe, CWD was reported in a reindeer (*Rangifer tarandus tarandus*) from Norway in 2016 (*1*). Since 2016, several cases have been reported in Norway, Sweden, and Finland in multiple species, including reindeer, red deer (*Cervus elaphus*), and moose (*Alces alces*) (*2*).

Whereas CWD strains circulating in North America exhibit some uniformity (*3*), the cases found in Europe are more variable. Transmission into rodent models has revealed multiple CWD strains that are apparently different than strains in North America, and moose cases in Norway have demonstrated biochemical patterns distinct from previous cases in Europe (*4*). We characterized the interspecies transmission potential of 1 moose CWD isolate from Norway (Norwegian Veterinary Institute identification no. 16–60-P153) (*4*) by intracerebral injection of mouse models expressing the normal prion protein (PrP^{C}) sequences from several species (Figure, panel A).