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## Welcome to the American Association of Food Safety and Public Health Veterinarians

The AAFSPHV represents veterinarians working in:

- Public health agencies
- Departments of agriculture
- Wildlife health agencies
- Environmental agencies
- Animal welfare agencies
- Military service
- Private practice
- Shelter medicine
- Industry
- Academia
- Food safety agencies

## PRESIDENT'S CORNER



Angela Demaree, DVM, MPH  
 President  
 American Association of Food  
 Safety & Public Health  
 Veterinarians (AAFSPHV)  
<http://www.aaphv.org/>

Greetings Colleagues,

As I've stepped into the role of serving as your next President of the AAFSPHV, I've been asked, "What do you want to accomplish over the next two years of your Presidency?"

For me, it's not about what I want to do or how I might accomplish that vision, but rather, it's about leadership. How can I best support the mission and vision of the organization, our board, and you, our members?

I started by reviewing our Bylaws and Mission Statement.

"Section 1: The mission of the Association is to promote the science and art of food safety, public health, epidemiology, and preventive medicine by providing an expert forum for the discussion of issues of importance to the veterinary profession and the development of professional recommendations and resolutions. The Association consistently supports programs to promote and improve the professional education, communication, and collaboration among food safety and public health veterinarians in order to reduce human illness, animal illness and promote public health.

"Section 2: The objectives of this association:

- a. Elevate the standard of Food Safety & Public Health Veterinarians
- b. Provide a unified voice to promote the interests and improve the image of veterinarians in the practice of Food Safety and Public Health
- c. Produce and promote communication, understanding, and professional information among members of the Association and among colleagues in the world veterinary, food safety and public health community
- d. Increase the knowledge of food safety and public health in veterinarians engaged in public or private practice
- e. Emphasize the importance of the veterinarian's role in public health, the food production continuum (farm to consumption) and One Health
- f. To communicate and engage with other veterinary specialties; with related agricultural and industrial associations; with related research and educational institutions; and with recognized consumer organizations."

Our Past-Presidents have taken this charge seriously and have started and fostered programs and relationships with other organizations we can be proud of. Through surveys and outreach, we've learned that continuing education for our members is meaningful and important. We are partnering with the ACVPM and NAFV to provide monthly webinars with free CE. In addition, we continue to partner with the NAFV to host the Food Safety Symposium at both the AVMA and USAHA meetings, ensuring excellent content on timely topics relevant to public health and food safety is available to veterinarians in attendance at these meetings.

Most recently, Dr. Debonis, helped to usher us into the 21st Century with a website we can all be proud of to attract new members, continue to serve our membership, and make it easier for you to post questions and interact with your association.

So, what's next? Are we meeting these objectives and exceeding your expectations?

To answer those questions, I need your help.

You may have seen a questionnaire or survey, or you soon will. Please take the time to respond. This is YOUR association, and we want to understand better how we can best serve and meet your needs.

To be truly member-driven, we need your input and participation. I'm tapping every one of you on the shoulder and encouraging you to participate in a way that is most meaningful to you. We have openings on our Education, Communication, and Finance Committees and need speakers on relevant and important public health, one health, and food safety topics for our monthly webinars.

**Send an email with your interest to:**

Kelly Vest: Finance Committee  
kgvest8@gmail.com

Jane Lewis - Student Outreach Committee  
jmlvet94@gmail.com

Donna Debonis - Communication Committee  
PastPresident@aafsphv.org

Chelsea Buckley: Speaking and Education Committee  
Pres-elect@aafsphv.org

The world is changing faster than ever, misinformation can spread more quickly than the public health community can provide data-driven research and answers, and we need your input, now, more than ever, to learn how we can best serve your current needs in ways that align with and exemplify our mission now and in the future.

We look forward to hearing from you!

**Angela Demaree, DVM, MPH**  
**President American Association of Food Safety & Public Health**

## FROM THE EVP

AAFSPHV members,

**Renewal notices** have been sent out to members. Please renew; we need your support and participation. Members who do not renew by March 31, 2023 will be removed from the member roster.

**Listserv/Message Board:** Please share your announcements, news, events, or CE in topics relevant to our members, or job listings. Log into your member account>click Listserv/Message Board>select General Message Board>Post New Message

**Survey:** I will be sending a survey out to membership in April. We are creating a contact list for members willing to:

1. Be a mentor to students
2. Do informational interviews with those interesting in public health careers
3. Present a topic at our partner ACVPM monthly CE webinars
4. Speak via webinar with student groups in One Health or Public Health
5. Volunteer for one of our committees: Education, Communication and Finance Dr.

Katherine Waters  
AAFSPHV Exec VP

[aafsv.execvp@gmail.com](mailto:aafsv.execvp@gmail.com)



## Editor's Note

### SEEKING MEMBER NEWS AND UPDATES

Thank you to everyone who was able to get news submitted for our newsletter this quarter. We continue to seek more member input to share updates and achievements.

The Quarter 2 edition for 2023 of the newsletter will be released in the first week of July. All submissions for the July edition should be submitted to me by June 21<sup>st</sup> by 5pm CST. Any and all submissions can be submitted to [editor@aafsphv.org](mailto:editor@aafsphv.org)

As always, you are welcome to send me any news and updates at any time to be included in the upcoming newsletter. We would love to feature member accomplishments whether it is awards, new job alerts, changes in offices, or volunteer work. We love to hear from you! If you have any questions or suggestions, please don't hesitate to reach out!

Best,  
Tori Novak, DVM, MPH  
AAFSPHV Editor



### Please Subscribe!

Be sure to subscribe to our [YouTube channel](#) and subscribe and listen wherever you get your podcast.



# Committee Updates

## Update from the Communications Committee

Please continue to subscribe and share our podcast and our YouTube channel. You can make a difference in a colleague's life by sharing these videos! Why is that? Veterinarians who feel trapped in their career and are unhappy often don't realize that there are so very many more options available to them. In these stories, we talk about those many options and how many unusual and amazing jobs are out there. Most don't even require an additional advanced degree, simply being open to learning about all of these careers that we talk about in this series. So, share and subscribe and bring this information to light for your colleagues who are seeking a change now.

That said, contact me if you are ready to be interviewed! Please reach out to me so we can set up a time. I conduct the interviews via zoom and typically last only an hour. I look forward to hearing from you!

Please join our Groups:



<https://www.linkedin.com/groups/4926618/>



<https://www.facebook.com/aafsphv>



<https://twitter.com/AAFSPHV>

Donna DeBonis

[drdebonis@gmail.com](mailto:drdebonis@gmail.com)

Check out our latest interviews here!

[S2 E 3 Interview with Kristen K. Clark, DVM, MPH, DACVPM, CCRT - YouTube](#)



## Update from the Committee for Student Outreach

The 2023 Student Membership Campaign and Scholarship Funds Request (for meeting attendance) were distributed to program contacts in February and again in March.

Also, I received this message from Will Sander: " As a quick update, I had at least 50 students either take one of the student membership flyers or scan the QR code at the ACVPM booth at SAVMA symposium. Hopefully it will generate some student members."

Jane Lewis, DVM, MSFS, DACVPM

## Member News

### ❖ [Cross-campus center tackles antimicrobial resistance:](#)

The new Cornell Center for Antimicrobial Resistance Research and Education aims to fight the rise of antibiotic resistance. The new center aims to understand the nature of antimicrobial resistance and address the problem with an inter-disciplinary approach including medicine, life sciences, and social sciences.

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## ENVIRONMENTAL HEALTH AND TOXICOLOGY

### Long term trends in floating plastic pollution within a marine protected area identifies threats for Endangered northern bottlenose whales

“The Gully”, situated off Nova Scotia, Canada, is the largest submarine canyon in the western North Atlantic. This unique oceanographic feature, which became a Marine Protected Area (MPA) in 2004, is rich in marine biodiversity and is part of the critical habitat of Endangered northern bottlenose whales (*Hyperoodon ampullatus*). To understand the potential impact of plastic pollution in the MPA and on this Endangered cetacean, we evaluated trends over time in the abundance and composition of plastics and compared these to the stomach contents of recently stranded northern bottlenose whales. From the 1990s-2010s, the median abundance of micro-sized (<5 mm) and small plastics (5 mm-2.5 cm) increased significantly, while the median abundance of large plastics (>2.5 cm) decreased significantly. Plastic abundance from the 2010s for micro-sized and small plastics varied from 5586-438 196 particles km<sup>-2</sup>, higher than previously measured estimates for surrounding offshore areas. Polymers identified using FTIR spectroscopy included polyethylene, polypropylene, polyethylene terephthalate polyester, nylon, alkyds (paint), and natural and semi-synthetic cellulosic fibers. The abundance of large debris ranged from 0 to 108.6 items km<sup>-2</sup> and consisted of plastic sheets and bags, food wrappers and containers, rope, fishing buoys, and small plastic fragments. Whale stomach contents contained fragments of fishing nets, ropes, bottle caps, cups, food wrappers, smaller plastic fragments, fibers, and paint flakes, consistent with the composition and character of items collected from their critical habitat. Despite being far from centres of human population, the unique oceanographic features of The Gully (i.e. currents and bathymetric complexity) may concentrate plastic debris, increasing exposure rates of whales to plastic pollution. The increase in micro-sized and small plastics over time suggests associated health and welfare impacts of ingested plastics should be accounted for in future recovery plans for this Endangered species.

Authors: Noreen E. Kelly, Laura Feyrer, Heidi Gavel, Olga Trela, Wayne Ledwell, Heather Breeze, Emmaline C. Marotte, Leah McConney, Hal Whitehead

Source: (2023). Environmental Research, Volume 227, 2023, 115686, ISSN 0013-9351, <https://doi.org/10.1016/j.envres.2023.115686>

### Lead exposure is correlated with reduced nesting success of an urban songbird

Lead exposure is a concern in urban ecosystems, with physiological and behavioral effects well documented in humans. Wildlife inhabiting urban ecosystems are also exposed to lead, yet little work has documented the sublethal effects of lead exposure in urban wildlife. We studied northern mockingbirds (*Mimus polyglottos*) in three neighborhoods of New Orleans, Louisiana, two with high soil lead and one with low soil lead, to better understand how lead exposure may influence mockingbirds' reproductive biology. We monitored nesting attempts, measured lead concentrations in blood and feathers of nestling mockingbirds, documented egg hatching and nesting success, and assessed rates of sexual promiscuity in relation to neighborhood soil lead levels. We found that nestling mockingbirds' blood and feather lead levels reflected the soil lead levels of their neighborhoods and nestling blood lead levels were similar to those of adult mockingbirds in the same neighborhoods. Nest success, as evaluated by daily nest survival rates, was higher in the lower lead neighborhood. Clutch sizes varied substantially across neighborhoods, but rates of unhatched eggs did not covary with neighborhood lead levels, suggesting that other drivers are influencing variation in clutch sizes and hatching success in urban habitats. At least one-third of nestling mockingbirds were sired by an extra-pair male, and there was no relationship between extra-pair paternity rates and neighborhood lead levels. This study provides insight on how lead contamination may influence reproduction in urban-dwelling wildlife and suggests that nestling birds could serve as useful bioindicators of lead levels in urban neighborhoods.

Authors: Lauren G. Hitt, Sarah Khalil, Annelise Blanchette, Myra E. Finkelstein, Erik N.K. Iverson, Stephanie C. McClelland, Renata Durães Ribeiro, Jordan Karubian

Source: (2023). Environmental Research, Volume 227, 115711, ISSN 0013-9351, <https://doi.org/10.1016/j.envres.2023.115711>

### Method for establishing soil contaminant discharge inventory: An arsenic-contaminated site case study

The existing method to survey site pollution is generally based on soil-groundwater sampling and instrumental analysis, which enables us to access the detailed soil pollution status while lacking quantitative association with industrial activities. It is urgent to understand contaminant discharge modes and establish a discharge inventory for achieving process-targeted pollution control. This

study took a 40-year phosphate fertilizer-sulfuric acid site as an example and constructed a contaminant tracing method based on on-site investigations and detailed industrial data. These investigations and data were combined to determine the characteristic pollutant of this site, arsenic. And the calculation process of four-pathway pollution modes (atmospheric deposition, wastewater, solid waste leaching, and storage dripping) is derived from the existing acceptance criteria and risk assessment guidelines. They are set to calculate the arsenic's factory-to-soil discharge flux. The absent process contaminant release information and parameters, such as discharge coefficient, were obtained from soil-groundwater pollution control standards and discharge handbooks. It was found that the high concentration of arsenic (around 1930 mg g<sup>-1</sup>) was preponderantly caused by sulfur-iron slag and tailing leaching (96.19%), while the other pathways accounted for only 0.13% (atmospheric deposition), 3.59% (wastewater) and 0.09% (storage tank). Results were verified by the measured arsenic concentration, and the difference was +16.29%, which was acceptable. Finally, a contaminant discharge inventory was established with high-resolution spatial distribution and time-scale (historical discharge) evolution. The innovation of this study lies in the preliminary construction of a method for formulating soil discharge inventory. This study would contribute to the refined management of site pollution and reduction of source contaminants discharge. In addition, it will help infer the pollution condition of sites that are difficult to sample so as to help the government achieve precise source control.

Authors: Weizhen Xue, Diwen Ying, Ye Li, Yi Sheng, Tianhao He, Peili Shi, Min Liu, Ling Zhao

Source: (2023). Environmental Research, Volume 227, 115700, ISSN 0013-9351, <https://doi.org/10.1016/j.envres.2023.115700>

### **Bioengineered microbial strains for detoxification of toxic environmental pollutants**

Industrialization and other anthropogenic human activities pose significant environmental risks. As a result of the hazardous pollution, numerous living organisms may suffer from undesirable diseases in their separate habitats. Bioremediation, which removes hazardous compounds from the environment using microbes or their biologically active metabolites, is one of the most successful remediation approaches. According to the United Nations Environment Program (UNEP), deteriorating soil health negatively impacts food security and human health over time. Soil health restoration is critical right now. Microbes are widely known for their importance in cleaning up toxins present in the soil, such as heavy metals,

pesticides, and hydrocarbons. However, the capacity of local bacteria to digest these pollutants is limited, and the process takes an extended time. Genetically modified organisms (GMOs), whose altered metabolic pathways promote the over-secretion of a variety of proteins favorable to the bioremediation process, can speed up the breakdown process. The need for remediation procedures, degrees of soil contamination, site circumstances, broad adoptions, and numerous possibilities occurring at various cleaning stages are all studied in detail. Massive efforts to restore contaminated soils have also resulted in severe issues. This review focuses on the enzymatic removal of hazardous pollutants from the environment, such as pesticides, heavy metals, dyes, and plastics. There are also in-depth assessments of present discoveries and future plans for efficient enzymatic degradation of hazardous pollutants.

Authors: Quratulain Maqsood, Aleena Sumrin, Rafia Waseem, Maria Hussain, Mehwish Imtiaz, Nazim Hussain

Source: (2023). Environmental Research, Volume 227, 115665, ISSN 0013-9351, <https://doi.org/10.1016/j.envres.2023.115665>

### **Sex-Specific Bioaccumulation, Maternal Transfer, and Tissue Distribution of Legacy and Emerging Per- and Polyfluoroalkyl Substances in Snakes (*Enhydryn chinensis*) and the Impact of Pregnancy**

The effects of sex and pregnancy on the bioaccumulation and tissue distribution of legacy and emerging per- and polyfluoroalkyl substances (PFASs) in Chinese water snakes were investigated. The bioaccumulation factor of PFASs showed a positive correlation with their protein-water partition coefficients (log KPW), and steric hindrance effects were observed when the molecular volume was > 357 Å<sup>3</sup>. PFAS levels in females were significantly lower than those in males. The chemical composition of pregnant females was significantly different from that of non-pregnant females and males. The maternal transfer efficiencies of perfluorooctane sulfonic acid were higher than those of other PFASs, and a positive correlation between the maternal transfer potential and log KPW was observed for other PFASs. Tissues with high phospholipid content exhibited higher concentrations of  $\Sigma$ PFASs. Numerous physiological changes occurred in maternal organ systems during pregnancy, leading to the re-distribution of chemicals among different tissues. The change in tissue distribution of PFASs that are easily and not-so-easily maternally transferred was in the opposite direction. The extent of compound

transfer from the liver to the egg determined tissue re-distribution during pregnancy.

Authors: Mei-Xia Ye, Xiao-Jun Luo, Yu Liu, Chu-Hong Zhu, Qun-Jie Feng, Yan-Hong Zeng, and Bi-Xian Mai

Source: (2023). *Environ. Sci. Technol*, 57, 11, 4481-4491, <https://doi.org/10.1021/acs.est.2c09063>

## EPIDEMIOLOGY AND BIostatISTICS

### Mapping Global Bushmeat Activities to Improve Zoonotic Spillover Surveillance by Using Geospatial Modeling

Human populations that hunt, butcher, and sell bushmeat (bushmeat activities) are at increased risk for zoonotic pathogen spillover. Despite associations with global epidemics of severe illnesses, such as Ebola and mpox, quantitative assessments of bushmeat activities are lacking. However, such assessments could help prioritize pandemic prevention and preparedness efforts. We used geospatial models that combined published data on bushmeat activities and ecologic and demographic drivers to map the distribution of bushmeat activities in rural regions globally. The resulting map had high predictive capacity for bushmeat activities (true skill statistic = 0.94). The model showed that mammal species richness and deforestation were principal drivers of the geographic distribution of bushmeat activities and that countries in West and Central Africa had the highest proportion of land area associated with bushmeat activities. These findings could help prioritize future surveillance of bushmeat activities and forecast emerging zoonoses at a global scale.

Authors: Soushieta Jagadesh, Cheng Zhao, Ranya Mulchandani, and Thomas P. Van Boeckel

Source: (2023). *Emerging Infectious Diseases*, 29(4), 742-750. <https://doi.org/10.3201/eid2904.221022>

### Bayesian latent-class modelling of quarantine testing procedures for American Bison (*Bison bison*) in the Greater Yellowstone Area to determine *Brucella abortus* freedom

American bison (*Bison bison*) quarantine protocols were established to prevent transmission of brucellosis outside the Greater Yellowstone Area, while allowing for distribution of wild bison for conservation and cultural purposes. Quarantine standards require rigorous testing over 900 days which has led to the release of over 200 bison to Native American tribes. Standards were evaluated using 15 years of laboratory and management

data to minimize the burden of testing and increase the number of brucellosis-free bison available for distribution.

All bison (n = 578) from Yellowstone National Park were corralled by the National Park Service and United States Department of Agriculture.

A statistical and management evaluation of the bison quarantine program was performed. Bayesian latent-class modeling was used to predict the probability of nondetection of a seroreactor at various time points, as well as the probability of seroconversion by days in quarantine.

At 300 days, 1 in 1,000 infected bison (0.0014 probability) would not be detected but could potentially seroconvert; the seroconversion model predicted 99.9% would seroconvert by day 294, and 12.8% of bison enrolled in quarantine would seroconvert over time. Using a 300-day quarantine period, it would take 30 years to potentially miss 1 seroreactor out of over 8,000 bison enrolled in the quarantine program.

Reducing the quarantine program requirements from over 900 days to 300 days would allow management of quarantined bison in coordination with seasonal movement of bison herds and triple the number of brucellosis-free bison available for distribution.

Authors: A. Springer Browne, Clayton Hallman, Rebecca Frey, Patrick R. Clarke, Christine R. Quance, Katie Portacci, Nicholas A. Ledesma, Burke Healey, and Chris Geremia

Source: (2023). *Journal of the American Veterinary Medical Association*, 261(4), 1-7. <https://doi.org/10.2460/javma.22.09.0424>

### Modelling parasite impacts of aquaculture on wild fish: The case of the salmon louse (*Lepeophtheirus salmonis*) on out-migrating wild Atlantic salmon (*Salmo salar*) smolt

For effective wild salmon (*Salmo salar*) conservation in areas where aquaculture of salmon is practiced it is necessary to identify where the key parasite, the salmon louse (*Lepeophtheirus salmonis*), will have an impact on these wild salmon. A simple modelling structure is implemented in a sample system in Scotland for assessing interaction between wild salmon and salmon lice from salmon farms. The model is demonstrated for case studies of smolt sizes and migration routes through salmon lice concentration fields derived for average farm loads from 2018 to 2020. Lice modelling describes production and distribution of lice, infection rates on hosts and biological development of lice. The modelling framework allows explicit assessment of the relationships between lice production, lice concentration and impact on hosts as they grow

and migrate. Lice distribution in the environment is determined using a kernel model, which summarises mixing in a complex hydrodynamic system. Smolt modelling describes their initial size, growth and migration pathways. This is illustrated for a set of parameter values applied to 10 cm, 12.5 cm and 15 cm salmon smolts. We found that salmon lice impact depends on initial size of host, smaller smolts will be more susceptible, while larger smolts are less impacted by a given number of lice encounters and migrate more rapidly. This modelling framework can be adapted to allow evaluation of threshold concentrations of lice in the water that should not be exceeded to avoid impacts on smolt populations.

Authors: Meadhbh Moriarty, Stephen C. Ives, Joanne M. Murphy, and Alexander G. Murray

Source: (2023). Preventive Veterinary Medicine, Volume 214, 105888, ISSN 0167-5877, <https://doi.org/10.1016/j.prevetmed.2023.105888>

### Relative contribution of essential and non-essential activities to SARS-CoV-2 transmission following the lifting of public health restrictions in England and Wales

We aimed to understand which non-household activities increased infection odds and contributed greatest to SARS-CoV-2 infections following the lifting of public health restrictions in England and Wales.

We undertook multivariable logistic regressions assessing the contribution to infections of activities reported by adult Virus Watch Community Cohort Study participants. We calculated adjusted weighted population attributable fractions (aPAF) estimating which activity contributed greatest to infections.

Among 11 413 participants (493 infections), infection was associated with: leaving home for work (aOR 1.35 (1.11-1.64), aPAF 17%), public transport (aOR 1.27 (1.04-1.57), aPAF 12%), shopping once (aOR 1.83 (1.36-2.45)) vs. more than three times a week, indoor leisure (aOR 1.24 (1.02-1.51), aPAF 10%) and indoor hospitality (aOR 1.21 (0.98-1.48), aPAF 7%). We found no association for outdoor hospitality (1.14 (0.94-1.39), aPAF 5%) or outdoor leisure (1.14 (0.82-1.59), aPAF 1%).

Essential activities (work and public transport) carried the greatest risk and were the dominant contributors to infections. Non-essential indoor activities (hospitality and leisure) increased risk but contributed less. Outdoor activities carried no statistical risk and contributed to fewer infections. As countries aim to 'live with COVID', mitigating transmission in essential and indoor venues becomes increasingly relevant.

Authors: Susan Hoskins, Sarah Beale, Vincent Nguyen, Yamina Boukari, Alexei Yavlinsky, Jana Kovar, Thomas Byrne, Ellen Fragaszy, Wing Lam Erica Fong, Cyril Geismar, Parth Patel, Annalan M. D. Navaratnam, Martie van Tongeren, Anne M. Johnson, Robert W. Aldridge, and Andrew Hayward

Source: (2022). Epidemiology & Infection, 151, E3. [doi:10.1017/S0950268822001832](https://doi.org/10.1017/S0950268822001832)

## FOOD SAFETY

### Warning labels as a policy tool to encourage healthier eating habits

Front-of-package (FOP) nutrition labeling policies based on warning labels have become increasingly popular, particularly in the region of the Americas. Nutritional warning labels aim at highlighting products with excessive content of nutrients associated with noncommunicable diseases. The aim of the present narrative review is to summarize the evidence about the effects of nutritional warning labels on consumer perception and behavior, both before and after policy implementation. The existing evidence suggests that this FOP nutrition labeling increases consumer ability to interpret nutritional information and discourages the choice of unhealthy products. Further research is needed to better understand the effect of warning label policies on food choices and long-term population health as well as product reformulation.

Authors: Gastón Ares, Lucía Antúnez, María R Curutchet, and Ana Giménez

Source: (2023). Current Opinion in Food Science, Volume 51, 2023, 101011, ISSN 2214-7993, <https://doi.org/10.1016/j.cofs.2023.101011>

### Challenges in the implementation of food safety and quality assurance systems in small-scale fisheries

Ninety percent of the world's fishers are directly involved in small-scale fisheries (SSFs), and many food safety and quality issues along the food value chains may be both irreversible and cumulative. Ensuring safe, high-quality aquatic products are key to sustaining life, promoting good health, and avoiding adverse health effects.

This paper aimed to highlight factors preventing the implementation of safety and quality assurance systems in SSFs by analysing the results from surveys on the implementation of Article 11 of the Food and Agriculture Organization of the United Nations (FAO) Code of Conduct for Responsible Fisheries (2017, 2019, and 2022).

The analysis considered responses to 15 closed-ended questions on food safety and quality obtained from 143 FAO Members and the European Union, and 87 open-ended replies addressing challenges in SSFs.

The major factors preventing the implementation of the Code's food safety and quality provisions were lack of sanitation and monitoring programmes, lack of infrastructure (particularly refrigeration facilities) lack of technical capacities and limited management of food safety risks along the value chains. Safety and quality assurance efforts were focused on international markets, resulting in less attention being paid to domestic markets where a high degree of informality was reported.

Improved implementation of safety and quality assurance systems will lead to safer food with higher nutritional quality, extended shelf-life and reduced post-harvest loss. Increased awareness of food safety issues in SSFs is a prerequisite for achieving several of the UN Sustainable Development Goals.

Authors: Esther Garrido Gamarro, Cecilie Smith Svanevik, Anne-Katrine Lundebye, Monica Sanden, Enrica D'Agostino, Marian Kjellevoid, Lauren Pincus, and Johannes Pucher

Source: (2023). Food Quality and Safety, Volume 7, 2023, fyad007, <https://doi.org/10.1093/fqsafe/fyad007>

### **Microbiological and physicochemical properties of farm bulk tank milk and antimicrobial resistance of its dominant bacteria**

This study determined the antibiotic resistance of the dominant bacteria in the 85 farm BTMs according to the guidelines recommended by the epidemiological cutoff values in the EUCAST. In addition, some physicochemical and microbiological properties of farm BTMs were investigated. The milk samples were divided into two groups according to their SCC values. The milk samples with higher SCC than 400,000 cells mL<sup>-1</sup> were further examined bacteriologically, and the antibiotic resistance of isolates was determined. The average TAMB value was 6.34 log CFU/mL in farm BTM. It was found that high-SCC values did not affect other physicochemical properties of BTM samples, such as fat, protein and total solids, except for lactose content. Seventy-two strains were isolated from 45 bulk milk samples. The most prevalent bacteria were *Enterococcus* spp. (23.61%). The other isolates were *Citrobacter* spp. (12.5%), *Staphylococcus* spp. (12.51%), *Serratia* spp. (11.12%), *Klebsiella* spp. (9.72%), *Bacillus* spp. (9.72%), and

*Enterobacter* spp. (8.33%). In antibiotic resistance analysis, 52.6% of Enterobacterales isolates showed cefoxitin resistance, and nine Enterobacterales isolates were determined as the presumptive ESBL producers. None of them was confirmed as ESBL producers. Moreover, MDR was detected in 83.3% of *Enterobacter* spp. isolates and all *Bacillus* spp. isolates. The over and inappropriate use of antibiotics in mastitis treatment may cause antibiotic-resistant microorganisms in milk. It was found that 52.7% of the isolated bacteria were MDR, which could pose a risk to public health and food safety, with the consumer's increasing interest in consuming raw milk.

Authors: Seda Ozdikmenli Tepeli, Murat Zorba, Musa Yalman, Ertuğrul Bilgucu, Nükhet Nilüfer Demirel Zorba

Source: (2022). Journal of Food Safety, 43( 1), e13022. <https://doi.org/10.1111/jfs.13022>

### **Crustaceans (shrimp, crab, and lobster): A comprehensive review of their potential health hazards and detection methods to assure their biosafety**

Crustaceans are popular seafood items worldwide owing to their rich nutritional value, unique tastes, and their incorporation in a variety of cuisines. There has been a great concern about the safety of crustaceans for human consumption being more prone to hazardous contaminants due to their exposure to diverse habitats and unhealthy farming and handling practices. These hazards can arise from chemical contaminants such as heavy metals, environmental pollutants, and biotoxins or biological sources, that is, pathogenic microbes and parasites. The different types of chemical contamination of crustaceans as well as biological hazards are reviewed as major part of this review. Although there are many reviews on contaminants in fisheries, nothing is traces to crustaceans. The current review compiles the food safety hazards of crustaceans arising from both chemical and biological origins and their impact on human health in farmed versus wild origins. The different methods of contaminants detection, viz. microbiological, molecular, and analytical methods, as well as control measures viz. cooking and processing methods that can be implemented to safeguard consumer safety are also reviewed. Future perspectives have been raised toward HACCP protocol implementation during handling, processing, and storage of crustaceans and posing real-time freshness monitoring tools such as intelligent packaging.

Authors Mohamed A. Farag, Somaia T. Mansour, Roua A. Nouh, and Amira R. Khattab

Source: (2022). Journal of Food Safety, 43( 1), e13026. <https://doi.org/10.1111/jfs.13026>

### Microbial diversity and community composition of fecal microbiota in dual-purpose and egg type ducks

**Introduction:** Ducks are important agricultural animals, which can be divided into egg and dual-purpose type ducks according to economic use. The gut microbiota of ducks plays an important role in their metabolism, immune regulation, and health maintenance.

**Methods:** Here, we use 16S rDNA V4 hypervariable amplicon sequencing to investigate the compositions and community structures of fecal microbiota between egg (five breeds, 96 individuals) and dual-purpose type ducks (four breeds, 73 individuals) that were reared under the same conditions.

**Results:** The alpha diversity of fecal microflora in egg type ducks was significantly higher than that in dual-type ducks. In contrast, there is no significant difference in the fecal microbial community richness between the two groups. MetaStat analysis showed that the abundance of Peptostreptococcaceae, Streptococcaceae, Lactobacillus, Romboutsia, and Campylobacter were significantly different between the two groups. The biomarkers associated with the egg and dual-purpose type ducks were identified using LEfSe analysis and IndVal index. Function prediction of the gut microbiota indicated significant differences between the two groups. The functions of environmental information processing, carbohydrate metabolism, lipid metabolism, xenobiotic biodegradation and metabolism, and metabolism of terpenoids and polyketides were more abundant in egg type ducks. Conversely, the genetic information processing, nucleotide metabolism, biosynthesis of amino acids and secondary metabolites, glycan biosynthesis and metabolism, fatty acid elongation, and insulin resistance were significantly enriched in dual-purpose type ducks.

**Discussion:** This study explored the structure and diversity of the gut microbiota of ducks from different economic-use groups, and provides a reference for improving duck performance by using related probiotics in production.

**Authors:** Jing Ouyang, Yuhang Li, Yongfei Wu, Hongbo Tang, Sumei Zheng, Yanpeng Xiong, Luping Wang, Cong Wang, Keyi Luo, Yuren Gao, Xueming Yan and Hao Chen

Source: (2023). Frontiers in Microbiology, 14, 1664-302X, <https://www.frontiersin.org/articles/10.3389/fmicb.2023.1092100>

## INFECTIOUS AND PARASITIC DISEASES

### Impact of Chronic Infection on Resistance and Tolerance to Secondary Infection in *Drosophila melanogaster*

Prior exposure to a pathogen can greatly influence the outcome of a secondary infection, and although invertebrates lack classically defined adaptive immunity, their immune response is still influenced by prior immune challenges. While the strength and specificity of such immune priming depends highly on the host organism and infecting microbe, chronic bacterial infection of the fruit fly *Drosophila melanogaster* with species isolated from wild-caught fruit flies provides broad nonspecific protection against a later secondary bacterial infection. To determine how chronic infection influences progression of secondary infection, we specifically tested how chronic infection with *Serratia marcescens* and *Enterococcus faecalis* impacted both resistance and tolerance to a secondary infection with an unrelated bacterium, *Providencia rettgeri*, by simultaneously tracking survival and bacterial load postinfection across a range of infectious doses. We found that these chronic infections increased both tolerance and resistance to *P. rettgeri*. Further investigation of *S. marcescens* chronic infection also revealed robust protection against the highly virulent *Providencia sneebia*, and that protection was dependent on the initial infectious dose for *S. marcescens* with protective doses corresponding with significantly increased dipterocin expression. While the increased expression of this antimicrobial peptide gene likely explains the increased resistance, increased tolerance is likely due to other alterations in organismal physiology, such as increased negative regulation of immunity or tolerance of ER stress. These findings provide a foundation for future studies on how chronic infection influences tolerance to secondary infection.

**Authors:** Abigail M. Wukitch, Madyline M. Lawrence, Francesco P. Satriale, Alexa Patel, Grace M. Ginder, Emily J. Van Beek, Owais Gilani, Moria C. Chambers

Source: (2023). Infection and Immunity, e00360-22, 91, 3, doi:10.1128/iai.00360-22, <https://journals.asm.org/doi/abs/10.1128/iai.00360-22>

### Potential medicinal plants to combat viral infections: A way forward to environmental biotechnology

The viral diseases encouraged scientific community to evaluate the natural antiviral bioactive components rather than protease inhibitors, harmful organic molecules or nucleic acid analogues. For this purpose, medicinal plants have been gaining tremendous importance in the field of attenuating the various kinds of infectious and non-infectious diseases. Most of the commonly used medicines contains the bioactive components/phytoconstituents that are generally extracted from medicinal plants. Moreover, the medicinal plants offer many advantages for the recovery applications of infectious disease especially in viral infections including HIV-1, HIV-2, Enterovirus, Japanese Encephalitis Virus, Hepatitis B virus, Herpes Virus, Respiratory syncytial virus, Chandipura virus and Influenza A/H1N1. Considering the lack of acceptable drug candidates and the growing antimicrobial resistance to existing drug molecules for many emerging viral diseases, medicinal plants may offer best platform to develop sustainable/efficient/economic alternatives against viral infections. In this regard, for exploring and analyzing large volume of scientific data, bibliometric analysis was done using VOS Viewer shedding light on the emerging areas in the field of medicinal plants and their antiviral activity. This review covers most of the plant species that have some novel bioactive compound like gnidicin, gniditrin, rutin, apigenin, quercetin, kaempferol, curcumin, tannin and oleuropin which showed high efficacy to inhibit the several disease causing virus and their mechanism of action in HIV, Covid-19, HBV and RSV were discussed. Moreover, it also delves the in-depth mechanism of medicinal with challenges and future prospective. Therefore, this work delves the key role of environment in the biological field.

Authors: Rhydum Sharma, Monika Bhattu, Ashutosh Tripathi, Meenakshi Verma, Roberto Acevedo, Pradeep Kumar, Vishnu D. Rajput, Jagpreet Singh

Source: (2023). Environmental Research, Volume 227, 115725, ISSN 0013-9351, <https://doi.org/10.1016/j.envres.2023.115725>

### **A one-health review on brucellosis in the United States**

Brucellosis is a highly infectious zoonotic disease of global significance due to its adverse impact on public health, economics, and trade. Despite being one of the most prevalent zoonoses worldwide, attention given to global brucellosis control and prevention has been inadequate. *Brucella* species of greatest one-health relevance in the US include those infecting dogs (*Brucella canis*), swine (*Brucella suis*), and cattle and

domestic bison (*Brucella abortus*). Although not endemic in the US, *Brucella melitensis* warrants awareness as it poses a risk to international travelers. While brucellosis has been eradicated from domestic livestock in the US, its detection in US companion animals (*B canis*) and US wildlife reservoirs (*B suis* and *B abortus*) and enzootic presence internationally pose a threat to human and animal health, warranting its spotlight on the one-health stage. The challenges of *B canis* diagnosis in humans and dogs is addressed in more detail in the companion Currents in One Health by Guarino et al, AJVR, April 2023. Human consumption of unpasteurized dairy products and occupational exposure of laboratory diagnosticians, veterinarians, and animal care providers are responsible for human exposures reported to the US CDC. Diagnosis and treatment of brucellosis is challenging due to the limitations of diagnostic assays and the tendency of *Brucella* spp to produce nonspecific, insidious clinical signs and evade antimicrobial therapy, making prevention essential. This review will focus on zoonotic considerations for *Brucella* spp found within the US along with their epidemiology, pathophysiology, clinical presentation, treatment, and control strategies.

Authors: Toby Pinn-Woodcock, Elisha Frye, Cassandra Guarino, Rebecca Franklin-Guild, Alexandra P. Newman, Joy Bennett, and Erin L. Goodrich

Source: (2023). Journal of the American Veterinary Medical Association, 261(4), 451-462. <https://doi.org/10.2460/javma.23.01.0033>

### ***Onchocerca* sp. in an imported Zangersheide gelding causing suspensory ligament desmitis**

A 5-year-old imported Zangersheide gelding was evaluated for SC swellings over both forelimbs and lameness localized to the distal metacarpus. Ultrasound examination of the SC masses was compatible with verminous granulomas. Linear hyperechoic foci were present within the suspensory ligament branches of both forelimbs, suggestive of ligamentous parasitic infiltrates. A diagnosis of onchocerciasis was confirmed on biopsy of a SC mass. The gelding was treated with ivermectin and a tapering course of PO dexamethasone but was eventually euthanized. Necropsy confirmed the presence of SC eosinophilic granulomas and degenerative suspensory ligament desmitis, both with intraligamentous nematodes. Given the location and appearance of the nematode, a diagnosis of *Onchocerca* sp., most likely *O. reticulata*, was made. Onchocerciasis should be included as a differential diagnosis for multifocal suspensory ligament desmitis with these sonographic

characteristics when paired with SC masses in imported European Warmbloods.

Authors: Kara A. Brown, Amy L. Johnson, Susan J. Bender, Thomas J. Nolan, Bianca Pfisterer, JoAnn Slack, Elinor Willis, Emily K. Rule

Source: (2023). *J Vet Intern Med.* 2023; 37( 2): 735- 739. [doi:10.1111/jvim.1665](https://doi.org/10.1111/jvim.1665)

### **Inferring the disruption of rabies circulation in vampire bat populations using a betaherpesvirus-vectored transmissible vaccine**

Transmissible vaccines are an emerging biotechnology that hold prospects to eliminate pathogens from wildlife populations. Such vaccines would genetically modify naturally occurring, nonpathogenic viruses (“viral vectors”) to express pathogen antigens while retaining their capacity to transmit. The epidemiology of candidate viral vectors within the target wildlife population has been notoriously challenging to resolve but underpins the selection of effective vectors prior to major investments in vaccine development. Here, we used spatiotemporally replicated deep sequencing to parameterize competing epidemiological mechanistic models of *Desmodus rotundus* betaherpesvirus (DrBHV), a proposed vector for a transmissible vaccine targeting vampire bat-transmitted rabies. Using 36 strain- and location-specific time series of prevalence collected over 6 y, we found that lifelong infections with cycles of latency and reactivation, combined with a high  $R_0$  (6.9; CI: 4.39 to 7.85), are necessary to explain patterns of DrBHV infection observed in wild bats. These epidemiological properties suggest that DrBHV may be suited to vector a lifelong, self-boosting, and transmissible vaccine. Simulations showed that inoculating a single bat with a DrBHV-vectored rabies vaccine could immunize >80% of a bat population, reducing the size, frequency, and duration of rabies outbreaks by 50 to 95%. Gradual loss of infectious vaccine from vaccinated individuals is expected but can be countered by inoculating larger but practically achievable proportions of bat populations. Parameterizing epidemiological models using accessible genomic data brings transmissible vaccines one step closer to implementation.

Authors: Megan E. Griffiths, Diana K. Meza, Daniel T. Haydon, and Daniel G. Streicker

Source: (2023). *Proceedings of the National Academy of Sciences*, e2216667120, 120(11), <https://doi.org/10.1073/pnas.2216667120>

## **PUBLIC HEALTH TOPICS**

### **Judicial Review of Public Health Powers Since the Start of the COVID-19 Pandemic: Trends and Implications**

During the COVID-19 pandemic, officials in the United States at all levels of government utilized their legal authorities to impose a wide range of measures designed to control the spread of SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2; the causative agent of COVID-19), including shutting down businesses, limiting the size of gatherings, requiring masking, and mandating vaccination.

These orders and regulations were challenged in court cases that resulted in more than 1000 judicial decisions. Common claims were based on alleged procedural and substantive due process violations, violations of religious liberty, and violations of officials’ scope of authority. In more than three fourths of the decisions, the court refused to grant the plaintiffs the relief sought. However, plaintiffs found success in several notable cases, especially in federal court. These recent decisions, as well as broader prepandemic trends, have important implications for public health officials’ exercise of their public health powers, especially when those exercises implicate religious liberty. In this legal environment, officials may need to rely more on the powers of persuasion than on their legal authority alone. (*Am J Public Health.* 2023;113(3):280-287.

<https://doi.org/10.2105/10.2105/AJPH.2022.307181>)

Since March 2020, officials at all levels of government (federal, state, and local) have utilized their legal authorities to issue a wide range of orders and regulations designed to slow the transmission of SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2; the causative agent of COVID-19). In response, individuals and entities around the country filed legal challenges. Courts have issued more than 1000 decisions in these cases.<sup>1</sup>

In more than three fourths of the more than 1000 decisions that we have collected, the court refused to give the plaintiff the relief sought. Nevertheless, some courts, including the US Supreme Court, have granted health officials less deference than they have traditionally received, especially in cases involving religious liberty or scope of authority.<sup>2</sup> This presents significant challenges to officials’ ability to prevent and respond to future health threats. In the discussion that follows, we offer an overview of the decisions we have compiled, describe the courts’ approaches to these claims, and consider the implications of these decisions for public health practice.



Authors: Wendy E. Parmet JD, and Faith Khalik JD

Source: (2023). American Journal of Public Health 113, 280\_287, <https://doi.org/10.2105/AJPH.2022.307181>

### **Identifying COVID-19 Vaccine Deserts and Ways to Reduce Them: A Digital Tool to Support Public Health Decision-Making**

A private-academic partnership built the Vaccine Equity Planner (VEP) to help decision-makers improve geographic access to COVID-19 vaccinations across the United States by identifying vaccine deserts and facilities that could fill those deserts. The VEP presented complex, updated data in an intuitive form during a rapidly changing pandemic situation. The persistence of vaccine deserts in every state as COVID-19 booster recommendations develop suggests that vaccine delivery can be improved. Underresourced public health systems benefit from tools providing real-time, accurate, actionable data. (Am J Public Health. 2023;113(4):363-367. <https://doi.org/10.2105/AJPH.2022.307198>)

Public health leaders can make better, more equitable decisions when they can clearly see and understand the problems. Being presented with potential solutions based on evidence further supports their decision-making and can aid in supporting health equity.

Authors: Rebecca L. Weintraub, Kate Miller, Benjamin Rader, Julie Rosenberg, Shreyas Srinath, Samuel R. Woodbury, Marinanicole D. Schultheiss, Mansi Kansal, Swapnil Vispute, Stylianos Serghiou, Gerardo Flores, Akim Kumok, Tomer Shekel, Evgeniy Gabilovich, Iman Ahmad, Molly E. Chiang, and John S. Brownstein

Source: (2023). American Journal of Public Health 113, 363\_367, <https://doi.org/10.2105/AJPH.2022.307198>

### **An analysis of existing national action plans for antimicrobial resistance—gaps and opportunities in strategies optimising antibiotic use in human populations**

At the 2015 World Health Assembly, UN member states adopted a resolution that committed to the development of national action plans (NAPs) for antimicrobial resistance (AMR). The political determination to commit to NAPs and the availability of robust governance structures to assure sustainable translation of the identified NAP objectives from policy to practice remain major barriers to progress. Inter-country variability in economic and political resilience and resource

constraints could be fundamental barriers to progressing AMR NAPs. Although there have been regional and global analyses of NAPs from a One Health and policy perspective, a global assessment of the NAP objectives targeting antimicrobial use in human populations is needed. In this Health Policy, we report a systematic evidence synthesis of existing NAPs that are aimed at tackling AMR in human populations. We find marked gaps and variability in maturity of NAP development and operationalisation across the domains of: (1) policy and strategic planning; (2) medicines management and prescribing systems; (3) technology for optimised antimicrobial prescribing; (4) context, culture, and behaviours; (5) operational delivery and monitoring; and (6) patient and public engagement and involvement. The gaps identified in these domains highlight opportunities to facilitate sustainable delivery and operationalisation of NAPs. The findings from this analysis can be used at country, regional, and global levels to identify AMR-related priorities that are relevant to infrastructure needs and contexts.

Authors: Esmita Charani, Prof Marc Mendelson, Scott J C Pallett, Raheelah Ahmad, Mirfin Mpundu, Oluchi Mbamalu, Candice Bonaconsa, Vrinda Nampoothiri, Sanjeev Singh, Nathan Peiffer-Smadja, Vanesa Anton-Vazquez, Luke S P Moore, Jeroen Schouten, Tomislav Kostyanec, Vera Vlahović-Palčevski, Diamantis Kofteridis, Juliana Silva Corrêa, and Alison H Holmes

Source: (2023). Lancet Glob Health; 11: e466-74, [https://doi.org/10.1016/S2214-109X\(23\)00019-0](https://doi.org/10.1016/S2214-109X(23)00019-0)

### **Co-created community contracts support biosecurity changes in a region where African swine fever is endemic - Part II: Implementation of biosecurity measures**

Smallholder subsistence pig production is common in Uganda and African swine fever (ASF) is endemic in the country, with its spread driven by human activities along the smallholder value chain. Previous research in the study area has revealed that many stakeholders are aware of how ASF is spread, its prevention and control, and have a generally positive attitude towards biosecurity. Despite this, even basic biosecurity is largely lacking. Costs, as well as a lack of adaptation to the local context, culture and traditions have been identified as factors hindering biosecurity implementation. Community engagement and local ownership of disease problems are increasingly recognised as important for improving disease prevention and control. The objective of this study was to investigate the capacity of participatory action at community level with broad inclusion of stakeholders to improve biosecurity in the smallholder pig value chain.

Specific attention was paid to participants' perceptions and experiences of implementing the biosecurity measures included in their co-created community contracts. The study was conducted in Northern Uganda in villages purposively selected on the basis of previous occurrences of ASF. In each village, farmers and traders were also purposively selected. At a first meeting, basic information about ASF was shared and participants presented with a list of biosecurity measures adapted for farmers and traders respectively. Participants discussed each measure in farmer and trader subgroups, decided on the measures to implement for one year, and signed a community contract to this effect. The following year, interviews were again undertaken and implementation support given. Interview data were coded and thematically analysed. Each subgroup chose a minimum of three and a maximum of nine measures, with wide variations between villages in their selection of measures. At the follow-ups, none of the subgroups had fully implemented what had been agreed in their contract, but all had changed some of their biosecurity routines. Some frequently recommended biosecurity measures, such as not borrowing breeding boars, were not considered feasible. Relatively simple and cheap biosecurity measures were rejected for reasons of cost, highlighting the participants' general level of poverty and the relevance of poverty as a specific factor governing disease control results. The participatory methodology allowing for discussions, co-creation and the option to refuse measures seemed to facilitate the implementation of measures that had initially been thought to be controversial. The broad community approach was deemed to be positive for strengthening community identity, cooperation and implementation.

Authors: Erika Chenais, Klara Fischer, Tonny Aliro, Karl Ståhl, and Susanna Sternberg Lewerin

Source: (2023). Preventive Veterinary Medicine, Volume 214, 2023, 105902, ISSN 0167-5877, <https://doi.org/10.1016/j.prevetmed.2023.105902>

### Impacts Over Time of Neighborhood-Scale Interventions to Control Ticks and Tick-Borne Disease Incidence

Background: Controlling populations of ticks with biological or chemical acaricides is often advocated as a means of reducing human exposure to tick-borne diseases. Reducing tick abundance is expected to decrease immediate risk of tick encounters and disrupt pathogen transmission cycles, potentially reducing future exposure risk.

Materials and Methods: We designed a placebo-controlled, randomized multiyear study to assess whether two methods of controlling ticks—tick

control system (TCS) bait boxes and Met52 spray—reduced tick abundance, tick encounters with people and outdoor pets, and reported cases of tick-borne diseases. The study was conducted in 24 residential neighborhoods in a Lyme disease endemic zone in New York State. We tested the hypotheses that TCS bait boxes and Met52, alone or together, would be associated with increasing reductions in tick abundance, tick encounters, and cases of tick-borne disease over the 4-5 years of the study.

Results: In neighborhoods with active TCS bait boxes, populations of blacklegged ticks (*Ixodes scapularis*) were not reduced over time in any of the three habitat types tested (forest, lawn, shrub/garden). There was no significant effect of Met52 on tick abundance overall, and there was no evidence for a compounding effect over time. Similarly, we observed no significant effect of either of the two tick control methods, used singly or together, on tick encounters or on reported cases of tick-borne diseases in humans overall, and there was no compounding effect over time. Thus, our hypothesis that effects of interventions would accumulate through time was not supported.

Conclusions: The apparent inability of the selected tick control methods to reduce risk and incidence of tick-borne diseases after years of use requires further consideration.

Authors: Richard S. Ostfeld, Stacy Mowry, William Bremer, Shannon Duerr, Andrew S. Evans Jr., Ilya R. Fischhoff, Alison F. Hinckley, Sarah A. Hook, Fiona Keating, Jennifer Pendleton, Ashley Pfister, Marissa Teator, and Felicia Keesing  
Source: (2023). Vector-Borne and Zoonotic Diseases 2023 23:3, 89-105, <https://doi.org/10.1089/vbz.2022.0094>