EXPERT

REPORT OF

KEEVE EDWARD NACHMAN, PHD

Community Association for Restoration of the Environment, Inc., Friends of Toppenish Creek, and Center for Food Safety, Inc.,

v.

Austin Jack DeCoster, DeCoster Enterprises, LLC, Agricultural Investment-Fund II, LLC, Idaho Agri Investments, LLC, Idaho Dairy Holdings, LLC, Dry Creek Dairies, LLC, Washington Agri Investments, LLC, Washington Dairy Holdings, LLC, DBD Washington, LLC, and SMD, LLC.

(E.D. Wash. No. 1:19-CV-3110-TOR)

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INTRODUCTION

1. I have been retained by the Plaintiffs, Community Association for Restoration of the Environment ("CARE"), Friends of Toppenish Creek ("Friends"), and Center for Food Safety ("CFS") (collectively, "Plaintiffs"), to evaluate facts and science and to render opinions on health risks associated with the Defendants', Austin Jack DeCoster, DeCoster Enterprises, LLC, Agricultural Investment-Fund II, LLC, Idaho Agri Investments, LLC, Idaho Dairy Holdings, LLC, Dry Creek Dairies, LLC, Washington Agri Investments, LLC, Washington Dairy Holdings, LLC, DBD Washington, LLC, and SMD, LLC.'s (hereinafter "Defendants"), manure management practices in the Lower Yakima Valley. My opinions focus primarily on the health impacts and risks associated with exposure to nitrates, pathogens, and zoonotic diseases primarily from drinking water, but also through other potential pathways, by the Defendants.

2. My review of the information made available to me confirms that the environment, and the residents of the Lower Yakima Valley, are exposed to significant risks to their health and well-being resulting from manure loading and nitrate contamination of groundwater used as the source of drinking water. The maximum contaminant level ("MCL") for nitrate in drinking water established by the U.S. Environmental Protection Agency

("EPA") is 10 milligrams per liter ("mg/L"), also calculated as parts per million or "ppm", while the MCL for nitrite is 1 mg/L, owing to the greater toxicity of nitrite. Health effects in the human population have been documented at exposure levels below 10 mg/L, suggesting that the EPA MCL may need to be lowered. The Defendants' contributions to groundwater contamination pose significant health threats to the human population coming in contact with the contaminated water. Other related threats to health from contaminated surface water and air exposure from the dairies also exist, but my work has not specifically evaluated them. Nonetheless, these additional exposures present additional health concerns.

3. My curriculum vitae is attached as Exhibit A. I was recently appointed the Robert S. Lawrence Associate Professor of Environmental Health and Engineering (primary) and Health Policy and Management (joint) at the Johns Hopkins Bloomberg School of Public Health. I was also recently appointed to the position Associate Director of the Johns Hopkins Center for a Livable Future (CLF). Prior to that, I was the the Food Production and Public Health Program Director and Science Director for Food Production, Health and Environment for the Center.

4. I received my Bachelor of Arts from Johns Hopkins University in 1999, my Master of Health Sciences in Environmental Health Sciences with

specialization in Radiation Health Sciences and Medical Physics from the Johns Hopkins Bloomberg School of Public Health in 2001, and my Doctor of Philosophy in Health Policy and Management with specialization in Environmental and Occupational Health Policy from the Johns Hopkins Bloomberg School of Public Health in 2006.

5. From 2006 to 2008, I was a Postdoctoral Fellow with the U.S. Environmental Protection Agency, Office of Policy, Economics and Innovation, National Center for Environmental Economics. From 2008 to 2009, I was a Toxicologist/Risk Assessor for the United States Army Corps of Engineers. In 2010, I joined the Johns Hopkins Bloomberg School of Public Health as an Assistant Scientist in the Departments of Environmental Health Sciences and Health Policy and Management and remained in that role until 2014, when I became an Assistant Professor in the Departments of Environmental Health and Engineering (primary) and Health Policy and Management (joint). I have been an Associate Professor since 2020, during which time I taught classes in risk assessment and food systems.

6. I have received funding from, among others, the United States Department of Agriculture, the National Institutes of Health, the EPA, and a number of foundations. One of my grants, from the EPA, is for developing a flexible framework for the prioritization of

processed sewage sludge (biosolids)-associated organic contaminants; another from the Tiny Beam Fund is for using the Kim Diet-Climate-Nutrition model to assess the value of varying dietary interventions on the use of antimicrobials in food production in low- and middle-income countries.

7. I have authored or co-authored eighty articles in peer-reviewed journals. I have delivered more than 150 presentations at scientific meetings or seminars, including for the Maryland General Assembly, House Committee on Health and Governmental Affairs, Subcommittee on Public Health; the American Public Health Association Annual Meeting; and the Columbia University Mailman School of Public Health. My work has been highlighted by national television, radio, print and internet media outlets, including ABC, CNN, CBS Radio, Comedy Central, NPR, the New York Times, the Washington Post, USA Today, the Guardian, the Baltimore Sun, and the San Francisco Chronicle. My research has twice been covered/parodied on the Colbert Report with Stephen Colbert, illustrating its spread into the public consciousness.

8. I have significant experience in the field of public health risks related to industrial farm animal food production methods such as those used in the Defendants' operation. Some of my experiences, as well as

others conducted by my colleagues at the CLF, most salient to this matter are described below.

a. The CLF is an inter-disciplinary group of faculty and staff that focuses attention on equity, health, and stewardship of the Earth's resources. Its mission is to "promote research and to develop and communicate information about the complex interrelationships among diet, food production, environment, and public health; to advance an ecological perspective in reducing threats to the health of the public, and to promote policies that protect health, the global environment and the ability to sustain life for future generations." Through research, education, policy development, and advocacy, CLF examines the relationships among diet, food production systems, the environment, and human health. Through CLF, I have focused my academic work on the problems of food systems, food security, and the threats to the environment and to public health posed by industrial food animal production. CLF conducts, supervises, and funds research on such topics as the emergence of antibiotic resistant bacteria as a consequence of the routine use of antibiotics in animal feed or water for non-therapeutic purposes; the contamination of air, water, and soil by bacteria, protozoan parasites, viruses, organic wastes such as ammonia and other nitrogen

compounds, the composition of feed used in industrial food animal production, the adverse effects of excess nutrients such as nitrogen and phosphorus from wastes produced by animals raised in confinement operations, the contamination of the environment and food products with arsenic as a consequence of the regular use of Roxarsone and other organic arsenic containing coccidiostats, used as growth promoters (a practice that was terminated in part as a result of research I published), and the impact of industrial dairy production on air and water quality. I have co-authored policy papers describing the harmful effects of the industrialization of agriculture and concentrated animal feeding operations ("CAFOs") on the ecosystem, the safety and quality of the food supply, and the degradation of air, water, and soils by excess concentrations of animal waste from dairy, beef cattle, swine, and poultry concentrated feeding operations, and the human health risks from air pollution with animal dander, dried manure fomites, endotoxins, ammonia, and hydrogen sulfide generated by CAFOs.

b. In 2005, the Pew Charitable Trusts provided grant support to the Johns Hopkins Bloomberg School of Public Health to establish the Pew Commission on Industrial Farm Animal Production. Several colleagues and faculty members of the CLF contributed background

technical reports to the Commission. The final report of the Commission was released on April 29, 2008, with the summary conclusion that the current industrial food animal production system poses unacceptable risks to the health of the public, the environment, rural communities, and the welfare of animals themselves. The final report made 23 specific recommendations to curb risks to public health and the environment. These recommendations were categorized into four areas: public health, environment, animal welfare, and community impacts. Some of these recommendations pertain to the type of manure management practices used at the Defendants' facilities.[1]

c. In Fall 2013, I led a CLF-authored follow-up analysis to the Pew Commission's 2008 investigation, "Industrial Food Animal Production in America: Examining the Impact of the Pew Commission's Priority Recommendations."[2] The 2013 Analysis provided specific recommendations to begin implementing the

[1] *See, e.g.,* Recommendations: Public Health # 4(c) (monitor farm soil and water for antimicrobial resistant organisms); Environment # 1 (improve enforcement), # 2 (implement new farm waste management systems within 10 years to protect public health and the environment), # 3 (increase and improve waste management monitoring), # 4 (increase research funding for improving waste management systems); Animal Welfare # 4 (better welfare practices will decrease threat waste management poses to public health); Community Impacts # 1 (better evaluation of site suitability for industrial animal facilities, including better evaluation of lagoon and land application suitability). Pew Charitable Trusts and Johns Hopkins School of Public Health, "Putting Meat on the Table: Industrial Farm Animal Production In the United States." (2008) (hereinafter "Pew Commission Report").

[2] Center for a Livable Future, "Industrial Food Animal Production in America: Examining the Impact of the Pew Commission's Priority Recommendations." (Oct. 22, 2013) (hereinafter "CLF Analysis").

recommendations made in 2008. In 2013, CLF recommended phasing out and banning non-therapeutic antimicrobials, improving disease monitoring and tracking, improving environmental regulation, and phasing out intensive confinement, among other recommendations.

d. Johns Hopkins and CLF researchers have also studied harmful air contaminants from dairies in the Lower Yakima Valley. In 2011, D'Ann L. Williams and colleagues published a scientific study examining the impacts of large-scale dairy operations on nearby communities by assessing particulate matter, ammonia, and cow allergen inside and outside homes in the Yakima Valley.[3]

9. All opinions expressed herein are to a reasonable degree of scientific certainty, unless otherwise specifically stated. I reserve the right to modify or supplement this report based on information obtained by me or the Plaintiffs after the date of this report.

10. My qualifications, including publications I have authored, may be found in Exhibit A to this report. I have not testified as an expert at depositions or at trial in the last four years. My fees for working on this project are $200 per hour, including travel time, plus travel and office-related

[3] *Williams*, D. et al. "Airborne cow allergen, ammonia and particulate matter at homes vary with distance to industrial scale dairy operations: an exposure assessment." *Environ. Health*. Vol. 10:72 (2011).

expenses. Deposition and trial time is billed at $250 per hour.

SUMMARY

11. Based on the materials I have reviewed in connection with this matter, in my opinion it is clear that the Defendants' manure management practices not only cause, but are, and have been, causing an imminent and substantial endangerment to human health or the environment, and that to protect public health, actions must be immediately implemented to curb the amount of contaminants reaching groundwater and remediate the contamination caused by Defendants' practices. The amounts of manure generated by the Defendants, the Defendants' lack of protective measures for environmental and health concerns, and the high levels of nitrate contamination in water samples at the facility all indicate that the Defendants' contributions to groundwater contamination pose significant health threats to the human population that comes in contact with the contaminated water. Related health threats through contact with contaminated surface water and air exposure from the dairies also exist but have not been evaluated in detail as part of my work. Nonetheless, these exposures present additional health concerns.

BASES AND METHODOLOGY

12. I reviewed a number of documents, data, samples, and studies in analyzing this case and developing my opinion. My analyses and

opinions are based on my experience as a researcher and my years of experience studying industrial food animal production facilities.

13. I reviewed Annual Reports submitted by Defendants for the DBD and SMD dairies, identified with the following Bates Nos.:

a. 2018 DBD Revised, DAIRIES-00018575

b. 2019 SMD, DAIRIES-00012512, as well as DAIRIES-00000607

c. 2019 DBD, DAIRIES-00012536

d. 2020 SMD, DAIRIES-00016540

e. 2020 DBD, DAIRIES-00016481

f. 2021 SMD – No Bates

g. 2021 DBD – No Bates

h. 2022 SMD – No Bates

i. 2022 DBD – No Bates

14. I reviewed data collected in connection with two investigations into the groundwater nitrate concentrations at the DBD facility. First, Water and Environmental Technologies, Inc. (WET) conducted a Rule 34 investigation on behalf of the Law Offices of Charles M. Tebbutt, P.C. between May 19 and May 21, 2021, where it collected groundwater samples from borings; second, Farallon Consulting, L.L.C. ("Farallon") conducted an investigation on June 29, 2021, from samples of ten monitoring wells at DBD.

15. I reviewed a wide array of publicly-available records from federal and

state agencies, and their subagencies and departments, which can be summarized as including records from the U.S. Environmental Protection Agency ("EPA"), U.S. Department of Health and Human Services ("HHS"), Washington State Departments of Ecology, Agriculture, and Health, and the Yakima County Department of Health.[4]

16. I reviewed studies on nitrates in groundwater in the region, including the Valley Institute for Research and Education study and the Heritage College Study.

17. I reviewed peer-reviewed scientific and policy publications related to: (1) industrial food animal manure production and management; (2) the predominance of contaminants[9] in groundwater, surface water, and soils near industrial food animal production facilities; (3) potential and actual health impacts of contaminants in groundwater, surface water, and soil; and (4) methods to curb or eliminate contaminants in groundwater, surface water, and soil so as to minimize or eliminate the risks to human health.

[4] For example, U.S. EPA, "Relation Between Nitrate in Water Wells and Potential Sources in the Lower Yakima Valley, Washington" (EPA-910-R-13-004) (March 2013) (hereinafter "EPA Study"); EPA "Monitoring Well Installation & Data Summary Report Lower Yakima Valley, Yakima Co., Washington" (Mar. 2013); EPA "Case studies on the impact of CAFOs on Ground Water Quality" (Sept. 2012); USGS "River-Aquifer Exchanges in the Yakima River Basin, Washington" (2011); EPA regulatory and policy documents regarding the MCL for nitrate; U.S. Census Bureau data; U.S. Food & Drug Administration National Antimicrobial Resistance Monitoring System reports (1998 and 1999); various U.S. Department of Health & Human Services, Centers for Disease Control and Prevention reports on nitrates, methemoglobinemia, spontaneous abortions, neural tube defects, and E. coli; Washington Department of Ecology reports on the Sumas-Blaine Aquifer (2012); Washington Department of Health reports "Well Water Quality and Infant Health Study" (2009) and "Nitrate Contamination of Drinking Water in Washington State" (2000); and Yakima County Nitrate Treatment Pilot Program and Final Report (June 30, 2011).

18. I reviewed documents created in connection with the Clean Drinking Water Project.

19. I reviewed portions (pp. 70-77) of the deposition testimony of Karina Chavarin.

20. I reviewed the expert report of Robert S. Lawrence, M.D., in the case of *Community Association for Restoration of the Environment, Inc., and Center for Food Safety, Inc., v. Cow Palace, LLC*, E.D. Wash. No. CV-13-3016-TOR (the "Lawrence Report"). I have adopted and updated significant parts of the Lawrence Report herein. I have worked and taught classes with Dr. Lawrence at Johns Hopkins University.

BACKGROUND

21. CAFOS AND PUBLIC HEALTH IMPACTS, GENERALLY & BRIEFLY

a. Animals raised in confinement produce large amounts of animal waste concentrated in a small area, contributing chemical hazards and pathogens to air, water, and soil; and increasing the risk of infectious diseases, food-borne infection and other adverse health outcomes associated with chemical contaminant exposures. To store CAFO manure, millions of gallons of liquid waste are commonly stored in open cesspits or "lagoons," while solid waste is often stored in piles at the facilities. In contrast with pasture-raised animals whose waste is

spread over vegetation and incorporated with the organic matter in soil, CAFOs create and accumulate manure far beyond what can be absorbed and used by the crops.

b. The impacts of surface water contamination from manure escaping the confines of industrial animal farms are well documented. This contamination has caused numerous bacterial outbreaks, some of which have sickened hundreds of people and killed others.[10] Groundwater contamination from manure is increasingly well-recognized as a health and ecosystem problem. As animal waste decomposes, it creates ammonia, nitrite, and nitrate. Nitrates and nitrites are hazardous to human health, especially to infants, the most vulnerable members of the human community. Nitrates and nitrites interact with organic material commonly found in polluted water to produce carcinogenic nitrosamines. These kinds of water contamination spread well beyond the boundaries of a facility, putting the health of the public at risk.[5]

22. THE DIFFERENT FORMS OF NITRATE AND HOW THEY INTERACT WITH THE HUMAN BODY

a. Understanding the environmental fate of nitrate and nitrite can help pinpoint potential sources of exposure and is important to

[5] Pew Commission Report at 11.

assess patient exposure, risk, prevention, and mitigation, and adverse health effects from exposure.[6] Nitrogen is a chemical element that can exist in different forms when linked to other elements. For purposes of this report, I considered the health impacts of nitrate (NO3), nitrite (NO2), and ammonium (NH4). Nitrate and nitrite exist in organic and inorganic forms. Most organic forms of nitrate and nitrite ingested by humans are synthesized medicinal products and are usually small hydrocarbon chains attached to a nitro-oxy-radical (-ONO2). Additional ingestion occurs when microbial action in soil or water decomposes wastes containing organic nitrogen into ammonium, which is then oxidized to inorganic nitrite and nitrate.[7] Nitrite is easily oxidized to nitrate, which is the compound predominantly found in groundwater and surface water.[8] Most consumption of nitrate through water is likely to occur by consuming drinking water, cooking with water, and other food and drink preparation activities. Cooking does not eliminate nitrate levels in water.[9] As water boils and converts liquid to water vapor, the concentration

[6] U.S. Department of Health & Human Services, Agency for Toxic Substances and Disease Registry, *ATSDR Case Studies in Environmental Medicine Nitrate/Nitrite Toxicity* at 23 (Dec. 5, 2013) (hereinafter "ATSDR").
[7] *See, e.g.,* ATSDR at 20, 22.
[8] *Id*.
[9] *See, e.g.,* CDC, Drinking Water, *Nitrate and Drinking Water from Private Wells* (Dec. 2, 2009).

of nitrate can actually increase in the remaining liquid phase of water.[10] There are other potential methods of inadvertent exposure as well, such as brushing teeth, and ingesting water while bathing, showering, or using pools and sprinklers. Nitrate is not absorbed through the skin so contaminated water can be used for bathing, but only if care is taken not to ingest any water. This is not an easy task with certain populations, such as children.

b. Once ingested, nitrate is converted to the more potent toxic compound nitrite. The conversion can occur quickly after ingestion through bacteria in saliva, the stomach, and small intestine.[11] Some studies have identified increases in inorganic nitrite levels one-hour post-ingestion, peaking at three hours post-ingestion.[12]

c. Certain factors influence the conversion from nitrate to nitrite and its toxicity. *In vivo* (in the body) conversion of nitrate to nitrite can significantly enhance nitrate toxicity.[13] Also, pH levels affect the conversion. Infants typically have higher pH levels (less acidity) than older persons in their gastrointestinal systems, making them

[10] *Id*.
[11] ATSDR at 43.
[12] ATSDR at 42.
[13] ATSDR at 43.

more susceptible to nitrite toxicity from elevated ingestion levels.[14] Local metabolic conditions such as tissue oxygenation and inflammation can also affect the conversion.[15] With respect to duration of nitrates in the human body, some studies indicate up to 70% may be excreted within 24 hours, but about 25% may be re-absorbed.[16]

23. ESTABLISHMENT OF HEALTH-BASED STANDARDS FOR NITRATE

a. The 10 mg/L MCL for nitrate was set by the EPA based on the critical effect of "early clinical signs of methemoglobinemia in excess of 10%" (meaning that the blood has more than a 10% reduced capacity to carry oxygen). The basis for the MCL was EPA's nitrate chronic oral reference dose (RfD), which used a no observed adverse effect level (NOAEL)-based point of departure of 10 mg nitrate-nitrogen/L, or 1.6 mg/kgBW-day with uncertainty and modifying factors both set at one. The principal studies supporting the NOAEL and RfD derivation were published in the early 1950s.[17] The RfD was last updated by the EPA Integrated Risk Information System (IRIS)

[14] *Id*.; *see also* Bryan, N. et al. "The Role of Nitrate in Human Health." *Advances in Agronomy* Vol. 119 Ch. 3 at 167 (2013) (suggesting infants less than three months are even more susceptible to methemoglobinemia).
[15] ATSDR at 43.
[16] ATSDR at 44.
[17] U.S. EPA, *Integrated Risk Information System (IRIS) Chemical Assessment Summary*, *Nitrate; CASRN 14797-55-8* (May 1, 1991), https://iris.epa.gov/static/pdfs/0076_summary.pdf.

program in 1991. The IRIS assessment for nitrate does not include an assessment of nitrate's potential to cause cancer or adverse reproductive outcomes, and thus those potential outcomes are not considered in the MCL derivation.[18]

b. There is an increasing body of scientific evidence published since the most recent update to the IRIS assessment that supports the need for reassessment of health effects associated with nitrate exposures in support of derivation of updated toxicological metrics (i.e. RfD and cancer classification and slope factors, if appropriate). Further, there have been efforts by U.S. federal agencies as well as intergovernmental advisory bodies to better characterize nitrate in light of more recent scientific evidence.

c. The World Health Organization's International Agency for Research on Cancer (IARC) published a 2010 monograph evaluating the evidence of nitrate's cancer-causing potential based upon studies published up until 2006, and concluded that ingested nitrate under conditions that result in endogenous nitrosation as *probably carcinogenic to humans (Group 2A)*.

d. In its third Six-Year Review, EPA's Office of Water moved nitrate

[18] *Int. J. Environ. Res. Public Health 2018*, *15*(7), 1557; https://doi.org/10.3390/ijerph15071557

from the category of "No new Information, NPDWR remains appropriate after review" to the category of "Health effects assessment in process (as of December 2015) or contaminant nominated for health assessment,"[19] noting explicitly that nitrate had been nominated for an IRIS reassessment. This suggests that the Office of Water anticipated that updates to the IRIS health assessment may have been a rationale for updating the MCL based on new science. The results of the fourth Six-Year Review have yet to be published as of February 2023.

e. In 2017, the EPA IRIS program published "Problem Formulation Materials/IRIS Assessment Plan" for an update to its nitrate assessment.[20] In this document, EPA IRIS indicates that the EPA Office of Water and EPA Region 5 had both expressed interest in updating the assessment. Of note, the Office of Water had indicated its need for an updated assessment in support of its six-year review of the National Primary Drinking Water regulations. The 2017 IRIS assessment plan for nitrate indicates that the Agency will focus on both non-cancer and (for the first time) cancer outcomes based on

[19] *Six-Year Review of 3 of Drinking Water Standards*, EPA, https://www.epa.gov/dwsixyearreview/six-year-review-3-drinking-water-standards (last visited Feb 21, 2023).
[20] U.S. EPA, *IRIS Assessment Plan for Nitrate and Nitrite* (Sept. 2017), *available at* https://ordspub.epa.gov/ords/eims/eimscomm.getfile?p_download_id=532696.

nitrate exposure. In the problem formulation section of the document, EPA IRIS indicates that it anticipates conducting systematic reviews for nitrate's relationship with cancer, hematological effects, developmental effects, thyroid effects, metabolic effects, and reproductive effects.[21] To facilitate this process, the document includes a Population, Exposures, Comparators, and Outcomes (PECO) framework to guide the systematic reviews. While the intent to conduct a systematic review of the literature does not confirm the occurrence of a causal relationship between exposure and a particular health effect, it is the first step in the current IRIS process towards an updating of the assessment. The nitrate reassessment was suspended in December 2018; no rationale was provided for its suspension, but a GAO report on the IRIS program said that, "according to EPA, 'suspended' means the chemical assessment may be restarted as agency priorities change."[22]

f. The Centers for Disease Control and Prevention's Agency for Toxic Substances and Disease Registry (ATSDR) revised its nitrate toxicological profile in 2017.[23] The profile summarizes evidence to

[21] *Id.* at 7.
[22] U.S. Gov't Accountability Off., Report to Cong. Requesters, *Chemical Assessments: Annual EPA Survey Inconsistent with Leading Practices in Program Management* at 12, n. 16 (Dec. 2020), *available at* https://www.gao.gov/assets/gao-21-156.pdf.
[23] U.S. Dep't of Health and Hum. Serv., Public Health Serv., Agency for Toxic Substances and Disease Registry, *Toxicological Profile for Nitrate and Nitrate* (July 2017), *available at* https://www.atsdr.cdc.gov/toxprofiles/tp204.pdf.

that point evaluating associations between nitrate exposure and cancer in various organ systems. While the ATSDR profile is not conducted using formal systematic review methods, the presentation of data is indicative of a sizable body of literature exploring nitrate's association with an array of cancers. Despite this, the ATSDR does not make a formal qualitative determination of nitrate's carcinogenicity status.

g. In a 2018 review of the epidemiologic studies of the health effects of drinking water nitrate led by Dr. Mary Ward of the National Cancer Institute of the National Institutes of Health (and including an authorship list that included scientists from the United States Geological Survey, Texas A&M University, University of Iowa, and Dutch and Spanish scientists),[24] the authors conclude that "[M]any studies observed increased risk with ingestion of water nitrate levels that were below regulatory limits," noting the "strongest evidence for a relationship between drinking water nitrate ingestion and adverse health outcomes (besides methemoglobinemia) is for colorectal cancer, thyroid disease, and neural tube defects." While the authors note that the literature base on nitrate is growing, there are not

[24] Mary H. Ward et al., *Drinking Water Nitrate and Human Health: An Updated Review*, 15 *Int. J. Env't Res. Public Health* 1557 (2018), *available at* https://www.mdpi.com/1660-4601/15/7/1557.

enough studies on single health endpoints to draw firm conclusions about risk. Despite that, the authors note that "[f]our of the five published studies of colorectal cancer found evidence of an increased risk of colorectal cancer or colon cancer associated with water nitrate levels that were mostly below the respective regulatory limits." In these studies, significant increases in colon cancer risk were observed in the range of drinking water nitrate concentrations of 3.87 mg/L up to 10 mg/L.[25]

h. It is clear that U.S. government and intergovernmental agencies, including those responsible for the regulation of toxics in drinking water, believe there is a scientific basis for reevaluating the quantitative toxicological metrics for nitrate. While the work to confidently predict the outcome of such a reevaluation has yet to be completed, EPA has expressed interest in classifying nitrate with regard to its carcinogenicity, and epidemiologic studies have been published reporting effects at drinking water nitrate concentrations below the current MCL. Taken together, it is likely that a classification of carcinogenicity and/or a lower chronic oral RfD,

[25] Jorg Schullehner et al., *Nitrate in Drinking Water and Colorectal Cancer Risk: A Nationwide Population-Based Cohort Study*, 143 Int'l Journal of Cancer 73 (2018), *available at* https://doi.org/10.1002/ijc.31306; Jane A. McElroy et al., 6 Journal of Water and Health 399 (2008), *available at* https://doi.org/10.2166/wh.2008.048; Nadia Espejo-Herrera et al., *Colorectal Cancer Risk and Nitrate Exposure Through Drinking Water and Diet*, 139 Int'l Journal of Cancer 334 (2016), *available at* https://doi.org/10.1002/ijc.30083.

both possible outcomes of an EPA IRIS reassessment of nitrate, would support the lowering of the nitrate MCL.

Irrespective of EPA action on the nitrate RfD or MCL, based on my assessment of the literature, it appears possible that adverse health outcomes may be possible at drinking water nitrate levels lower than the MCL. Methemoglobinemia is a somewhat uncommon condition characteristic of elevated nitrate exposure. Emerging evidence suggests, however, that nitrate exposure even at levels below the MCL may play a role in the emergence of other effects (e.g. neural tube defects, colon cancer).

i. Based on this information, and the documented health effects of ingesting drinking water below the MCL, I believe that a strong basis exists for EPA to consider lowering the MCL below 10 mg/L to protect the health of the average individual, and particularly the health of susceptible populations of the very young, the very old, and the immunocompromised. The EPA needs to review the MCL in light of accumulating evidence of toxic effects of nitrate when present in drinking water in the 5-10 mg/L level and especially when consumed on a chronic basis as appears to be the case in the Lower Yakima Valley.

24. POPULATION VULNERABILITY

a. Certain populations are more vulnerable to nitrate toxicity than others. U.S. Census data for four cities in the Lower Yakima Valley (Sunnyside, Grandview, Toppenish, and Prosser) show a solid presence of children under the age of five years of age (9.8%, 10.3%, 8.9%, and 4.1%, respectively).[26]

b. I would categorize children under five years of age as particularly vulnerable to the adverse health effects of nitrate-contaminated drinking water.

25. SCIENTIFIC STUDIES HAVE DOCUMENTED CONTAMINATION IN LOWER YAKIMA VALLEY RESIDENTIAL WELLS THAT EXCEED THE MAXIMUM CONTAMINANT LEVEL FOR NITRATE AND NITRITE

a. Data from the last 20 years show high levels of nitrate contamination in the Yakima Valley. In 2001-2002, the Valley Institute for Research and Education ("VIRE") tested 249 private wells of low-income residents in the lower Yakima Valley. The VIRE study gathered baseline data for groundwater in the area, and informed residents of the quality of their drinking water. The VIRE study sampled for nitrate+nitrite-N, fecal coliform, *E. coli* bacteria, arsenic, chloride, ammonia, pH, specific conductivity, temperature, dissolved oxygen,

[26] *See* U.S. Census Bureau, State & County Quick Facts Data for Grandview, Prosser, Sunnyside, Toppenish, Wapato, Washington (through June 2022).

and ferrous iron.[27] The VIRE Study focused on two regions: Region 1 included 54 wells around Buena, Toppenish, Wapato and Zillah. Region 2 included 195 wells around Grandview, Granger, Mabton, Outlook and Sunnyside.[28] While the VIRE study found nitrate levels above the MCL in approximately 21% of the residential wells tested in Region 2, another 28% of the wells in Region 2 tested had nitrate levels between 5.0 mg/L and 9.99 mg/L.[29] Region 1 had far fewer contaminated wells.

b. In 2001-2002, Heritage College conducted a field investigation of groundwater quality in the area extending from Zillah to Sunnyside, Washington. Heritage College sampled for nitrate-nitrogen, phosphate, total dissolved solids, dissolved oxygen, and alkalinity. Of the 40-54 wells (season-dependent) sampled for nitrate-nitrogen, the primary conclusion of the Heritage College study was that nitrate-nitrogen levels were "elevated" (> 10mg/L) in three areas of the study region, all near large dairies.[30]

The local newspaper, the Yakima Herald-Republic, ran a three-part series of articles in 2008 called "Hidden Wells, Dirty Water",

[27] R. Sell, Valley Institute for Research and Education, "Quality of Ground Water in Private Wells in the Lower Yakima Valley, 2001-02" at 6 (Dec. 2002) (hereinafter "VIRE Study").
[28] VIRE Study at 12.
[29] VIRE Study at 14, Figure 1.
[30] Heritage College, "Sunnyside Groundwater Study Final Report" at 1, Figure 1 (Aug. 13, 2003) (hereinafter "Heritage College Study").

investigating the magnitude of water contamination in the Lower Yakima Valley.[31] During the same timeframe, the Washington Department of Health announced that water in an elementary school in Outlook, Washington had tested above 10 mg/L for nitrate.[32]

c. In 2011, Johns Hopkins University Bloomberg School of Public Health published a study, "Airborne cow allergen, ammonia and particulate matter at homes vary with distance to industrial scale dairy operations: an exposure assessment."[33] This study focused exclusively on the Lower Yakima Valley, including the area in which DBD and SMD are situated. The study found that community exposures to airborne agents with known human health effects increased the closer a person lived to a CAFO.[34] One of the air agents studied, ammonia, is caused by the breakdown of urea in cow manure.

d. EPA Region 10's 2010-2012 study, "Relation Between Nitrate in Water Wells and Potential Sources in the Lower Yakima Valley Washington" ("EPA Study") sampling results for numerous

[31] Leah Beth Ward, "Hidden Wells, Dirty Water." *Yakima Herald Republic* (Oct. 2008).
[32] Since 2008, the Outlook Elementary School well has tested positive two more times for nitrates. The original well was 90 feet deep; a replacement well was dug to 132 feet deep and the second replacement well was dug to 243 feet deep. Nitrates in the 243-foot deep well were already at 4.4 mg/L. *See* Washington Department of Ecology, Quality Assurance Project Plan, Washington Nitrate Prioritization Project at 1 Pub. No. 14-10-005 (Jan. 2014).
[33] D'Ann L. Williams et al., *Airborne Cow Allergen, Ammonia and Particulate Matter at Homes Vary with Distance to Industrial Scale Dairy Operations: an Exposure Assessment*, 10 Env't Health 72 (2011).
[34] *Id.*

compounds further confirms the presence of contaminants in Lower Yakima Valley drinking water. Of note for Plaintiffs' purposes, the EPA Study identified excessively high levels of nitrates, nitrites, and ammonia in residential drinking water wells and in other wells. Additional sampling results coming from the Administrative Order on Consent ("AOC") between EPA and Cow Palace, The Dolsen Companies' sampling of drinking water on properties inhabited by Cow Palace employees and tenants, sampling performed by agencies such as the Yakima County Health District, Plaintiffs' sampling, and Defendant Dairies' August 2014 sampling further confirm the seriousness of the nitrate contamination of the groundwater that residents use for drinking water.

e. Other studies continue to expose the problems related to CAFOs and nitrate contamination. In late 2013, the Centers for Disease Control and Prevention ("CDC") published a comment "Investigation of a Cluster of Neural Tube Defects – Central Washington, 2010-2013."[35] The comment identified a high level of referral patterns in Central Washington for severe neural tube defects including anencephaly, spina bifida, and encephalocele. A follow-up study confirmed the

[35] CDC (2013) Central Washington.

presence of neural tube defect births in the Yakima County area and described a study confirming the results that the Yakima County area has an anencephaly rate of 8.4 per 10,000 live births. This rate is significantly higher than the national average of 2.1 per 10,000 live births. One of the recommendations from the study was to monitor "private well nitrate concentrations because of their potential association with birth defects and other adverse health outcomes."[36]

DBD AND HIGH NITRATE CONCENTRATIONS

26. I have reviewed the discovery information produced in this case concerning nitrates in groundwater at and near the DBD and SMD facilities. Based on my review of the records, it is my professional opinion that the amount of nitrates in the drinking water on and near the DBD and SMD facilities pose an imminent and substantial endangerment to public health and the environment.

27. A farm with 2,500 dairy cattle is estimated to create a waste load similar to a city of 411,000 people. A key difference is the fact that human waste is treated before discharge into the environment, whereas waste from CAFOs has no such requirement, and it is not treated, or treated minimally, before reaching the environment.[37] According to Defendants'

[36] *Id.*
[37] EPA Study at 46.

most recent Annual Reports, the DBD facility houses between 1300-2800 dairy cows and 300 heifers, producing 19.5 million gallons of liquid manure and 54,000 tons of solid manure. The SMD facility is not presently milking, according to the 2022 Annual Report. That facility houses 2,000 dairy heifers, however, and allegedly generates at least one million gallons of liquid manure and 12,000 tons of solid manure, all of which is allegedly sent to the DBD facility. Based on the above estimate, the DBD and SMD facilities have between two to three times as many cows, and thus produce a similar waste load as a human population of more than a million people. Moreover, the number of cows at DBD was substantially higher prior to 2020; the number of dairy cows and heifers in 2018 was 5,640, producing 54,020,062 gallons of liquid manure and 36,864 tons of sold manure;[38] and 5,500 in 2019, producing 75 million gallons of liquid manure and 36,864 tons of sold manure.[39]

28. The results of Farallon's analysis of samples from each of the ten monitoring wells at the DBD facility on June 29, 2021, are below. As indicated, the nitrate numbers are extremely high; seven of the ten wells were above the 10 mg/L MCL, and two of the samples were 200 or greater mg/L – more than *twenty times* the MCL. These data show a

[38] DAIRIES-00018575
[39] DAIRIES-00012536

substantial and alarming degree of nitrate contamination by the facility of

Table 3
Groundwater Analytical Results
Washington Dairies
Outlook, Washington
Farallon PN: 2628-001

Sample Location	Sample Date	Sample Identification	Analytical Results (milligra								
			Calcium[1]	Magnesium[1]	Potassium[1]	Sodium[1]	Chloride[2]	Fluoride[3]	Nitrate (as N)[4]	Nitrite (as N)[4]	Sulfate[5]
Shallow Perched Groundwater Zone - DBD Dairy											
FMW-01	6/30/2021	FMW-01-20210629	410	150	36	120	200	0.32	200	0.70	160
	6/30/2021	FMW-01-20210630	---	---	---	---	---	---	---	---	---
FMW-03	6/30/2021	FMW-03-20210629	320	160	40	120	540	0.57	210	1.0	450
	6/30/2021	FMW-03-20210630	---	---	---	---	---	---	---	---	---
FMW-04	6/30/2021	FMW-04-20210629	85	35	17	97	33	0.89	4.1	1.1	82
	6/30/2021	FMW-04-20210630	---	---	---	---	---	---	---	---	---
FMW-05	6/30/2021	FMW-05-20210629	46	16	9.7	180	14	0.46	5.0	1.2	66
	6/30/2021	FMW-05-20210630	---	---	---	---	---	---	---	---	---
FMW-06	6/29/2021	FMW-06-20210629	110	38	22	39	36	0.45	5.4	1.9	89
FMW-07	6/30/2021	FMW-07-20210629	160	62	19	52	85	0.40	62	1.9	88
	6/30/2021	FMW-07-20210630	---	---	---	---	---	---	---	---	---
Shallow Perched Groundwater Zone - SMD Dairy and Heifer Ranch											
FMW-08	6/29/2021	FMW-08-20210629	130	160	110	380	310	0.51	11	0.15	66
FMW-09	6/29/2021	FMW-09-20210629	93	58	320	280	420	1.1	32	1.3	220
FMW-10	6/29/2021	FMW-10-20210629	140	70	59	56	91	0.69	40	0.69	56
Intermediate Zone - DBD Dairy											
FMW-02	6/30/2021	FMW-02-20210629	100	38	2.8	110	46	0.60	12	0.77	190
	6/30/2021	FMW-02-20210630	---	---	---	---	---	---	---	---	---

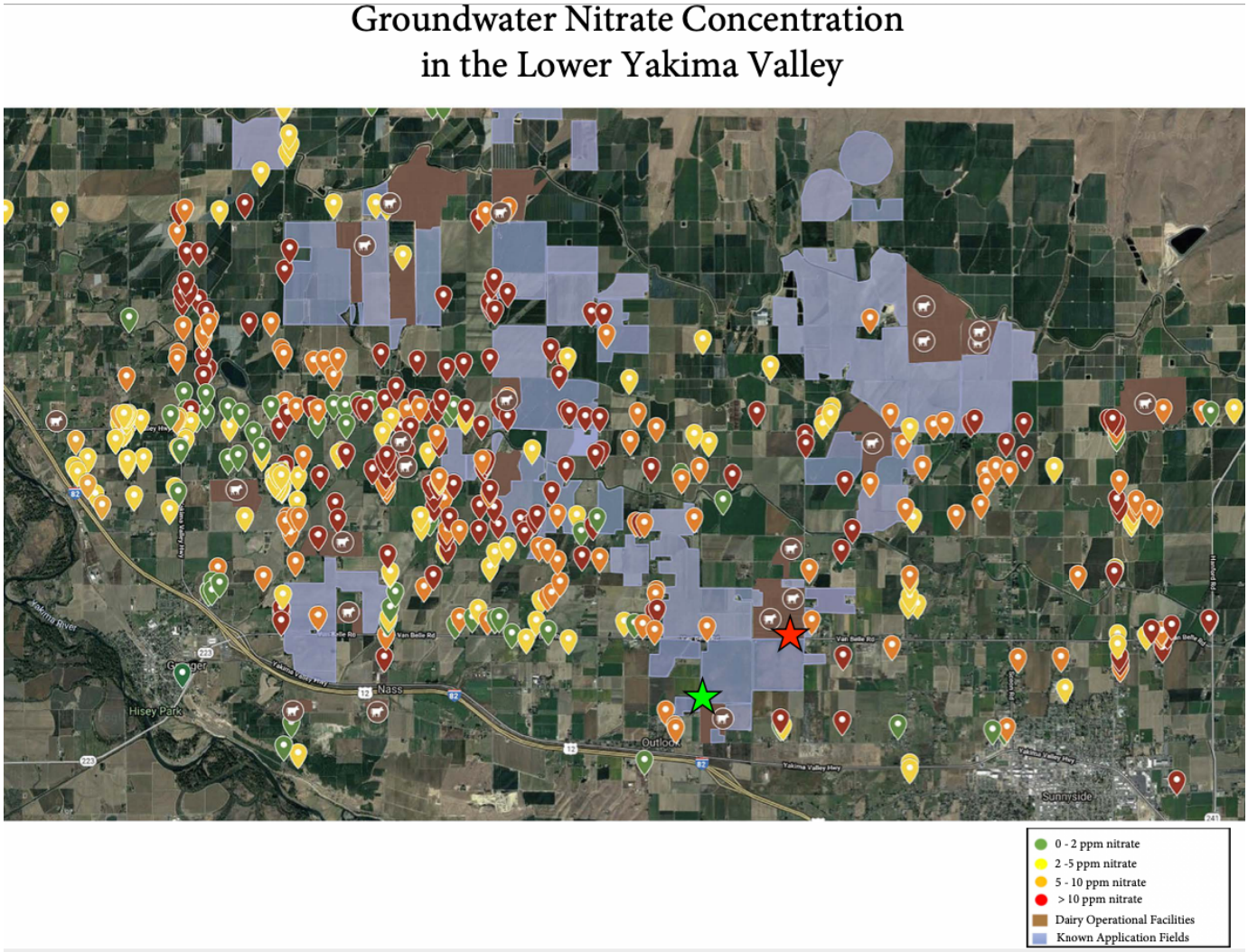
the groundwater.

29. The results of WET's analysis of its groundwater boring samples are below. Those numbers are not as high as those collected by Farallon and do not exceed the 10 mg/L MCL at DBD, but do exceed 10 mg/L at SMD. However, three of the samples at DBD were above 5 mg/L, which is in the range at which adverse health outcomes were observed, including cancer, as reported in the review of nitrate toxicity published by Dr. Mary Ward discussed in Section 23 above.

Table X. Groundwater Analytical Results

Sample ID	Date	Time	Sample type	Total Dissolved Solids		Total Alkalinity as $CaCO_3$		Chloride		Biochemical Oxygen Demand		Ammonia as N		Nitrogen (Kjeldahl, Total)		Nitrate		Nitrate + Nitrite		Nitrite		Orthophos-phate		Phosphorus (Total)	
				mg/L	Q	mg/L	Q	mg/L	Q	mg/L	Q	mg/L	Q	mg/L	Q	mg/L	Q	mg/L	Q	mg/L	Q	mg/L	Q	mg/L	Q
DBD-1-B-discrete	05/21/2020	11:00	Natural	753		1300		33		-		0.36		16.2		5.98		6.32		0.34		-		51	
DBD-CA-139-01	05/20/2020	10:05	Natural	740		510		52		<4		0.47		3.0		5.25		5.58		0.33		0.322		20.4	
DBD-CA-176-02	05/22/2020	12:10	Natural	760		450		50		<4		0.08		0.5		6.81		7.01		0.20		0.076		0.82	
SMD-05-01	05/21/2020	09:54	Natural	-		-		-		-		0.25		8.9		-		29.1		-		-		40.4	
SMD-L1	05/20/2020	15:40	Natural	-		-		-		-		1.61		26.5		-		76.5		-		-		44.5	
SMD-L3	05/20/2020	14:21	Natural	2700		2000		472		<4		<0.05		79		<0.01		0.05		0.05		0.019		0.65	
SMD-05-20-20	05/20/2020	14:50	Field Blank	<10		<4		<1		<2		<0.05		<0.5		<0.01		<0.01		<0.01		<0.005		<0.01	
1RX-052020	05/20/2020	17:30	Rinsate Blank	<10		<4		<1		<2		<0.05		<0.5		<0.01		<0.01		<0.01		<0.005		<0.01	

30. Moreover, the following image from the Clean Drinking Water Project illustrates well contamination in the Lower Yakima Valley as of October 2019. A number of wells in the immediate vicinity of DBD (indicated with a red star) and SMD (indicated with a green star) show the presence



of high levels of nitrate, both in the 5-10 mg/L and >10 mg/L ranges.

31. In addition, the data from the Lawrence Report regarding Cow Palace and the "Cluster" Dairies is also informative on the degree of endangerment created by Defendants' operations. The Lawrence Report discusses, among other things, the EPA Region 10's 2010-2012 study of drinking water in the Lower Yakima Valley, which found that some downgradient wells from Cow Palace and the "Cluster" Dairies were more than four times the MCL.[40] The data from Cow Palace is extensive and shows a significant threat to the community; if the same extensive testing were done around DBD, it is likely that the results would be similar.

32. I am also aware of other nitrate sampling programs in the Lower Yakima Valley, such as those organized by the Yakima Health District, the Lower Yakima Valley Groundwater Management Area, and the Washington Department of Health. All confirm the pervasive contamination problem of the groundwater. I also reviewed the final report of the Yakima County Nitrate Treatment Pilot Program, issued on June 30, 2011, which showed that 180 of 271 laboratory tests for nitrate were above the 10 mg/L MCL.[41]

33. Finally, I'll note that I was quite surprised by the deposition testimony of

[40] Lawrence Report at 26.
[41] Yakima Co. Nitrate Treatment Pilot Program Final Report (June 30, 2011)

Karina Chavarin, an employee at DBD, when she indicated that she had not tested the well water at her residence directly adjacent to the DBD facility,[42] nor did she appear interested in getting a free test,[43] despite the fact that she has children.[44] It is extremely important that residents understand the substantial health risks that the contaminants released by these facilities pose to them; the fact that a key employee of the facility was unaware is not indicative of a company culture that safeguards its stakeholders against the health and environmental risks it creates.

TREATMENT OF NITRATE-CONTAMINATED WATER

34. The MCL for nitrate and nitrite prescribes treatment methods using the "best available technology," or BAT. The BATs for treating nitrate are ion exchange, reverse osmosis, and electrodialysis.[45] For nitrite, the BATs are ion exchange and reverse osmosis only.[46]

35. People with high nitrate drinking water have limited options to ensure safe water.

They can purchase bottled water, or undertake treatment of their contaminated drinking water. From a public health standpoint, bottled water and BAT treatment methods are only temporary and partially effective solutions to address the underlying contamination problem and

[42] K. Chavarin Dep. 72:18-19.
[43] *Id.* 75:24-25.
[44] *Id.* 74:17-18.
[45] 40 C.F.R. § 141.62(c).
[46] *Id*.

transfer responsibility for clean and safe drinking water on to the consumer.

36. Reverse osmosis (RO) systems are water purification systems, generally installed at the point-of-use such as the kitchen sink. Water is pushed through a membrane and the filter system, reducing or removing certain impurities. Nitrate, nitrite, and total nitrogen may be reduced or removed through reverse osmosis systems. RO systems do not eliminate coliform bacteria; installing a separate ultraviolet light may be one way to inactivate coliform bacteria. RO system products are typically certified through the National Sanitation Foundation and the Water Quality Association.

37. Reverse osmosis systems vary in filter and membrane quality. Better membrane quality, and thus better-quality water, comes at a price. The Yakima County's Nitrate Treatment Pilot Program estimated that RO systems cost "around $800 per unit" to install and that maintenance of the system including periodic replacement filters is $20 per month.[47] Those numbers are likely higher now due to general inflation impacts.

38. It is important to maintain RO systems to protect the public from nitrates. These systems installed at the point-of-use in home kitchens will protect

[47] *See* Yakima Co. Public Services Webpage "Yakima County's Nitrate Treatment Pilot Program" available at http://www.yakimacounty.us/nitrateprogram/english/FAQ_RO_2.htm.

residents of the home only if they use the water from the RO as their sole drinking source and refrain from consuming tap water in the bathroom or ingesting water while showering or bathing. The decrease in function of RO systems comes from clogging of the membrane filter across which contaminated water is forced, ultimately slowing the flow of water from the apparatus. There are no safeguards to prevent the impatient user from bypassing the system or drawing water from other sources in the household not connected to the RO system. I regard this as a major vulnerability in the risk reduction strategy of relying on point-of-use RO systems.

39. There are also other inconveniences of using RO systems, which may dissuade their use and thus affect public health. For example, they function at notoriously slow flow rates, so basic cooking activities such as filling a teakettle or large pot take significant amounts of time. This is true of "on demand" systems and 2-4 gallon tank systems, like what was installed pursuant to the Administrative Order on Consent between EPA and Cow Palace. They are also easily clogged, decreasing flow rates even further, shortening the lifespan of filters and the system, increasing costs of maintaining the reverse osmosis system, and

making regular maintenance all the more important.[48] While for individuals or small families simple solutions may exist (such as carafe filters), these are unlikely to suit the water intake needs (drinking and cooking) of a family. Lastly, RO systems filter out a large amount of wastewater; some estimates state that 2-5 gallons of waste water are produced for every gallon of water filtered.[49] All of these effects contribute to the increased cost of RO systems.[50]

40. Another problem is that while RO systems treat the water to be consumed at the point-of-use, they do not treat water that is used domestically for a variety of other purposes, such as showering, brushing teeth, or providing water for domestic and farm animals, which present threats to their health as well.

41. Yet another problem with RO systems is that evidence suggests that when levels exceed around 60 mg/L, as has occurred in some residential wells in the area, effectiveness of removal decreases and may result in levels of concern, even above the MCL, even with the

[48] The system used by Yakima County, for example, says in the second paragraph of the owners guide that "[t]he important thing to remember is to change out your filters on a regular basis. The quality of your water is only as good as the quality of your filters…". Culligan Aqua- Cleer Manual at 4.
[49] *See* Water Filter Buying Guide, Consumer Reports (May 2013) available at http://www.consumerreports.org/cro/water-filters/buying-guide.htm?pn=0; CAI Technologies, Inc. "Selecting A Reverse Osmosis Drinking Water System" (2013) available at http://www.caitechnologies.com/water-softeners/selecting-a-reverse-osmosis-drinking-water- system.htm
[50] *See, e.g.,* R. Rautenbach et al. "Nitrate Reduction of well water by reverse osmosis and electrodialysis – studies on plant performance and costs." *Proceedings of the Third World Congress on Desalination and Water Reuse.* Vol. 65 (Nov. 1987) pp. 241-258 (abstract).

system in place.[51]

42. Combined these problems increase the likelihood that even if people have RO systems, that they may not continue to maintain them, or use them. Thus, the assertion that RO systems alone are adequate to protect the public from nitrate contamination in their drinking water is not defensible.

RECOMMENDATION BASED ON CONCLUSIONS

43. Based on my review of the well water data and knowledge of the health risks posed by nitrate in drinking water, I recommend that immediate intervention be pursued to treat residents' well water to reduce nitrate levels. I recommend exposure to drinking water contaminated with nitrates be avoided and that alternative water supplies be made available to the exposed population immediately.

Keeve Edward Nachman, Ph.D.

[51] J. Schoeman, *Nitrate-Nitrogen Removal with Small-Scale Reverse Osmosis, Electrodialysis Andion-Exchange Units in Rural Areas*, Water SAVol. 35, No. 5 (Oct. 2009), *available at* https://www.researchgate.net/publication/262429263_Nitrate-nitrogen_removal_with_small-scale_reverse_osmosis_electrodialysis_and_ion-exchange_units_in_rural_areas.

EXHIBIT A: CURRICULUM VITAE

Revised January 17, 2023

CURRICULUM VITAE

Keeve Edward Nachman

PERSONAL DATA

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EDUCATION AND TRAINING

***Postdoctoral Fellow**, United States Environmental Protection Agency, Office of Policy, Economics and Innovation, National Center for Environmental Economics, Washington, DC, October 2006 – September 2008*

***Doctor of Philosophy (PhD) in Health Policy and Management with specialization in Environmental and Occupational Health Policy**, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, August 2006*
Thesis Title: A Comparative Multi-pathway Probabilistic Risk Assessment of Human Exposures to Arsenic Resulting from the Use of Pelletized Poultry House Waste and Biosolids Fertilizers
Thesis Advisor: Dr. Thomas Burke, Professor, Department of Health Policy and Management

***Master of Health Sciences (MHS) in Environmental Health Sciences with specialization in Radiation Health Sciences and Medical Physics**, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, May 2001*

***Bachelor of Arts (BA) in Writing Seminars**, Johns Hopkins University, Baltimore, MD, May 1999*

PROFESSIONAL EXPERIENCE

***Associate Professor**, Baltimore, MD, April 2020 - Present*
Departments of Environmental Health and Engineering (primary) and Health Policy and Management (joint), Johns Hopkins Bloomberg School of Public Health

***Assistant Professor**, Baltimore, MD, October 2014 – April 2020*
Departments of Environmental Health and Engineering (primary) and Health Policy and Management (joint), Johns Hopkins Bloomberg School of Public Health

***Assistant Scientist**, Baltimore, MD, July 2010 – October 2014*
Departments of Environmental Health Sciences and Health Policy and Management, Johns Hopkins Bloomberg School of Public Health

***Food Production and Public Health Program Director and Science Director for Food Production, Health and Environment**, Baltimore, MD, April 2009 – Present*
Johns Hopkins Center for a Livable Future

***Toxicologist/Risk Assessor**, Baltimore, MD, September 2008 – April 2009*
United States Army Corps of Engineers, Engineering Division, Hazardous, Toxic and Radioactive Waste Branch, Remedial Investigation and Design Section

***Environmental Scientist/ Postdoctoral Fellow**, Washington, DC, October 2006 – September 2008*
United States Environmental Protection Agency, Office of Policy, Economics and Innovation, National Center for Environmental Economics

Environmental Health Risk Assessor/Project Manager, Baltimore, MD, October 2005 – September 2006
Johns Hopkins Bloomberg School of Public Health, Department of Environmental Health, Division of Environmental Health Engineering

PROFESSIONAL ACTIVITIES

Society Membership and Leadership
American Public Health Association (2009 – present)
- Moderator, "Food safety, social disparities: Antibiotic resistance in the food system, A to Z" at American Public Health Association Annual Meeting, Denver, CO, November 2010.
- Water and Health Committee (2016 – present)

Society for Risk Analysis (2011 – present)
- Moderator, "Regulatory Risk Analysis Symposium" at Society for Risk Analysis Annual Meeting, Denver, CO, December 2014.

Science and Regulatory Advisory Panel, Water and Environment Research Foundation (2009-2010)

International Society for Environmental Epidemiology (2008 – 2009, 2018 - present)
- Session Chair, "Risk Analysis and Burden of Disease" at International Society of Environmental Epidemiology and International Society of Exposure Analysis Joint Meeting. Pasadena, CA, October 2008.

Participation on Advisory Panels
Maryland Attorney General's Environmental Advisory Council (2010 – present)
JHSPH Department of Environmental Health Sciences DrPH Committee (2011 – present)
JHSPH Interdepartmental Implementation Science Committee (2012 – present)
Maryland Department of Health and Mental Hygiene Food Safety Roundtable (2012 – present)
Consumer Reports Scientific Advisory Council (2013 – present)
World Health Organization Foodborne Disease Burden Epidemiology Reference Group – Heavy Metals Panel (2013 – 2014)
Maryland Pesticide Education Board, Board President (2013 – 2017)
Advisory Committee, Third Annual Environmental Justice and Environmental Health Disparities in Maryland and Washington, DC Conference (2014)
Community Greening Resource Network Advisory Board (2014 – present)
Dartmouth Toxic Metals Superfund Research Program External Advisory Committee (2014 – present)
Collaborative on Food with Arsenic and associated Risk and Regulation Steering Committee (2015-2018)
Expert Panelist, EPA Workshop on Temporal Exposure Issues for Environmental Pollutants: Health Effects and Methodologies for Estimating Risk (2016)

Selected Stakeholder (Academic), United States Government Accountability Office, Report to the Ranking Member, Subcommittee on Labor, Health and Human Services, Education, and Related Agencies, Committee on Appropriations, House of Representatives – Food Safety: Federal Efforts to Manage the Risk of Arsenic in Rice (2018)
Member, Review of DOD's Revised Approach to Deriving an Occupational Exposure Level for Trichloroethylene (TCE) ad hoc committee, Board on Environmental Studies and Toxicology, National Academies of Sciences, Engineering, and Medicine (2022)
Obesity and the Food System Steering Committee Member, Bloomberg American Health Initiative (2022 – present)
Bloomberg American Health Initiative, Evidence Workgroup (2022 – present)

Program or Project Development
Director, Food Production and Public Health Program, Johns Hopkins Center for a Livable Future (2010 – present)
Senior Director – *Teaching the Food System* Online Curriculum (http://www.jhsph.edu/teachingfood)

Consultations
Wake Forest Innocence and Justice Clinic (2018 – present)
Consumers Union/Consumer Reports, various projects (2011 – present)
EPA STAR Graduate Fellowship Review Panel: Risk Assessment (2011)

Legislative Briefing and Technical Support
Advisor, MD Senator Clarence Lam (2019)
Advisor, MD Delegate Robbyn Lewis (2017 - 2018)
Advisor, MD Senator Richard Madaleno (2017) – drafted Community Health Air Act
Advisor, MD Sen. Karen Montgomery (2013 – 2014)
Advisor, US Rep. Louise Slaughter (D-NY) (2010 – 2018)
Advisor, US Rep. Steve Israel (D-NY) (2009 - 2017)
Advisor, MD Del. Tom Hucker (2009 – 2013)
Advisor, MD Sen. Paul Pinsky (2009 – 2013)
Maryland General Assembly, Committee on Health and Governmental Affairs, Public Health Subcommittee, briefing on the health risks and benefits of consuming raw versus pasteurized milk (invited – February 4, 2015)

Testimony
Maryland Senate Bill 359 (2010) – Pesticide Reporting (March 4)
Maryland House Bill 953 (2010) – Agriculture – Commercial Feed – Arsenic Prohibition (March 5)
Maryland Senate Bill 859 (2010) - Agriculture – Commercial Feed – Arsenic Prohibition (March 16)
Maryland Senate Bill 417 (2011) - Agriculture – Commercial Feed – Arsenic Prohibition (March 1)
Maryland House Bill 754 (2011) - Agriculture – Commercial Feed – Arsenic Prohibition (March 2)
Maryland House Bill 167 (2012) – Agriculture – Commercial Feed – Arsenic Prohibition (March 8)
Maryland Senate Bill 207 (2012) – Agriculture – Commercial Feed – Arsenic Prohibition (February 14)
Maryland Senate Bill 520 (2013) – Agriculture – Commercial Feed and Drinking Water – Antimicrobial Drug Prohibition (February 26)
Maryland Senate Bill 521 (2013) – Agriculture – Meat and Poultry – Antibiotic Use – Labeling (February 26)
Maryland House Bill 775 (2013) - Maryland Pesticide Reporting and Information Act (February 27)

Maryland House Bill 79 (2016) - Health – Milk Products – Raw Milk – Consumer–Owned Livestock (written only)
Maryland House Bill 211 (2016) – Environment and Transportation - Neonicotinoid Pesticides – Labeling, Signage, and Restrictions on Sales and Use (written only)
Maryland Senate Bill 133 (2018) – Education, Environment and Health – Community Healthy Air Act (January 27)
Maryland House Bill 26 (2018) – Environment and Transportation – Community Healthy Air Act (February 7)
Maryland Senate Bill 542 (2019) – Education, Environment and Health – Community Healthy Air Act (February 27)

EDITORIAL ACTIVITIES

Peer Review Activities

Professional Journals

- African Journal of Environmental Science and Technology
- Air Quality, Atmosphere and Health
- American Journal of Epidemiology
- American Journal of Public Health
- Applied Biochemistry and Biotechnology
- BMC Veterinary Research
- British Medical Journal
- Cell Biology and Toxicology
- Chemical Research in Toxicology
- Current Environmental Health Reports
- Ecotoxicology and Environmental Safety
- Environmental Health
- Environmental Health Perspectives (2020 Top Peer Reviewer Awardee)
- Environment International
- Environmental Pollution
- Environmental Research
- Environmental Research Letters
- Environmental Science and Technology
- Environmental Modelling and Software
- Exposure and Health
- Foodborne Pathogens and Disease
- Food Chemistry
- Frontiers in Ecology and the Environment
- Health Affairs
- Human and Ecological Risk Assessment
- International Journal of Environmental Research and Public Health
- International Journal of Hygiene and Environmental Health
- Journal of Agricultural and Food Chemistry
- Journal of Environmental Quality
- Journal of Exposure Science and Environmental Epidemiology
- Journal of Hazardous Materials
- Journal of the Royal Society Interface

- Journal of the Science of Food and Agriculture
- Journal of Trace Elements in Medicine and Biology
- Landscape and Urban Planning
- Local Environment
- Microbial Drug Resistance
- Nature Biotechnology
- Nature Sustainability
- New England Journal of Medicine
- PLOS Biology
- PLOS One
- Proceedings of the National Academy of Sciences
- Science
- Science of the Total Environment
- Thorax
- Zoonoses and Public Health

Books
- American Chemical Society Books - Emerging Contaminants: Pharmaceuticals, Personal Care Products and Organohalogens
- Elsevier book proposal reviewer (Pharmacology and Toxicology)

Federal Government
- United States Environmental Protection Agency/National Center for Environmental Economics Working Paper Series
- Agency for Toxic Substances and Disease Registry, Ad Hoc Reviewer (2015)

Other Technical Reports

- National Resources Defense Council Technical Report on Antibiotic Approvals (2014)
- National Resources Defense Council Technical Report on Industry Antibiotic Policy (2015)
- National Academy of Engineering, The Bridge: Linking Engineering and Society (2022)

Editorial Board Membership

Associate Editor, *Exposure and Health* (2022 – present)

Editorial Review Board, *Environmental Health Perspectives* (2017 – present)

Section Editor (Food), *Current Environmental Health Reports* (2014 - present)

Ad Hoc Review of Proposals

Johns Hopkins Center for a Livable Future Predoctoral Fellowship Review Panel (2009 - present)
Johns Hopkins Center for a Livable Future Innovation Grant Review Panel (2010)
Johns Hopkins Center for a Livable Future Carl Taylor Grant Review Panel (2010 - present)
Johns Hopkins Center for a Livable Future Aquaculture Research Grant Review Panel (2013 – present)
EPA STAR Graduate Fellowship Review Panel: Risk Assessment (2011)

Foundation for Food and Agriculture Research (2017 - 2018)
California Breast Cancer Research Program (2019, 2020 [Review panel Chair])
NIEHS Superfund Review Panel (2021)

HONORS AND AWARDS

Honors

Delta Omega Public Health Honor Society, May 2007
Center for a Livable Future Doctoral Fellowship, July 2005
Center for a Livable Future Doctoral Fellowship, July 2004
Risk Sciences and Public Policy Institute Certificate, May 2001

Awards

JHSPH Teaching Excellence/Outstanding Teaching (years awarded in parentheses)

- For Case Studies in Food Production and Public Health (2015, 2016, 2017, 2020, 2021, 2022)
- For Essentials of Environmental Health (online) (2021)
- For Introduction to the Food Systems and Public Health (2015, 2018, 2020, 2021)
- For Introduction to the Risk Sciences and Public Policy (2014, 2020, 2021)
- For Risk Assessment and Food Production Practices (2018)
- For Topics in Risk Assessment (2014, 2016, 2017, 2019, 2020, 2021, 2022)
- For Topics in Risk Assessment (online) (2018, 2019, 2020, 2021)

Excellence in Baltimore Public Health Practice, Johns Hopkins Office of Public Health Practice and Training, April 2019
Lipitz Public Health Policy Award, May 2018
Society for Risk Analysis, Dose-Response Working Group (travel award), October 2014
EPA "S" Award (Spatial Databases Linking Project), July 2008
EPA "S" Award (Probabilistic Risk Activities), July 2008
EPA "S" Award (Probabilistic Risk and Risk Assessment Portal Activities), July 2007
Health Policy and Management Departmental Scholarship, September 2002

PUBLICATIONS

Journal Articles (signifies peer review)

******indicates corresponding author;* [†]*indicates student mentee first author*

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Best practices for growing safely in urban soils: https://youtu.be/BcNMteh1t14
Safe Urban Harvests Study: Overview of results: https://youtu.be/g-qWOU8al8o
Baltimore City Soil Safety Policy: What you need to know: https://youtu.be/RMa8fTzxAqI

CURRICULUM VITAE

Keeve Edward Nachman

PART II

TEACHING

Advisees

Saima Cheema, MD, MPH (MPH capstone advisee), May 2010

Michael Crupain, MD, MPH (MPH capstone advisee – Preventive Medicine residency), May 2011

Yitzchak Lax, MHS (Environmental Health Sciences), 2010 - 2011

Ashley White, BA/MHS (Environmental Health Sciences), 2011 - 2012

Beth Brewer, MHS (Environmental Health Sciences), May 2012

Kenneth Felsenstein, BA/MHS (Environmental Health Sciences), 2011 - 2012

Charissa Williar, MPH (Environmental Health Sciences), May 2012

Karen Shore, MPH (part-time), May 2013

Martin Fogl, MHS (Environmental Health Sciences), May 2013

Paul Ryberg, MS (Environmental Science and Policy, Environmental Planning), May 2013

Caroline Katz, BA/MHS (Environmental Health Sciences), 2012-2013

Jessica VanHook, MPH (part-time internet-based MPH capstone advisee), May 2014

Alexander Ting, MHS (Environmental Health Sciences), May 2014

Anne Bertuninson, MPH (part-time internet-based MPH capstone advisee), December 2014

Colby Eisen, MHS (Environmental Health Sciences), May 2015

Douglas Woods, MPH (part-time), December 2015

Sarah Triglio, MPH (part-time MPH capstone advisee), December 2015

Lisa Poirier, MHS (Environmental Health Sciences), May 2016

Anne Wellde, MPH (MPH capstone advisee), May 2016

Andrew Stolbach, MPH (part-time), May 2016

Cara Schulte, MHS (Environmental Health Sciences), May 2017

Harpreet Pannu, MPH (MPH capstone advisee), May 2017

Atul Aravindakshan, MPH (MPH capstone advisee), May 2017

Jin Young Park, MPH (part-time), May 2017

Jasmine Selemitsos, MPH (part-time), December 2017

Adrienne Kramer, MHS, May 2018

Abigail Reich, MPH, May 2018

Maya Spaur, ScM (Environmental Health and Engineering), May 2019

Maegan McBride, MPH, May 2019

Raia Contractor, MPH, May 2019

Barrett LaRussa, MPH, May 2019

Maliha Choudhury, MHS, July 2019
Ian Woodworth (MPH capstone advisee), May 2019
Hattie DeLisle (part-time internet-based MPH capstone advisee), May 2019
Mandy Liao (part-time internet-based MPH capstone advisee), May 2019
Kayla Meza, MPH, May 2020
Yiguang Zhu, MHS, May 2020
Nolan Dowd (MPH capstone advisee), May 2020
Grace Bachman, MHS (capstone advisee, Health Behavior and Society), March 2021
Sara Lupolt, PhD (Environmental Health & Engineering), June 2021
Brianna Bradley, MPH, May 2021
Jillian Tse, MPH/Bloomberg American Health Fellow, May 2021
Aimee Bourey, ScM (Environmental Health and Engineering), May 2022
Shelby Luce, MPH (part-time), May 2022
Kitty Fisher, MPH, May 2022
Naomi Tice, MPH, May 2022
Lisa Weltzien, MPH, May 2022
Qinfan Lv, ScM (Environmental Health & Engineering), expected May 2023
Christina LiPuma, MPH, expected May 2023
Alexander Welna, MPH, expected May 2023
Iman Habib, ScM (Environmental Health and Engineering), expected May 2024
Elizabeth Chatpar, ScM (Environmental Health and Engineering), expected May 2024
Beth Brewer Riess, DrPH (Environmental Health & Engineering), expected May 2024
Andrea Chiger, PhD (Environmental Health & Engineering), expected May 2024
Hannah Holsinger, DrPH (Environmental Health & Engineering), expected May 2024
Andrea Jacobson, MPH, expected May 2024
Amanda Geyer, MPH (part-time), expected May 2024
Chase McNulty, MPH (part-time), expected May 2024
Kelsey Mueller, MPH (part-time), expected May 2024
Tara McGinty, MPH, expected May 2024
Neva Jacobs, DrPH (School-wide), expected May 2025
Aimee Bourey, PhD (Environmental Health and Engineering), expected May 2026
Mattie Boden, MPH (part-time), expected May 2026
Tessa Cushman, MPH (part-time), expected May 2026
Sarah Freeman, MPH (part-time), expected May 2026
Amanda Gatinella, MPH (part-time), expected May 2026

Liza Goss, MPH (part-time), expected May 2026
Amy Mullan, MPH (part-time), expected May 2026
Danielle Nabak, MPH (part-time), expected May 2026

Preliminary Oral Participation
Soawapak Hinjoy, Epidemiology, August 2010
Robert Borotkanics, Environmental Health Sciences, February 2012
Laura Zheng, Environmental Health Sciences, June 2012
Stacy Woods, Environmental Health Sciences, November and December 2013
Ben Davis, Environmental Health Sciences, November and December 2014
Kyle Dunn, Health Policy and Management, August 2015
Philip McNab, Health, Behavior and Society, September 2015
Megan Wallace, Epidemiology, April 2016
Miranda Spratlen, Environmental Health Sciences, May and July 2016
Ann Carroll, Environmental Health Sciences, June 2016
Chrys Cronin, Environmental Health Sciences, July 2016
Martha Powers, Environmental Health & Engineering, October 2016
Jennifer Rous, Environmental Health & Engineering, February 2017
Sarah Attreed, Environmental Health & Engineering, March 2017
Ian Sanchez, Environmental Health & Engineering, March 2017
Hyunju Kim, International Health, October 2017
Katie Overbey, Environmental Health & Engineering, May 2018
Maya Spaur (ScM), Environmental Health & Engineering, June 2018
Gabriel Innes, September 2018 and October 2018
Amelie Hecht, Health Policy and Management, October 2018
Qifang Bi, Epidemiology, November 2018
Andrew Patton, Environmental Health & Engineering, January 2019 and June 2019
Sara Lupolt, Environmental Health & Engineering, March and April 2019
Donia Moustafa (ScM), May 2019
Kyle Aune, Environmental Health & Engineering, August 2019
Joseph Yracheta, Environmental Health and Engineering, September 2019
Monica Lee, Environmental Health and Engineering, January 2020
Hannah Holsinger, Environmental Health and Engineering, April 2020 and May 2020
Ian Yesilonis, Earth and Planetary Sciences, November 2020
Elsie Moore, Environmental Health and Engineering, July 2021

Lais Miachon, International Health, September 2021
Andrea Chiger, Environmental Health and Engineering, September 2021
Kayla Iuliano, Environmental Health and Engineering, October 2021 and January 2022
Elizabeth Graham, International Health, October 2021
Aimee Bourey (ScM), Environmental Health and Engineering, October 2021
Andrea Chiger, Environmental Health and Engineering, November 2021
Tyler Smith, Environmental Health and Engineering, November 2021
Emma Clare Lewis, International Health, December 2021
Beth Riess, Environmental Health and Engineering, February 2022
Jessica Cargill, Environmental Health and Engineering, February 2022
Qinfan Lv (ScM), Environmental Health and Engineering, June 2022
Steven Sola, Environmental Health and Engineering, June and August 2022
Anna Tillery, Environmental Health and Engineering, July 2022
Molly Schwalb, Epidemiology, August 2022

Thesis Reader
Anne Nigra, ScM, Epidemiology, May 2016
Sara Solon-Hanover, MSPH, Health, Behavior and Society, May 2018
Maya Spaur, ScM, Environmental Health & Engineering, May 2019
Aimee Bourey, ScM, Environmental Health & Engineering, May 2022

Thesis Committee Membership
Katie Overbey, Environmental Health & Engineering, May 2020
Gabriel Innes, Environmental Health & Engineering, May 2020
Alexandra Lorentz, Environmental Health & Engineering, May 2020
Elsie Moore, Environmental Health &Engineering, December 2022

Thesis Defense Committee
Yukyan Lam, PhD, International Health, May 2017
Megan Wallace, DrPH, Epidemiology, August 2017
Gabriel Innes, PhD, Environmental Health & Engineering, March 2020
Katie Overbey, PhD, Environmental Health & Engineering, March 2021
Sara Lupolt, PhD, Environmental Health & Engineering, June 2021
Elizabeth Thomas, PhD, International Health, August 2021
Taylor Etzel, PhD, Environmental Health and Engineering, February 2022

Quinn Marshall, PhD, International Health, August 2022 (chair)

Chris Brueck, PhD, Environmental Health and Engineering, December 2022

Massive Open Online Course Instruction – Coursera Platform

Primary Instructor (2013 – Present)

- Course: An Introduction to the U.S. Food System: Perspectives from Public Health (Faculty: Drs. Keeve Nachman and Robert Lawrence) – total enrollment: 17,164; completion rate: 15% (Coursera average is between 3 – 10%)

Guest lecturer (2014 – Present)

- Course: Chemicals and Health (Faculty: Dr. Megan Latshaw)

Classroom Instruction

Johns Hopkins Bloomberg School of Public Health – Baltimore, MD

Primary Instructor

- Course: 180.606 Case Studies in Food Production and Public Health (2014 – Present, 4th and Summer Terms)
- Course: 180.620.81 Food Systems and Public Health (Co-Instructors: Drs. Robert Lawrence and Polly Walker) (2016 – Present)
- Course: 180.600.01 Introduction to the Risk Sciences and Public Policy (1st term onsite offering 2015 – Present; 3rd term online offering 2022 - Present)
- Course: 180.841.98 Introduction to Environmental Health – Barcelona Institute (2016)
- Course: 317.860.98 Risk Assessment and Food Production Practices – Barcelona Institute (2017)

Co-Instructor (with major responsibilities)

- Course: 180.620.81 Food Production, Health and the Environment (Faculty: Drs. Robert Lawrence, Keeve Nachman, and Polly Walker) (2011 – 2015)
- Course: 317.615.01 Topics in Risk Assessment (Faculty: Drs. Mary Fox and Keeve Nachman) (2013 – Present)
- Course: 317.615.81 Topics in Risk Assessment (Faculty: Drs. Mary Fox and Keeve Nachman) (2016 – Present)

Guest lecturer (2006 – Present)

- Course: Methods in Quantitative Risk Assessment (Instructor: Dr. Mary Fox)
- Course: Methods in Quantitative Risk Assessment (Online) (Instructor: Dr. Mary Fox)
- Course: Introduction to Risk Sciences and Public Policy (Instructor: Dr. Thomas Burke)
- Course: Introduction to Risk Sciences and Public Policy (Online) (Instructor: Dr. Thomas Burke)
- Course: Risk Policy, Management and Communication (Instructors: Drs. Mary Fox and Thomas Burke)
- Course: Topics in Risk Assessment (Instructors: Dr. Thomas Burke and Mr. Ronald White)
- Course: Principles of Environmental Health (Instructor: Dr. Ernst Spannhake)
- Course: Mini-Med School: Food Systems, Health and a Livable Future (Instructor: Dr. Robert Lawrence)
- Course: Current Issues in Public Health (Instructor: Dr. Edyth Schoenrich)
- Course: Public Health Practice (Instructors: Dr. Thomas Burke and Ms. Beth Resnick)
- Course: Food Technology and Health (Instructor: Dr. Jed Fahey)

- Course: Advanced Environmental Health (Instructor: Dr. Michael Trush)
- Course: Environmental and Occupational Health Law and Policy (Instructor: Dr. Paul Locke)
- Course: Chemicals and Health (Instructors: Dr. Megan Latshaw and Ms. Beth Resnick) (Coursera – MOOC)
- Course: Methods in Exposure Science (Instructors: Drs. Kirsten Koehler and Meghan Davis)
- Course: Current Issues in Policy Analysis (Instructors: Dr. Pierre-Gerlier Forest)
- Course: The Environment and Your Health (Instructors: Drs. James Yager, Joseph Bressler and Megan Latshaw)

Johns Hopkins Medical Institution – Baltimore, Maryland
Guest lecturer (2015, 2017)
- Course: Microbiology instruction (Instructor: Dr. Maunank Shah)

University of Maryland School of Public Health – College Park, MD
Guest lecturer (2008 – present)
- Course: Principles of Toxicology (Instructor: Dr. Amy Sapkota)
- Course: Introduction to Risk Assessment (Instructor: Dr. Amir Sapkota)
- Course: Introduction to Environmental Health (Instructor: Dr. Amir Sapkota)

Columbia University, Mailman School of Public Health – New York, New York
Guest lecturer (2010)
- Course: Topics in Environmental Health Sciences (Instructor: Dr. Joseph Graziano)

University of California, San Francisco – San Francisco, CA
Guest lecturer (2010 – 2016)
- Course: Reach the Decision Makers (Instructors: Dr. Tracey Woodruff and Ms. Patrice Sutton)

Dartmouth Institute for Health Policy and Clinical Practice – Hanover, NH
Guest lecturer (2012)
- Course: Environmental and Occupational Health (Instructors: Drs. Carolyn Murray and Robert McLellan)

Other instruction

- Johns Hopkins Center for Talented Youth (CTY) – Course: "U.S. Food Systems from a Public Health Perspective" 1-day course for middle and high school students and parents (2014 – 2015)

RESEARCH GRANT PARTICIPATION

Current

- Leveraging Time-Activity Data to Improve Exposure Estimation and Lung Health Interventions in Environmental Justice Communities (12/2022 – 11/2023), Johns Hopkins BREATH Children's Center (supported by NIEHS award P2CES033415)
    - PI: Sara Lupolt ($20,000, no salary support)
    - This pilot study aims to collect high-resolution time-activity pattern data for children in a fenceline community and develop quantitative adjustment factors for air pollutant exposure estimation for children in fenceline communities.
    - Role: Co-Investigator

- Neurotoxicity Due to Environmental Complex Metal Mixtures Exposures (9/20/2022 – 8/31/2025) NIH/NINDS 1RF1NS130672-01
    - MPIs: Fenna Sille, Shyam Biswal, Keeve Nachman, Thomas Hartung ($2,421,557, 9% salary years 1 - 5)
    - The objective of this project is to evaluate the influence of metal mixtures on the incidence on neurological disorders across the lifespan. Specifically, we will examine the mechanistic perturbations and clinical markers of neurological disease as a function of exposure to individual metals (lead, chromium, cadmium, and arsenic), and resulting from exposures to mixtures of these chemicals. Implications for risk assessment will be explored, and we will assess the potential for development of quantitative modifying factors to better predict neurological disease risks.
    - Role: Principal Investigator

- Environmental Monitoring and Assessment Near Fossil and Petrochemical Infrastructure (09/01/22 – 8/31/2024), no grant number, Bloomberg Philanthropies
    - PI: Peter DeCarlo ($2,760,000, 20% salary years 1 -3)
    - This project utilizes state-of-the art measurements of particulate matter composition and hazardous air pollutants to determine exposure and subsequent risk of air pollutants in vulnerable communities living at the fenceline of industrial facilities. We combine high spatial resolution measurements in a cumulative risk framework to improve assessment of risk at the neighborhood level.
    - Role: Co-Principal Investigator

- Petrochemicals and Cumulative Risk Postdoctoral Fellowship (9/14/2022 – 8/13/2023), no grant number, Environmental Defense Fund
    - PI: Keeve Nachman ($79,287, 7% salary)
    - The objective of this funding is to support a postdoctoral fellow to develop cumulative risk analyses with the Bloomberg Initiative-funded petrochemicals team and to assist scientists at the Environmental Defense Fund in their work on EPA Toxic Substances Control Act risk evaluations.
    - Role: Principal Investigator

- Curbing the use of medically important antibiotics in food production: profiles of low- and middle-income countries (LMICs) and guidance for identifying priority interventions (11/1/2022 – 10/31/2023), no grant number, Tiny Beam Fund
    - PI: Keeve Nachman ($25,0000, no salary)
    - The objective of this project is to use the Kim Diet-Climate-Nutrition model to assess the value of varying dietary interventions on the use of antimicrobials in food production in low- and middle-income countries.
    - Role: Principal Investigator

- INnovations to generate estimates of children's soil/dust inTake (INGEST) (8/1/2021 – 6/30/2024), EPA R840200
    - PI: Keeve Nachman ($1,350,000, 25% salary years 1 - 3)
    - The objectives are to longitudinally characterize lifestage- and developmental milestone-specific macro-activity and microenvironmental patterns for children, prospectively collect and analyze in-home macro-activity video footage to describe the environmental and human factors that modify children's micro-activity patterns and identify organic chemical fingerprints in three environmental and two biological samples using non-targeted analytical approaches to propose novel organic candidate tracer compounds and tracer mixtures for estimation of children's soil and dust intake.
    - Role: Principal Investigator

- Fate and Transport of Unregulated Organic Contaminants in Biosolids - Development of a Human and Environmental Exposure Risk Framework (9/1/2021 – 8/31/2024), EPA R840247
    - PI: Carsten Prasse ($1,498,000, 20% salary years 1 – 3)
    - The goal of this research is to develop a flexible framework for the prioritization of biosolids-associated organic contaminants (BOCs). The objectives are to 1) characterize the occurrence, fate, and transport of BOCs after land application of biosolids; 2) model BOC exposures and perform hazard and risk assessments to identify high-priority BOCs; and 3) utilize an array of communication channels to translate our findings and methodology for the wastewater and agriculture communities, regulators, and the general public.
    - Role: Co-Principal Investigator

- Transit's Path Forward in a Pandemic: Uniting Public Health Policy and Transportation Policy through the Scientific Analysis of Aerosols and an Integrated Epidemiological and Agent-Based Mobility Model (5/27/2021 – 5/26/2023), Subcontract to NY Mass Transit Administration under Federal Transit Administration funding
    - PI: Keeve Nachman ($275,000, 20% salary)
    - Our goal is to take a cross-disciplinary systems approach that meaningfully integrates the scientific knowledge base with the operational expertise of stakeholders from the transportation sector. Such an approach is needed to identify the most effective and efficient immediate- and longer-term strategies to assure safe operation and ridership of MTA transit services. Underlying this approach is a framework for risk-based decision making that draws upon the knowledge of experts in public health and transportation science, contextualizing their approaches in the needs of the decision-makers.
    - Role: Principal Investigator

- Urban Aquaculture for Climate Justice and Local Food Sovereignty (06/01/21-05/30/23) Johns Hopkins University, Alliance for a Healthier World
    - PIs: Nicole Labruto and Carsten Prasse ($100,000, 4% salary, years 1 – 2)
    - This project will explore the feasibility of community-led urban aquaculture on the shoreline of south Baltimore as a possible strategy to support local food sovereignty and contribute to the restoration of urban ecosystems.

- Role: Co-Investigator

- CLF-RBA-2-FY19 Carrageenan as a source of arsenic, lead and cadmium to infant foods (3/1/2019 – 1/31/2023) Center for a Livable Future Directed Research Program
  - PI: Keeve Nachman ($109,500, no salary support)
  - The goal of this research is to conduct an international market-basket study of infant formula foods for analysis of As species, Cd, and Pb and to use these measurements alongside complementary measurements of these metals in breast milk to conduct a comparative dietary toxic metals exposure analysis across the various types of infant foods.
  - Role: Principal Investigator

- CLF-RBA-6-FY19 Soil carbon fluxes and beef cattle: how different production systems, methodology, and scope of LCAs impact reported GHG emissions (6/1/2019 – 11/31/2023), Center for a Livable Future Directed Research Program
  - PI: Keeve Nachman ($17,000, no salary support)
  - The goal of this research is to assess how methodological differences in ruminant-livestock life cycle assessments explain variation among study results and interpretation.
  - Role: Principal Investigator

- Maximizing the Knowledge Gained from California Senate Bill 27 (2018 – 2022) No number, Wellcome Trust
  - PI: Lance Price ($3.5 million, no salary support 2018 – 2022)
  - The goal of this project is to supplement the support from our NIAID ARES project (below) to expand our analyses of the impacts of California Senate Bill 27 to include four animal products (beef, chicken, pork, and turkey), and three pathogens (*E. coli*, *Salmonella*, and *Campylobacter*) in both retail meat and clinical isolates. It also expands our capacity to conduct genomic analyses and characterize the population dynamics of *E. coli*.
  - Role: Co-Investigator

- Antimicrobial Resistant E. coli before and after California Senate Bill 27 (ARES): A Natural Experiment (05/09/2017 – 04/30/2022), NIH/NIAID 1R01AI130066-01A1 REVISED
  - PI: Sara Tartof, Kaiser Permanente of Southern California ($4,026,995, 10%, 5% salary support, years 1,5 and 2-4, respectively)
  - This project aims to leverage whole genome sequencing and expansive electronic health record data to determine whether an upstream, statewide policy to reduce antibiotic use in livestock production will have a down-stream, beneficial impact on human health.
  - Role: Principal Investigator (JHU site)

Pending

- Drinking Water as a Driver of Health Disparities in Urban Populations, NIH/NIEHS
  - PI: Kellogg Schwab ($2,500,000, 5% salary years 1-5)

- This grant will incorporate environmental justice principles into drinking water exposure science including a community-based participatory research approach to assess whether low-income urban populations are disproportionately exposed to lead and Legionella due to old pipes, stagnant water, and a lack of maintenance of drinking water systems outside of the public domain.
- Role: Co-Investigator

Completed

- Environmental Monitoring and Assessment Near Fossil and Petrochemical Infrastructure (10/1/2021-8/31/2022), Bloomberg Philanthropies
  - PI: Peter DeCarlo ($1,073,161, 15% salary)
  - This pilot study leverages multiple air pollution measurement platforms to improve the characterization of neighborhood scale exposure and risk to a suite of hazardous air pollutants in fenceline communities near petrochemical infrastructure.
  - Role: Co-Investigator

- Characterizing the Spatial Temporal Dynamics and Human Health Risks of *Vibrio parahaemolyticus* Bacteria in Estuarine Environments (2016 – 2022), NIH/NIAID
  - PI: Frank Curriero ($2,800,000, 15% salary support [2016 – 2021])
  - Role: Co-Investigator. I will aid in development and conduct of the quantitative microbial risk assessment (QMRA) in support of estimation of burden of *Vibrio parahaemolyticus* infections resulting from consumption of shellfish from two distinct estuarine environments.

- The Ending Drinking Water Disparities - A Community Right to Know project (7/1/21 – 6/30/22), Bloomberg American Health Initiative
  - PI: Fox, ($59,725, 7% salary support)
  - Main Objectives: The project will evaluate water quality reporting under the Safe Drinking Water Act and develop user-centered design recommendations for improved consumer communication.
  - Role: Co-Investigator

- USDA GNE-19-209 Healthy Soils, Healthy Farmers: Assessing farmers' soil contact activities & soil contamination on urban & rural farms (8/1/2019 – 7/31/2021), United States Department of Agriculture/Sustainable Agriculture Research and Education Program
  - PI: Keeve Nachman ($15,000, 1% salary support 2019-2021)
  - The proposed research aims describe the soil contact activities and behaviors of urban and rural farmers and update an existing survey tool to quantify farmers' soil contact activities for future occupational health assessments; and measure and compare soil contaminant concentrations on rural and urban farms to contextualize risks of potential exposure to soil contaminants in Maryland.
  - Role: Principal Investigator

- USDA-NACA Cooperative Agreement for urban agriculture research (2019 – 2020), 58-8040-8-021 United States Department of Agriculture, Agricultural Research Service
    - PI: Keeve Nachman ($83,000, 1% salary support 2019-2020)
    - The goal of this pilot project is to leverage samples from the Safe Urban Harvests study to explore exposures to residues of organic contaminants and to facilitate comparisons of nutrient content across urban-grown and retail produce.
    - Role: Principal Investigator

- Partnering with City Government to Advance Urban Agriculture Safety in Baltimore City (2018 – 2019) No number, Johns Hopkins Lipitz Public Health Policy Faculty Award
    - PI: Keeve Nachman ($15,000, no salary support)
    - The goal of this project is to use findings from the Safe Urban Harvests study to develop evidence-based recommendations to aid the Baltimore Office of Sustainability in revising the City's urban agriculture soil safety policy, and to create and distribute a collection of free, print and electronic informational resources to encourage the safe conduct of urban agriculture.
    - Role: Principal Investigator

- CLF-RBA-4-FY19 Hurricane Florence Flooding in North Carolina: Mobilization of Contaminants by Extreme Flood Events and Impact on Human Exposure (9/1/2018 – 2/31/2020), Center for a Livable Future Directed Research Program
    - PI: Keeve Nachman ($53,984, no salary support)
    - The goal of this project is to perform a rapid-response assessment of water contamination in flooded rivers to characterize the potential for increased human exposures of direct relevance to health to inform preparedness activities in the U.S. and globally for storms that produce heavy flooding in areas with dense animal production.
    - Role: Principal Investigator

- The law of unintended consequences: Will the implementation of California SB27 impact animal health and well-being? (2017 – 2018) No number, Johns Hopkins Practical Ethics Award
    - PIs: Davis, Meghan and Fanzo, Jessica (Co-PIs, $67,500, 1% salary support 2017-2018)
    - The goal of this project is to characterize the immediate impact of SB27 on animal health and welfare and examine ethical trade-offs associated with the California law.
    - Role: Co-Investigator

- Building a baseline for assessing the human health impact of a landmark legislative intervention on antibiotic use in industrial poultry production (2017/01/01 - 2017/12/31) 010NAC2017, Johns Hopkins Fisher Center Discovery Program
    - PI: Keeve Nachman ($49,000, 1% salary support [2017])
    - The goal of this project is to develop a biorepository of E. coli isolates from retail chicken meat and human urinary tract infections to serve as a baseline in assessing the impact of California Bill SB27, a legislative intervention aimed at combatting antimicrobial resistance through restrictions on agricultural antimicrobial use.

- Role: Principal Investigator

- CLF-RBA-6-FY16 The Safe Urban Harvests Study of Urban Agriculture Participants in Baltimore City (1/1/2016 – 12/31/2017), Center for a Livable Future Directed Research Program
  - PI: Keeve Nachman (no salary support)
  - The purpose of this study is to characterize exposures to toxic metals among urban agriculture practitioners in Baltimore City and for those consuming urban-grown produce.
  - Role: Principal Investigator

- Behavioral Patterns and Potential Exposure Risks among Baltimore Urban Foragers (7/2014 – 12/2016), United States Department of Agriculture, Forest Service
  - PI: Keeve Nachman ($42,970, 8% salary support [2014])
  - This study aims to understand the foraging behaviors among Baltimore urban foragers in order to facilitate the modeling of cancer risks and non-cancer hazards related to chemical contaminant exposures.
  - Role: Principal Investigator

- Visualizing Opportunities for a Food Animal Atlas: A Scoping Project (9/2014 – 9/2015), the Clarence Heller Charitable Foundation, GRACE Communications Foundation, Panta Rhea Foundation, and the Thread Fund
  - PI: Keeve Nachman ($35,000 [through 2 grants and 2 gifts], 3% salary support [2014-15])
  - This goal of this project is to conduct a landscape assessment and evaluation of the data resources needed to create a dynamic, geospatially-referenced atlas of the components of the industrial food animal production sector in the United States
  - Role: Principal Investigator

- CLF-RBA-14-FY14 A market-basket study of turkey meat products to assess exposures to nitarsone, inorganic arsenic, and other arsenic species and corresponding risks (3/1/2014 – 3/31/2015), Center for a Livable Future Directed Research Program
  - PI: Keeve Nachman ($87,283, no salary support)
  - The goal of this project was to conduct a 3-city market basket study to support the estimation of daily dietary exposures to arsenic species among turkey consumers and estimated cancer risks associated with ingestion of iAs attributable to nitarsone use in animal production.
  - Role: Principal Investigator

- Antibiotic and other residues in poultry products sold in grocery stores pilot project (7/2012 – 1/2013), The Pew Charitable Trusts
  - PI: Keeve Nachman ($15,000)
  - Main Grant Objective: The purpose of this study is to characterize the residues of 59 pharmaceuticals and personal care products in retail poultry meat for the purpose of estimation of human exposure through chicken consumption.
  - Role: Principal Investigator

- Understanding Urban Gardeners' Perceptions of Risk from Soil Contamination: Identifying and Sharing Resources to Mitigate Contaminant Exposure (9/2011 – 9/2012) Johns Hopkins Urban Health Institute
  - PI: Keeve Nachman ($10,000)
  - The purpose of this study is to characterize the perceptions of risk from garden-based soil contaminants among urban community gardeners in Baltimore City, and to identify gaps in

knowledge and information resources which could prove helpful in understanding and mitigating these risks.
    - Role: Principal Investigator

- Follow-up on Spring Valley Health Study (9/2011-8/2012), District of Columbia Department of Environment
    - PI: Mary Fox ($250,000)
    - The project responds to continuing community concerns regarding environment and health related to historical activities (WWI chemical weapons development, testing, and related waste disposal) and ongoing remediation of buried munitions and contaminated soil.
    - Role: Co-Investigator, responsible for leading environmental health assessment.

- Consumer Reports testing project (August 2012 – December 2013), Consumer Reports
    - PI: Keeve Nachman ($57,000, no salary support)
    - The purpose of this study is to design and conduct a confidential testing project for a foodborne contaminant for the Consumer Reports magazine from start to finish, including advising on product selection, selection of laboratory, sample preparation, data analysis and risk estimation and characterization.
    - Role: Principal Investigator

- CLF-RBA-3-FY11 Roxarsone, Inorganic Arsenic, and Other Arsenic Species in Chicken: A U.S.-Based Market Basket Sample (3/1/2014 – 3/31/2015), Center for a Livable Future Directed Research Program
    - PI: Keeve Nachman ($185,500, no salary support)
    - The goal of this project was to conduct a 10-city market basket study of retail chicken to characterize arsenic species exposures and corresponding cancer risks associated with roxarsone use in industrial chicken production among poultry consumers.
    - Role: Principal Investigator

ACADEMIC SERVICE

Division and/or Department

JHSPH Department of Environmental Health and Engineering PhD Committee (Exposure Sciences and Environmental Epidemiology and Sustainability tracks) (2014 – present)
JHSPH Department of Environmental Health and Engineering DrPH Committee (2011 – present)
JHSPH Department of Environmental Health and Engineering MHS Committee (2011 – present)
JHSPH Department of Environmental Health Sciences MHS Admissions Committee (2013 – present)
JHSPH Department of Environmental Health Sciences MSPH in Toxicology Testing and Human Health Risk Assessment committee (2013 – present)
JHSPH Department of Environmental Health and Engineering Practice and Policy Committee (2013 – present; Committee Chair 2020 - present)
JHSPH Department of Environmental Health Sciences Summer Institute Planning Committee (2015 – present)
JHSPH Department of Environmental Health & Engineering Research Committee (2016 – 2021)
JHSPH Department of Environmental Health & Engineering Educational Programs Committee (2019 – 2020)
JHSPH Department of Environmental Health & Engineering Strategic Planning Committee (2019 – present)
JHSPH Department of Environmental Health & Engineering Sustainability PhD track planning committee (2019 – 2021)

JHSPH Department of Environmental Health & Engineering Environmental Sustainability, Resilience, and Health PhD Track Director (2021 - present)
JHSPH Department of Environmental Health and Engineering Executive Committee (2020 – present)

School

JHSPH Faculty Senate (2015 – 2017, 2019 - 2021)
JHSPH Interdepartmental Implementation Science Committee (2012 – 2015)
JHU Sustainability Leadership Council Research Committee (2019 – present)
Search Committee for Chair of the Department of Health Policy and Management (2021 – 2022)
Baltimore Community Engagement Committee (2021 – present)
Obesity and the Food System Steering Committee, Bloomberg American Health Initiative (2022 – present)
Evidence Workgroup, Bloomberg American Health Initiative (2022 – present)

PRESENTATIONS

Scientific Meetings

Resnick B, Burke, T, **Nachman KE**, Zablotsky J. *The Profile of Maryland Environmental Public Health Practice*. Maryland Conference of Local Environmental Health Directors. Annapolis, MD. September 2003.

Streeter R, Malecki K, Ettinger A, Herbstman J, **Nachman KE**, Resnick B, Burke T. Environmental Public Health Tracking: Laying the Foundation. Geomed Conference - Baltimore, MD. October 2003.

Resnick B, Burke T, Zablotsky J, **Nachman KE.** Academic-Practitioner Partnerships in Action: Enhancing Maryland Environmental Public Health Capacity. American Public Health Association Annual Meeting. San Francisco, CA. November 2003.

Resnick B, Burke T, **Nachman KE**, Zablotsky J. *The Profile of Maryland Environmental Public Health Practice*. Maryland Conference of Local Environmental Health Directors. Annapolis, MD. December 2003.

Burke T, Resnick B, **Nachman KE**, Zablotsky J. *Environmental Public Health: Past and Future.* National Center for Environmental Health Annual Conference. Atlanta, GA. December 2003.

Burke T, Resnick B, **Nachman KE**, Zablotsky J. *Center Activities and Accomplishments.* Centers for Disease Control and Prevention Year Three Capacity Building Meeting. Atlanta, GA. March 2004.

Resnick B, **Nachman KE**, Zablotsky J. *The Profile in Maryland Environmental Health Practice—An Update*. Maryland Conference of Local Environmental Health Directors. Annapolis, MD. March 2004.

Resnick B, Malecki K, **Nachman KE**, Zablotsky J, Streeter R, Herbstman JB, Ettinger A, Burke T. *Data Usage for Environmental Public Health Tracking: The Devil is in the Details*. Many Voices – One Vision: 2004 Environmental Public Health Tracking Program Conference. Philadelphia, PA. March 2004.

Resnick B, Zablotsky J, **Nachman KE**, Burke T. *The People Network: Bridging the Environment and Health Gap.* Many Voices – One Vision: 2004 Environmental Public Health Tracking Program Conference. Philadelphia, PA. March 2004.

Zablotsky J, **Nachman KE**, Burke T, Resnick B. *The Johns Hopkins Center for Excellence in Environmental Public Health Tracking.* Many Voices – One Vision: 2004 Environmental Public Health Tracking Program Conference. Philadelphia, PA. March 2004.

Resnick, B. Sherrard S, **Nachman KE**, Zablotsky J. *Local Environmental Public Health Practice in 2004 and Beyond: A Maryland Example.* National Association of County and City Health Officials Annual Meeting. St. Paul, MN. July 2004.

Nachman KE, Zablotsky J, Resnick B, Burke T. *The Profile of Maryland Environmental Public Health Practice*, American Public Health Association Annual Meeting. Washington, D.C., November 2004.

Litt J, Tran N, Chossek-Malecki K, Neff R, Resnick B, **Nachman KE**, Apelberg B, Wismann A, Burke T. *Identifying priority health conditions, environmental data and infrastructure needs: A synopsis of the Pew Environmental Health Tracking project*. American Public Health Association Annual Meeting. Washington, DC., November 2004.

Nachman KE. *Arsenic – A Roadblock to Management Options for Poultry House Waste?* EPA Regional Conference on Animal Feeding Operations. Adelphi, MD, December 2004.

Nachman KE, Breysse P. Evaluation of Risk Assessment Report for the Southwest Area Park K-9 Facility. Baltimore County Fraternal Order of Police, Lodge #4. Carnie, MD, October 2005.

Streeter R, Resnick B, Curriero F, Zablotsky J, **Nachman KE**, Burke TA. Characterizing arsenic in eastern Maryland groundwater: A community/academic collaboration. American Public Health Association Annual Meeting. Philadelphia, PA., December 2005.

Resnick B, Zablotsky J, **Nachman KE**, Burke T. Northeast Environmental Public Health Profile: An Expansion of the Maryland Profile. American Public Health Association Annual Meeting. Philadelphia, PA., December 2005.

Streeter R, Resnick B, Curriero F, Zablotsky J, **Nachman KE**, Burke T. Evidence of the Environment's Relationship to Health. American Public Health Association Annual Meeting. Philadelphia, PA., December 2005.

Nachman KE. Arsenic – A Roadblock to Management Options for Poultry House Waste? American Public Health Association Annual Meeting. Philadelphia, PA., December 2005.

Nachman KE. The Public Health Consequences of Arsenical Antimicrobial Drugs Used in Industrial Poultry Production. 10th Anniversary of the Johns Hopkins Center for a Livable Future. Baltimore, MD, December 2006.

Silbergeld EK, Nweke O, **Nachman KE**, Aposhian V. Arsenicals and Food Animal Production. 12th International Conference of the Pacific Basin Consortium for Environment and Health Sciences. Beijing, China, October 2007.

Sapkota A., Perodin J., Maring E.F., **Nachman K.**, Ritz B., and Shenassa E.D. Asthma Exacerbation Resulting From Exposure to Traffic Exhaust: A Meta-Analysis (Poster), November 2008.

Gaber N, Foley G, **Nachman K**, Sunderland E. Evaluation Practices used across EPA for Determining when an Environmental Model is Suitable for Informing Decisions. Society for Risk Analysis Annual Meeting, December 2008.

Nachman KE. From Farm to Tap: Impacts of Intensive Animal Agriculture on Water Quality and Human Health. Invited seminar, Mississippi River Basin Agriculture Caucus, Minneapolis, MN, July 2009.

Nachman KE, Parker JD. Fine Particulate Air Pollution and Asthma in Adults (Poster). International Society for Environmental Epidemiology Annual Meeting, Dublin, Ireland, August 2009.

Parker JD, Kravets NF, Woodruff TJ, **Nachman KE**. Air Pollution and Mortality for Black and White Adults in the United States: Results from the U.S. National Health Interview Survey. International Society for Environmental Epidemiology Annual Meeting, Dublin, Ireland, August 2009.

Neff RA, **Nachman KE**, Dolan K, Rosenthal A, Hartle J. Pesticide Levels in Imported Produce: Policy and Oversight Gap. 137th American Public Health Association Annual Meeting. Philadelphia, PA., November 2009.

Kim B, Kurtz-Nicholl J, Horrigan L, **Nachman KE**. Engaging youth in the food system through education. Oral presentation, 138th American Public Health Association Annual Meeting, Denver, CO, November 2010.

Nachman KE, Parker JD. Disparities in Race/Ethnicity in Relation to Air Pollution Exposure and Asthma in Adults. USEPA Symposium: Strengthening Environmental Justice and Decision Making: A Symposium on the Science of Disproportionate Environmental Health Impacts. Washington DC, March 2010.

Love DC, Rodman S, Neff R, **Nachman KE**. Importing tainted seafood: A comparison of veterinary drug residue detections by the US, EU, Canada and Japan. American Public Health Association Annual Meeting. Washington, DC, November 2011.

Nachman KE, Fain K, Shah S, Smith TJ, Fox MA. Comparability of toxicological evaluation frameworks for veterinary and human pharmaceuticals and environmental chemicals across five federal programs. Society for Risk Analysis Annual Meeting. Charleston, SC, December 2011.

Margulies J, Dix K, Kim B, Palmer A, **Nachman, K.** "Understanding Urban Gardeners' Perceptions of Risk from Soil Contamination: Communication of Risk Knowledge and Resources between Individuals, Communities and Institutions." 72nd Annual Meeting of the Society for Applied Anthropology, Baltimore, Maryland, March 2012.

Love DC, Halden RU, Davis MF, **Nachman KE**. "Feather Meal Contains Multiple Antimicrobials and Enrofloxacin at Levels that Inhibit Susceptible *E. coli*." American Society of Microbiology 2012 Annual Meeting, San Francisco, California, June 2012.

Nachman KE, Smith TJ, Truant PL., "Volatile organic compounds at animal production sites – gaps in knowledge and regulatory shortcomings." North Carolina Environmental Justice Summit, Whittakers, North Carolina, October 2012.

Smith TJ, Rubenstein LS, **Nachman KE**. "Public Access to Information about Airborne Hazardous Releases from Animal Feeding Operations". North Carolina Environmental Justice Summit, Whittakers, North Carolina, October 2012.

Fry J, Laestadius L, **Nachman KE**, Neff RA. "The Role of State and Local Health Departments in Addressing Public Health Concerns Related to Industrial Food Animal Production and Implications for Environmental Justice." North Carolina Environmental Justice Summit, Whittakers, North Carolina, October 2012.

Margulies J, Kim B, Dix K, Poulsen M, Palmer A, **Nachman KE**. "Understanding Urban Gardeners' Perceptions of Risk from Soil Contamination: Identifying and Sharing Resources to Mitigate Contaminant Exposure". American Public Health Association 2012 Annual Meeting, San Francisco, CA, October 2012.

Fry J, Laestadius L, **Nachman KE**, Neff RA. "Who is looking out for rural health? Local and state health departments' responses to industrial food animal production in eight states". American Public Health Association 2012 Annual Meeting, San Francisco, CA, October 2012.

Nachman KE. "Industrial Food Animal Production and Injustice". First Annual Symposium on Environmental Justice and Health Disparities in Maryland and DC, University of Maryland, College Park, College Park, MD, November 2012.

Fry JP, Laestadius L, Grechis C, **Nachman KE**, Neff RA. "Engagement of government agencies with environmental public health issues surrounding industrial food animal production in eight states: An example of environmental public health systems research". National Environmental Health Association 2013 Annual Educational Conference, Washington, DC, July 2013.

Fox MA, **Nachman KE**, Fain K, Smith T. "Comparing drug and chemical evaluation frameworks: Improving strength and transparency". 141st American Public Health Association Annual Meeting, Boston, MA, November 2013.

Nadimpalli M, Rinsky J, Hall D, Pierce E, Pisanic N, Larsen J, **Nachman K**, Love D, Wing S, Stewart J, Heaney C. Persistence of livestock-associated methicillin and multidrug-resistant Staphylococcus aureus among industrial hog operation workers in North Carolina. 3rd ASM-ESCMID Conference on Methicillin-resistant Staphylococci in Animals: Veterinary and Public Health Implications. Copenhagen, Denmark, November 2013.

Maron DF, Smith TJ, **Nachman KE**. "Restrictions on antimicrobial use in food animal production: A cross-country regulatory and economic survey". 141st American Public Health Association Annual Meeting, Boston, MA, November 2013.

Heaney C, Pisanic N, Nadimpalli M, Rinsky J, Love D, **Nachman K**, Perl TM, Wing S, Stewart J. "Concurrent Exposure to Drug-Resistant *Staphylococcus aureus*, Influenza A Virus, and Hepatitis E Virus Among Industrial Hog Operation Workers". IDWeek, Philadelphia, PA, October 2014.

Heaney C, Pisanic N, Nadimpalli M, Rinsky J, Love D, **Nachman K**, Perl TM, Wing S, Stewart J. "*Staphylococcus aureus* CC398 and Pig-Specific Fecal Bacteriodales QPCR Concentrations Decline With Increasing Time Away From Work Among Industrial Hog Operation Workers". IDWeek, Philadelphia, PA, October 2014.

Nachman KE. "Industrial Animal Agriculture in the Bay: Disproportionate Burden and Health Issues". Third Annual Symposium on Environmental Justice and Environmental Health Disparities in Maryland and Washington, DC. College Park, MD. December 2014.

Nachman KE. "Transparency considerations for toxicological evaluation approaches for veterinary and human pharmaceuticals, environmental chemicals, and food and food additives across seven US federal programs". Society for Risk Analysis Annual Meeting, Denver, CO. December 2014.

Love DC, Fry JP, West P, Engstrom P, **Nachman KE**, Lawrence RS. "Interconnections Between Agriculture and Aquaculture: Implications for a Sustainable and Resilient Food System." Soil Science Society of America Annual Conference, Minneapolis, MN, November 2015.

Nachman KE., Ginsburg G, Miller M, Murray C, Nigra A. "Arsenic, food, U.S. policy and public health: identifying key challenges". Collaborative on Food with Arsenic and associated Risk and Regulation (C-FARR) Conference at Dartmouth College, Hanover, NH, November 2015.

Zuidema, C, Synk C; Kim BF. Harding J, Rak S, Emery M, **Nachman KE**. "Development of an Environmental Health Risk Assessment Framework for Consumption of Foraged Items in the Urban Environment: a Baltimore, MD Case Study using Berries and Greens." Oral Presentation at the Urban Food System Symposium (UFSS), Olathe, KS. June 2016.

Synk C; Kim BF. Rogers G, Harding J, Davis CA, Emery M, **Nachman KE**. "Gathering Baltimore's bounty: Characterizations of urban foraging behaviors, motivations, and barriers." Oral Presentation at the Urban Food System Symposium (UFSS), Olathe, KS. June 2016.

Synk C, Kim B, Rogers G, Harding J, Davis C, Emery M, Hurley P, & **Nachman KE**. "Gathering Baltimore's bounty: Characterizations of urban foraging behaviors, motivations, and barriers." Oral Presentation at the Yale Food System Symposium, New Haven, CT. September 30, 2016.

Nachman KE. "Arsenic and Diet: Translating Emerging Scientific Evidence into U.S. Public Health Policy" American Association for Advancement of Science 2017 Meeting, Boston, MA. February 2017.

Kim B, Santo R, Scatterday A, Fry J, Synk C, Mekonnen M, Hoekstra A, Neff R, **Nachman K**. Targeting Plant-Centric Dietary Interventions for Climate Change Mitigation. American Public Health Association Annual Meeting, Atlanta, GA. November 2017.

Murray C and **Nachman K**. Mitigating Dietary Arsenic Exposure: Current status in the US and recommendations for an improved path forward. American Public Health Association Annual Meeting, Atlanta, GA. November 2017.

Ramsing B, Neff R, **Nachman K**, Kim H, Hricko C. Leveraging Dietary Patterns and Policy to Mitigate Climate Impacts. American Public Health Association Annual Meeting, Atlanta, GA. November 2017.

Nigra AE, Sanchez TR, **Nachman KE**, Harvey D, Chillrud SN, Graziano JH, Navas-Acien A, Decline in arsenic exposure in the United States from 2003 to 2014: the impact of the Environmental Protection Agency maximum contaminant level. NIEHS Superfund Research Program Annual Meeting, December 2017, Philadelphia, PA.

Nachman KE. The Community Healthy Air Act. The 4th Symposium on Environmental Justice and Health Disparities in Maryland and the Washington, DC Region, May 2018, College Park, MD.

Neff R, Kim B, Hecht A, Santo R, Fry J, **Nachman K.** A GWP20/100 Analysis of Greenhouse Gas Emissions from Global Wasted Food: Educating About Methane, Agriculture and Human Values Conference, June 2018, Madison, WI.

Kim H, Rebholz CM, Caulfield LE, Ramsing B, **Nachman KE**. Trends in Dietary Sources of Protein in US Adults: Results from the National Health and Nutrition Examination Survey 1999-2010. 2018 American Society for Nutrition Annual Meeting, Boston, MA, June 2018.

Lupolt S, Santo R, Kim BF, Viqueria R, Evans E, Illuminati J, Burrows R, Swanenberg A, Huang J, **Nachman K**. Characterizing risks from heavy metal contamination in soil, irrigation water, and urban-grown produce form Baltimore City's urban farms and gardens; 2018 Urban Food System Symposium, August 2018, Minneapolis, MN.

Nachman KE: Safe Urban Harvests: Implications for Nutrition and Food Safety. USDA Beltsville Agricultural Research Center Symposium on Urban Agriculture. September 2018, Beltsville, MD.

Nachman KE. Soil and Food Safety. Soil Health Institute 2018 Conference on Connections Between Soil Health and Human Health, October 2018, Silver Spring, MD.

Lupolt S, Santo R, Kim BF, **Nachman K**. Assessing heavy metal exposures in irrigation water and growing media among urban farmers and gardeners in Baltimore, MD. 2018 American Public Health Association Annual Meeting, November 2018, San Diego, CA.

Lupolt S, Santo R, Kim BF, **Nachman K**. A comparison of toxic and beneficial metal content in urban-grown, peri-urban, conventional, and certified organic fruits and vegetables. 2018 American Public Health Association Annual Meeting, November 2018, San Diego, CA.

Nachman KE. Safe Urban Harvests: Agriculture and Human Health. American Society of Agronomy/Crop Science Society of America/Canadian Society of Agronomy 2018 Joint Meeting, November 2018, Baltimore, MD.

Burrows R, Lupolt S, Evenson B, Santo R, Kim B, **Nachman K.** Climate Change Mitigation Through Urban Agriculture: Assessing the Potential Capacity of Agricultural Production in Baltimore. Poster session presented at the Johns Hopkins mini-symposium, Changing By Degrees: Multidisciplinary Approaches to Climate Change at the National Academy of Sciences. May 2019, Washington, DC.

Lupolt S, Santo R, Kim BF, Green CE, Codling EE, Chen, R, Rule A, **Nachman K**. The Safe Urban Harvests Study: Assessing exposure to six toxic metals among urban agriculture participants in Baltimore, MD. 2019 International Society for Exposure Science/International Society for Indoor Air Quality Annual Joint Meeting, August 2019, Kaunas, Lithuania.

Santo R, Lupolt SN, **Nachman KE**, "Findings from the Safe Urban Harvests Study: A survey of soil, water, and produce from Baltimore farms and gardens" at Baltimore Ecosystem Study 21st Annual Research Conference, October 23, 2019, University of Baltimore, Baltimore, MD.

Nachman KE, Industrial Food Animal Production and Human Health. American Public Health Association Annual Meeting, Philadelphia, PA., November 2019.

Nachman KE, Shepherding science into the decision-making process: case studies in food production and public health. International Society for Environmental Epidemiology Annual Meeting, Online, August 2020.

Lupolt SN, Santo RS, **Nachman KE**. Characterizing exposures to heavy metals in urban-grown produce from Baltimore City's urban farms and gardens. 2020 Urban Food System Symposium, October 2020, Virtual Conference.

Nachman KE, Why and How to Write an Environmental Epidemiology Commentary. International Society for Environmental Epidemiology Annual Meeting, New York, NY, August 2021.

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Invited Seminars

Burke T, Resnick B, **Nachman KE**, Zablotsky J. Local Public Health Practice. Public Health Association for Student Experience (PHASE) Lecture Series. Johns Hopkins Bloomberg School of Public Health. July 2003.

Resnick B, **Nachman KE**, Zablotsky J. *The Profile of Maryland Environmental Public Health Practice*. Maryland Department of the Environment. Baltimore, MD. September 2003.

Burke T, Resnick B, Malecki K, Streeter R, **Nachman KE.** The Future of Public Health: Environmental Public Health Tracking, National Exposure Research Laboratory (NERL) Environmental Protection Agency, Raleigh North Carolina. November, 2003

Resnick B, **Nachman KE**, Zablotsky J. *The Profile in Maryland Environmental Health Practice.* Region III Environmental Protection Agency and the Agency for Toxic Substances and Disease Registry. Philadelphia, PA. December 2003.

Burke T, Resnick B, **Nachman KE**, Zablotsky J. *The Profile of Maryland Environmental Health Practice—An Update*. Maryland Association of County Health Officers Monthly Meeting. Baltimore, MD. March 2004.

Nachman KE, Apelberg B. Building on the Work of the Pew Environmental Health Commission: The Utility of National Datasets for Environmental Public Health Tracking. Johns Hopkins Center of Excellence for Environmental Public Health Tracking Luncheon. Baltimore, MD. October 2004.

Nachman KE, A Journey into the World of Poop: Center for a Livable Future Lunch Meeting. Baltimore, MD. February 2005.

Burke T, Resnick B, **Nachman KE**, Zablotsky J. Advancing Maryland Environmental Health Practice. Maryland State-Local Liaison Committee Meeting. Maryland Department of Environment. Baltimore, MD, January 2006.

Resnick B, **Nachman KE**, Zablotsky J. The Northeast Regional Profile of Local Environmental Health Practice. Pennsylvania Environmental Health Directors Meeting. Harrisburg, PA, March 2006.

Nachman KE, Breysse P. Evaluation of Human Health Risk Assessments Performed for the Southwest Area Park Canine Facility. Baltimore County Fraternal Order of Police, Lodge #4. Carnie, MD, May 2006.

Nachman KE. Pelletized Waste Fertilizers: A Case Study in Arsenic Exposure. USEPA, National Center for Environmental Economics. Washington, DC. May 2006.

Nachman KE. Assessment of Human Health Risks Resulting from Exposures to Arsenic During the Use of Pelletized Poultry House Waste and Biosolids Fertilizers. Thesis Seminar. Baltimore, MD, August 2006.

Nachman KE. Risk Assessment: Current Applications and Future Direction. Invited seminar, National Center for Health Statistics, Office of Analysis and Epidemiology Seminar Series, Hyattsville, MD, March 2009.

Nachman KE. From Farm to Tap: Impacts of Intensive Animal Agriculture on Water Quality and Human Health. Capitol Hill Briefing, Washington DC, June 2009.

Nachman KE. Industrial Food Animal Production: Known Threats and Emerging Issues. Invited seminar, USEPA National Center for Environmental Research, Washington DC, June 2009.

Nachman KE. EPA's Integrated Risk Information System. University of Maryland School of Public Health. College Park, MD, October 2009.

Nachman KE. Arsenical drugs in food animal production: Where we're going and how we'll get there. Invited seminar, Columbia Superfund Research Program Seminar Series, Columbia University Mailman School of Public Health, New York, NY, March 2010.

Nachman KE. The human health risks associated with industrial food animal production. Johns Hopkins Bloomberg School of Public Health. Baltimore, MD, September 2010.

Nachman KE. The Smokestack Effect: Data, Media and Action. University of California, San Francisco. Reach the Decision Makers Webinar. San Francisco, CA, October 2010.

Nachman KE. The human health risks associated with industrial food animal production. Mini-Med School: Food Systems, Health and a Livable Future. Odyssey Lecture Series. Baltimore, MD, October 2010.

Nachman KE. Choice of Exposure Assumptions Used in Modeling Inorganic Arsenic Cancer Risk. Johns Hopkins Bloomberg School of Public Health. Baltimore, MD, April 2011.

Nachman KE. The Health and Environmental Impacts of Large-Scale Meat & Poultry Production. Maryland Hospitals for a Healthy Environment Food Conference: Local Sustainable Meat and Poultry: Making the Shift in Institutional Purchasing. Clarksville, MD, May 2011.

Lawrence RS, **Nachman KE**. Industrial Food Animal Production and the High-meat Diet: Health and Environmental Consequences. Invited webinar for the Center for Science in the Public Interest, June 2011.

Nachman KE. Animal Waste, Produce Safety, and the Food Safety Modernization Act. Public Health Practice Grand Rounds, Johns Hopkins Bloomberg School of Public Health. Baltimore, MD, September 2011.

Nachman KE. Industrial Food Animal Production, Human Health and the Environment. Invited seminar: Dietary Managers' Association Annual Meeting. Ocean City, Maryland, October 2011.

Nachman KE and Farming for the Future Program Personnel. 11 Things You Probably Didn't Know About Industrial Food Animal Production. 2011 Food Day Teach-In. Baltimore, MD, October 2011.

Nachman KE. Arsenical drugs in food animal production. Dartmouth Institute for Health Policy and Clinical Practice. Hanover, NH, February 2012.

Nachman KE. Industrial food animal production: consequences for agricultural communities and food safety. Invited seminar: Dartmouth Hitchcock Medical Center Grand Rounds. Hanover, NH, February 2012.

Nachman KE. Arsenical drugs in food animal production. Invited webinar: Healthy Food Action/Institute for Agriculture and Trade Policy, March 2012.

Nachman KE. The use of antibiotics in food animal production and the value and limitations of monitoring for livestock antibiotics. Environmental Integrity Project Field Sampling Training Session, Washington, DC, April 2012.

Nachman KE. Arsenical drugs in food animal production. Network for Public Health Law, Eastern Regional Conference. Baltimore, MD, June 2012.

Nachman KE. Antimicrobial Resistance and Food Animal Production: Developments since Putting Meat on the Table. Meeting of the Former Commissioners of the Pew Commission on Industrial Food Animal Production, Baltimore, MD, October 2012.

Nachman KE. Consumers Union Panel: Arsenic in Foods. New York, NY October 2012.

Nachman KE. Arsenic in food. Meeting of the Health Advisory Board of the Johns Hopkins Bloomberg School of Public Health, Baltimore, MD. October 2012.

Kim BF, **Nachman KE**. Urban Community Gardeners' Knowledge and Attitudes Related to Soil Contamination Risks. Baltimore Community Greening Resource Network Annual Meeting, Baltimore, MD. January 2013.

Kim BF, **Nachman KE**. Urban Community Gardeners' Knowledge and Attitudes Related to Soil Contamination Risks. Baltimore Master Gardeners' Monthly Meeting and Lecture Series, Baltimore, MD. March 2013.

Nachman KE. Arsenic-based drugs in food animal production. Indiana CAFO Watch 2013 Conference, Indianapolis, IN. August 2013.

Nachman KE. From Bench to Legislation: Using Evidence to Inform Decision-making. Johns Hopkins Bloomberg School of Public Health Environmental Health Sciences Faculty Meeting, Baltimore, MD. September 2013.

Kim B, Dix K, Poulsen M, Margulies J, Palmer A, **Nachman K**. Baltimore Urban Community Gardeners' Knowledge and Perceptions of Soil Contaminant Risks. Poster, Baltimore Ecosystem Study Annual Meeting, Baltimore, MD. October 2013.

Nachman KE. Recent research in industrial food animal production and public health. Wisconsin Rural Health Forum, Sturgeon Bay, WI. November 2013.

Nachman KE. Caramel Color and 4-Methylimidazole in Soda: A Cancer Risk Assessment. Presentation to FDA/CFSAN/OFAS, College Park, MD, January 2014.

Nachman KE. A crash course in antibiotics in animal agriculture. New York City Bar Association Symposium ("Animal Agriculture: What Is Its Impact On the Environment?"), New York, NY, March 2014.

Nachman KE. Urban Soil Safety Panel. Parks and People Foundation, Community Greening Resource Network Meeting, Baltimore, MD, September 2014.

Nachman KE. Food Day Special: The 21st Century Jungle (webinar moderator and presenter). Invited webinar: Health Food Action, October 2014.

Nachman KE. The Public Health Crisis of Antibiotic Misuse in Animal Agriculture. Invited seminar, A Woman's Journey Annual Conference, Baltimore, MD, November 2014.

Nachman KE. Arsenic-based Animal Drugs: A Case Study in Scientific Evidence, Media Coverage, and Policy Change. Invited seminar: Dartmouth Toxic Metals Superfund Research Program, Hanover, NH, November, 2014.

Nachman KE. CAFOs, Air Pollution and Public Health. Invited press conference: Environmental Integrity Project and the Humane Society of the United States, Washington, DC, January 2015.

Davis BJK, Li CX, **Nachman KE**. The Health Risks and Benefits of Consuming Raw versus Pasteurized Milk: A Scientific Literature Review. Briefing to the Maryland General Assembly, House Committee on Health and Governmental Affairs, Subcommittee on Public Health. Annapolis, Maryland, February 2015.

Nachman KE. Recent research in industrial food animal production and public health. After the Siting – Health Forum. Bayfield, WI, February 2015.

Nachman KE. A crash course in antibiotics in animal agriculture. New York City Bar Association Symposium ("Superbug Farm: A Discussion on Antibiotics in Agriculture"), New York, NY, June 2015.

Nachman KE. A crash course in antibiotics in animal agriculture. Natural Products Expo East, Baltimore, MD, September 2015.

Nachman KE. Antibiotic use in food animal production and public health risks. Johns Hopkins Bayview Medical Center Grand Rounds, Baltimore, MD, September 2015.

Nachman KE. Translating Science for Policymakers. Unite for Sight Webinar, December 2015.

Santo R, Kim B, Scatterday A, Synk C, Fry J, **Nachman K**, Neff R. Less Meat, Less Heat: Climate Benefits of Dietary Shifts in Selected Countries. COP21 Paris Climate Conference. December 2015.

Nachman KE. Collecting actionable surveillance data – the US perspective. Designing a Monitoring and Accountability Framework for Antibiotic Resistance (Workshop). Duke Sanford School of Public Policy, Durham, NC, December 2015.

Nachman KE. Poultry drugs, arsenic and public policy: a case study in evidence-based advocacy. NIH Science Policy Discussion Group, Bethesda, MD, February 2016.

Nachman KE. Antibiotic use in food animal production and public health risks. Comparative Pathobiology Seminar Series, Johns Hopkins School of Medicine, Baltimore, MD, February 2016.

Nachman KE. The public health crisis of antibiotic misuse in animal agriculture. Executive Support Staff Group, Johns Hopkins Medical Institutions, Baltimore, MD, March 2016.

Nachman KE. Exploring the Societal Burden of Animal Agricultural Antibiotic Use. True Cost of American Food Conference, San Francisco, CA, April 2016.

Nachman KE. Evidence for environmental transmission of antibiotic-resistant bacteria from industrial farms. Food Forum of the Institute of Medicine of the National Academy of Sciences. Washington, DC, April 2016.

Kim BF, **Nachman KE**. Soil Matters: A Symposium on Urban Soils: Contamination and Mitigation. Community Greening Resource Network Event. Baltimore, MD, August 2016.

Nachman KE. Arsenic-based poultry drugs: a case study in industrial agriculture and cancer. National Cancer Institute, 15th Annual Cancer Prevention Fellowship Program Fall Symposium, Bethesda, MD, September 2016.

Nachman KE. Risks and perceptions among urban agriculture participants in Baltimore. University of Maryland, Baltimore County, Baltimore, MD, October 2016

Nachman KE. A crash course in antibiotics in animal agriculture. One Health Day Symposium, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, November 2016.

Nachman KE. Industrial Food Animal Production in Low- and Middle-Income Countries: Current trends and future priorities. Webinar. Johns Hopkins Center for a Livable Future, Baltimore, MD, December 2016.

Nachman KE. Building a baseline for assessing the human health impact of a landmark legislative intervention on antibiotic use in industrial poultry production. Clinical Conundrums seminar series of the Sherrilyn and Ken Fisher Center for Environmental Infectious Diseases, Baltimore, MD, April 2017.

Nachman KE, Fox MA, Burke TA. Tutorial on NAS Report Science and Decisions: Regulatory Risk Assessment. Invited Webinar, PHRE Rapid Response Network, University of California, San Francisco, May 2017.

Nachman KE. Arsenic-based poultry drugs: Turning evidence into policy. Interdisciplinary Toxicology Program Seminar Series, University of Illinois Urbana-Champaign, Champaign, IL, October 2017.

Nachman KE. Safe Urban Harvests: Study Overview and Preliminary Results. United States Department of Agriculture, Agricultural Research Service, Beltsville Human Nutrition Research Center. 2017-2018 BHNRC Seminar Series, Beltsville, Maryland, January 2018.

Nachman KE. Translating Public Health Science in the Modern Era: Essential, Sometimes Uncomfortable, but Usually Rewarding. NIEHS Northeast Regional Superfund Meeting (Invited Keynote), Boston, Massachusetts, April 2019.

Nachman KE. Moving Beyond the Baseline to Assess the impact of California's SB27. Infectious Disease and Clinical Research Topics seminar series of the Sherrilyn and Ken Fisher Center for Environmental Infectious Diseases, Baltimore, MD, June 2019.

Nachman KE, Lupolt S, Santo R, Kim B, Green C, Codling E, Chen R, Rule A. The Safe Urban Harvests Study: a community-driven assessment of metals exposure in the context of urban agriculture. Seminar for European Food Safety Administration US visit, Baltimore, MD, September 2019.

Lupolt S, Santo R, **Nachman KE**, "Findings from the Safe Urban Harvests Study: A survey of soil, water, and produce from Baltimore farms and gardens" at University of Maryland Extension- Baltimore City Master Gardeners Speaker Series, September 17, 2019, Cylburn Arboretum, Baltimore, MD.

Nachman KE, "The Safe Urban Harvests Study: An Exploration of Urban Agriculture and Metals Exposure in Baltimore", the Johns Hopkins Center for Human Nutrition Seminar Series, Baltimore, MD., October 2019.

Nachman KE, "Country-specific dietary shifts to mitigate climate and water crises", Alliance for a Healthy World Symposium, Baltimore, MD, November 2019.

Nachman KE, "The Safe Urban Harvests Study: Metals, Decision-making and Risk Communication". Columbia Superfund Research Program Seminar Series, New York, November 2019.

Nachman KE, "Changing Diets for a Changing Climate" Rotary Club of Richmond, Richmond, VA. March 2021

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MEDIA/PRESS INTERVIEWS

USA Today, September 2009 (Testing for toxics at schools sparks questions, lawsuits)

Food Safety News, September 2009 (Bill Introduced to Ban Arsenic Antibiotics in Feed)

Times Beacon Record, November 2009 (Israel: Pass the turkey, hold the poison)

WTOP DC, November 2009 (Do you know what turkeys are gobbling?)

FDA Week, Jan 2010 (Animal Antibiotic Ban Advocates Fire Back At GOP Lawmaker's Op-Ed)

FDA Week, Feb 2010 (Stakeholders Pull Out The Guns Following CBS Animal Antibiotic Special Report)

FDA Week, Jun 2010 (Lawmakers Press For Bolstered Antibiotics Monitoring Activities)

York Daily Record, September 2010 (Peach Bottom Township in fight over farm with AG Tom Corbett)

National Public Radio, November 2010 (No Arsenic In Pardoned Turkeys, But It Might Be In Yours)

NPR Environment in Focus (radio), February 2011 (Nachman interview)

WAMU radio, February 2011 (Nachman interview)

Bay Daily, February 2011 (MD Attorney General to Poultry Industry: Get the Arsenic Out of Chicken)

Bay Daily, March 2011 (Lobbying By Poultry Industry in Maryland Keeps Arsenic in Chicken Feed. Attorney General Gansler Fights For Ban at Federal Level)

Southern Maryland Today, February 2011 (Hold the Arsenic)

Tennessean, March 2011 (Tennessee organic farmer worries corporate chicken farm will harm area)

Change.org, March 2011 (Drugs in Animal Feed Pose Dire Human Health Risks)

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San Francisco Chronicle, June 2012 (Trader Joe's prodded to drop meat with antibiotics)

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Redbook, July 2012 (Get a new grocery list!)

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International Business Times, April 2014 (Antibiotic Resistance: How Livestock Lobbyists and Drug Companies Hinder The US Fight Against Superbugs)

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Men's Health, December 2014 (The Scary Truth About Chicken)

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Feedstuffs, January 2015 (EPA sued over CAFO regulation petitions)

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Bay Journal, January 2015 (EPA sued over inaction on factory farm air pollution)

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Beverage Daily, February 2015 (Study suggests 4-MEI in soft drinks presents 'avoidable and unnecessary' cancer risk)

New York Times, March 2015 (Obama Seeks to Double Funding to Fight Antibiotic Resistance)

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Reader's Digest, May 2015 (50 Secrets Food Manufacturers Don't Tell You That Could Change the Way You Eat)

The Oregonian, May 2015 (Antibiotic-resistant superbugs drive chicken producers to change)

Baltimore WBFF News (TV), November 2015 (Overuse of antibiotics in livestock poses health risk to kids)

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Old Line Plate (online blog), February 2018 (Foraging for Food In Baltimore)

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Urban Food Futures, May 2018 (Unnoticed, yet happening: food foraging in the city)

CNN (TV), May 2018 (What`s in the Diets of Animals Raised for Food, and Why Might That Matter to Some Consumers?)

ScienceLine, July 2018 (Foragers are eating wild in America's concrete jungles)

Baltimore Sun, January 2019 (Maryland will test to determine if Eastern Shore chicken farms are polluting the air)

Delmarva Now, January 2019 (Maryland air quality monitoring plan reignites poultry battle)

Food and Environment Reporting Network, January 2019 (In Maryland, poultry industry monitoring initiative restarts debate)

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Chesapeake Bay Journal, February 2019 (Poultry industry critics fight to clear the air on emissions)

Delmarva Now, April 2019 (Chicken industry sees slow growth in 2018 but continued drop in growers)

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Huffington Post, September 2019 (Why Going Vegetarian Isn't Necessarily The Best Diet For The Planet)

Newsweek, September 2019 (This is the best diet to save the planet)

CBS Radio, September 2019 (Nachman interview)

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Washington Times, September 2019 (Vegetarian diets harsher on environment than eating some meat: Study)

Telegraph, September 2019 (Eating some meat is better for the environment than going vegetarian, new study finds)

Yahoo News, September 2019 (Meat-free diets 'can be worse for the environment')

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WBEZ Chicago - Chewing Podcast, October 2019 (Nachman interview)

100° (French language), January 2020 (Alimentation et protection de la planète : par où commencer pour réduire le bilan carbone de nos assiettes ?)

WYPR Baltimore radio and web, March 2020 (Eastern Shore Residents Push State Lawmakers For Limits On Chicken Farms)

Fast Company, May 2020 (4 ways to protect food workers and the food supply during the pandemic)

Food and Environment Reporting Network (Ag Insider), July 2020 (Covid-19 cases appear to be slowing at meat plants. But companies aren't releasing test results)

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CDIRAP News, May 2021 (Fewer drug-resistant microbes found in organic meat)

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Bloomberg News, March 2022 (Pork With Toxic Risk Is in U.S. Food Supply Amid FDA Stalemate)

HUB at Johns Hopkins University, February 2022 (Researchers to develop new methods for estimating children's exposure to chemicals)

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Inside EPA, November 2022 (Researcher Hopeful EPA Will Adopt Best Practices In TSCA Evaluations)

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COMMENTS TO OR RESPONSES TO SOLICIATIONS FROM FEDERAL, STATE AND LOCAL AGENCIES

USDA/APHIS – February 15, 2010 (Re: USDA Environmental Impact Assessment of J101 and J103 alfalfa - APHIS-2007-0044)

USDA/GIPSA – June 22, 2010 (Re: Proposed Rule: Implementation of Regulations Required Under Title XI of the Food, Conservation and Energy Act of 2008: Conduct in Violation of the Act, 75 Federal Register 35338)

Letter to directors of CDC (Thomas Frieden) and NIAID (Anthony Fauci) – June 29, 2010 (Re: Testimony before House Energy and Commerce Subcommittee on Health)

FDA/CVM – September 16, 2010 (Re: Written comments and questions for the September 19-20, 2010 Veterinary Medical Advisory Committee on Genetically-Engineered Salmon)

FDA – November 1, 2010 (RE: Comment on Strategic Priorities Document - Docket No. FDA-2010-N-0506)

Yakima Regional Clean Air Agency – December 9, 2010 (Comment on the document entitled, "Air Quality Management Policy and Best Management Practices for Dairy Operations")

USEPA/OAR - March 7, 2011 (RE: Comment on the Development of Emission-Estimating Methodologies for Animal Feeding Operations - EPA-HQ-OAR-2010-0960)

Farm Credit Administration – May 25, 2011 (RE: FCA 76 Fed. Reg. 30280)

USEPA/OPP – August 17, 2011 (RE: Comment on Engineered Nano-Materials in Pesticides - EPA-HQ-OPP-2010-0197)

USDA – October 18, 2011 (Re: USDA Response to the GAO Report on Antimicrobials Used in Food Animals)

FDA – December 2, 2011 (RE: Public Comment on FDA Transparency Initiative - FDA-2009-N-0247)

FDA/CVM – December 7, 2011 (RE: Public Comment on the Animal Drug User Fee Act - Docket No. FDA-2011-N-0656)

CDC/ITFAR – December 9, 2011 (RE: Public Comment on ITFAR's Action Plan to Combat Antimicrobial Resistance)

USEPA/OW – January 19, 2012 (RE: Comment on Concentrated Animal Feeding Operation Reporting Rule - EPA-HQ-OW-2011-0188)

Letter to USDA Undersecretary of Agriculture for Research, Education and Economics – February 6, 2012 (Re: Antimicrobial resistance research)

FDA/CVM – March 6, 2012 (RE: Public Comment on Cephalosporin Extralabel Use Ban - Docket No. FDA-2008-N-0326)

USDA/FSIS – May 29, 2012 (RE: Public Comment on the Modernization of Poultry Slaughter Inspection - Docket No. FSIS-2011-0012)

USEPA/OAR – June 11, 2012 (RE: Comment on Emissions Estimating Methodologies (Docket No. EPA-HQ-OAR-2010-0960)

FDA/CVM – July 12, 2012 (RE: Comment on Draft Guidance for Industry #213 (Docket No. FDA-2011-D-0889-0001)

FDA/CVM – July 12, 2012 (RE: Veterinary Feed Directive; Draft Text for Proposed Regulation (Docket No. FDA-2010-N-0155))

FDA – August 22, 2012 (RE: The Produce Safety Rulemaking for the Food Safety Modernization Act)

CDC/ITFAR – November 5, 2012 (RE: Comment to the Interagency Task Force on Antimicrobial Resistance (CDC-2012-0011)

FDA/CVM – November 7, 2012 (RE: Antimicrobial Animal Drug Sales and Distribution Reporting (FDA-2012-N-0447))

FDA/CVM – January 4, 2013 (RE: Animal Drug User Fee Act (ADUFA) Reauthorization (Docket No. FDA-2013-N-0656))

USDA/NOSB – March 19, 2013 (RE: Comment on Extension of Expiration Date for Oxytetracycline (AMS-NOP-12-0070))

FDA – November 15, 2013 (RE: Comments on the Proposed Rule for Standards for the Growing, Harvesting, Packing, and Holding of Produce for Human Consumption and the Proposed Rule for Current Good Manufacturing Practice and Hazard Analysis and Risk-Based Preventive Controls for Human Food (Docket Nos. FDA-2011-N-0920 (RIN 0910-AG36) and FDA-2011-N-0921 (RIN 0910-AG35)))

FORMAL CORRESPONDENCE WITH FEDERAL LEGISLATORS

House Subcommittee on Energy and Power – October 24, 2011 (RE: The Public Health Impacts of the Farm Dust Regulation Prevention Act of 2011 (H.R. 1633))

Rep. Henry Waxman – August 9, 2012 (RE: Public Health Consequences of the Superfund Common Sense Act (H.R. 2997))

PERSONAL STATEMENT OF RESEARCH AND RESEARCH OBJECTIVES

I am interested in the interface between science and policy, and the application of a multidisciplinary lens to solve environmental public health problems from the local to the global scale. My research focus is largely the development and application of methods in the risk sciences, often in the context of the food system. In addition to my efforts in developing knowledge and evidence, I am committed to ensuring that the findings of my research are presented to legislative and regulatory policymakers, public health practitioners and the public in a form that is accessible and actionable.

My involvement in the field of public health and the risk sciences spans more than twenty years and includes experiences working in two federal agencies on issues related to toxicology and chemical risk assessment. My research of food system issues (including antibiotic misuse and arsenic-based drugs) uses a multidisciplinary approach to identify and characterize public health risks that can be addressed through modifications to production practices, human behaviors, or other attainable policy levers.

I have published in high-profile publications documenting public health risks stemming from veterinary drug use in industrial food animal production. My work has been highlighted by national television, radio, print and internet media outlets, including ABC, CNN, CBS Radio, Comedy Central, NPR, the New York Times, the Washington Post, USA Today, the Guardian, the Baltimore Sun, and the San Francisco Chronicle. My research has twice been covered/parodied on the Colbert Report with Stephen Colbert, illustrating its spread into the public consciousness.

I endeavor to ensure that my scholarly work has a life beyond the peer-reviewed literature; my work on arsenical drugs has been translated into a law in Maryland and has been proposed as legislation in numerous sessions of the U.S. Congress. I serve on advisory panels for numerous state agencies and frequently advise federal and state legislators on issues related to food production, public health, and food safety. I also routinely interface with non-governmental organizations (e.g. Environmental Defense Fund, Consumers Union, the Pew Charitable Trusts, Food and Water Watch, and the Union of Concerned Scientists) interesting in using scientific evidence to advocate for policies aimed at minimizing unnecessary chemical exposures.

Outside of my research and advocacy work, I am committed to relaying acquired skills and lessons learned to the next generation of public health researchers and practitioners. To this end, I have a robust mentoring and education portfolio; I co-direct the Environmental Sustainability, Resilience and Health doctoral training program, co-direct the Food Systems MPH concentration, co-direct certificate programs in the Risk Sciences and in Food Systems, lead or co-instruct five courses in the risk sciences and food systems, teach an online massive open online course (with an enrollment of 18,000 students in its first run) and advise numerous PhD, DrPH, masters students and postdoctoral fellows. I have also overseen an effort to develop a free, online food system curriculum for undergraduate and high school students.

My research interests include: the public health and global environmental consequences (i.e. climate change, water use, etc.) of food production systems; chemical and microbial food safety; risk assessment and communication; children's environmental health; exposure factor development (occupational, early lifestage) regulatory approaches to synthesis of scientific evidence in decision-making; and transparency in federal rulemaking.