JOHNS HOPKINS
CENTER *for* A LIVABLE FUTURE

February 14, 2023

Amy van Saun
Senior Attorney
Center For Food Safety
2009 NE Alberta St.
Portland, OR 97211

Disclaimer: The opinions expressed herein are our own and do not necessarily reflect the views of The Johns Hopkins University.

RE: Public Health Implications of Industrial-Scale Animal Production

Dear Ms. Saun,

We are researchers at The Johns Hopkins Center for a Livable Future, based at the Bloomberg School of Public Health in the Department of Environmental Health and Engineering. The Center engages in research, policy analysis, education, and other activities guided by an ecologic perspective that diet, food production, the environment, and public health are interwoven elements of a complex system. We recognize the prominent role that food animal production plays regarding a wide range of public health issues surrounding that system.

After reviewing extensive evidence of the public health, environmental and community negative impacts of industrial-scale food animal production (IFAP) also referred to as Concentrated Animal Feeding Operations (CAFO), the American Public Health Association adopted a "Precautionary Moratorium on New and Expanding Concentrated Animal Feeding Operations" (APHA, 2019). This document outlines the negative effects of the enormous amounts of manure and waste produced by large-scale animal production, as well as the injustices experienced by workers and communities that are influenced by these facilities. Of considerable importance is the influence large-scale animal operations have on the proliferation of antimicrobial resistance and considering the recent COVID-19 outbreak, the potential for species-to-species transfer of emergent diseases. APHA believes that the externalized costs are likely to mount in coming years, as growing evidence indicate that CAFOs pose health and environmental risks and negative impacts. The resolution outlines 12 legislative and regulatory steps that need to be taken to mitigate the public health threats before establishing new or expanding existing CAFOs. CAFO regulations and their enforcement have failed to adequately protect human health and the environment. Excluding oversight by local and state government and public health departments

only enhances the potential for these negative consequences in the absence of robust Federal regulation.

We provide a summary of this information and referenced research articles which we believe to be highly relevant to local communities, policymakers and other interested parties related to the large-scale animal production.

Summary of Public Health Concerns Associated with IFAP

Inherent in these industrial agricultural complexes are the concentration of processes, animal crowding, production wastes and physical infrastructure. The primary human health concerns related to IFAP include: infections resulting from transmission of harmful microorganisms from animal operations to nearby residents; respiratory effects from increased exposure to air pollution from animal operations; and multiple negative health impacts due to increased exposure to soil, ground and/or surface waters that can be contaminated by manure from animal operations. These factors have implications for both workers, animals, and the communities that are proximal and that interact with these industries. These concerns are described in more detail below.

<u>Disease Transmission</u>

The poor conditions, including crowding, characteristic of industrial animal operations present opportunities for disease transmission among animals, and between animals and humans (Gomes, 2014, Rostagno, 2009). Communities in near these facilities, may have an increased risk to a variety of hazardous airborne, waterborne, and particulate matter (dust) exposures (Williams 2011, De Rooij 2019, Gržinić 2022). One concern is the biological exposures from the transmission of harmful microorganisms from the processing, handling, storage and spreading of liquid and fecal wastes or transmission through the associated contamination of air, soil and water with pathogenic organisms or via flies (Baykov 1999, Graczyk 2001, Spencer 2004, Burgos 2005, Sapkota 2007, Price, 2007, Rule, 2008, Graham 2008, Graham 2009, Balderrama-Carmona 2014, Jahne 2015, de Matos 2020, Leaman 2022). Recent studies have evaluated human enteric disease patterns of the pathogenic organisms, *Cryptosporidia* and *Campylobacter* and found higher incidence of these diseases based on proximity to IFAP (Grout 2022). A growing body of evidence has implicated large-scale animal production in the spread of microbes that can cause infectious diseases, including antibiotic-resistant strains such as MRSA, *E.coli, Campylobacter* (Sapkota 2007, Price 2007, Casey, 2013, Wichmann 2014, Poulsen 2018, Amato 2020).

Of additional concern is community and worker exposure to pathogens that are resistant to antibiotics used in human medicine. The common practice of administering antibiotics to animals at levels too low to treat disease (non-therapeutic use) in IFAP, fosters the proliferation of antibiotic-resistant pathogens. Resistant infections in humans are more difficult and expensive to treat (Roberts 2009) and more often fatal (Filice, 2010) than infections with non-resistant

strains. A growing body of evidence provides support that antibiotic-resistant pathogens are found on animal operations that administer antibiotics for non-therapeutic purposes (Price, 2007, Schulz 2012) and are also found in the environment in and around production facilities, (Schulz 2012, Burgos 2005, Sapkota 2007, Graham 2008) specifically in the manure,(Graham 2008, Wichmann 2014, USEPA 2013, Amato, 2020, Buta 2021) air, (Schulz 2012) and flies (Graham 2009). Proximity to IFAP has been associated with increased health care encounters (van Dijk 2016, Rasmussen 2017), hospitalizations, use of corticosteroids (Rasmussen 2017) and antibiotic use (Roof 2021).

Zoonotic transfer of illness from animal to human is a concern. Recently an outbreak of avian flu H5N8 was reported in Russian poultry workers who were exposed by direct contact with infected flocks. While this outbreak did not spread from human to human, it was the first time this strain has infected humans illustrating the increased risk for future outbreaks and epidemics (Devitt 2021).

Of critical importance, research suggests that the infectious agent for COVID-19, SARS-CoV-2, may have originated from an animal as a zoonotic illness that was transferred to humans. It has been shown that zoonotic transmission of disease agents is a common process for emerging human illness (Mackenzie 2013, Opriessnig 2020). Once introduced, these diseases can then transfer from person-to-person.

During the COVID-19 pandemic there have been reported outbreaks among workers in industrial-animal production facilities as well as animal processing facilities. Investigating the contributing factors associated with these outbreaks have highlighted crowded working conditions, long hours of work and poor COVID safety protocols. These production facilities and the health of the workers in those facilities directly influence community health and transmission of the disease (Waltenberg 2020).

A recent analysis of data collected by the National Institutes of Health's Agriculture Health Study determined that proximity of residents to intensive animal production facilities, was associated with risk for non-Hodgkin Lymphoma and leukemia. (Fisher, 2020) While this study did not specify number or type of animal facilities, these findings accounted for other occupational exposures to animals and pesticides, thus supporting evidence of additional long-term and chronic effects of exposures by living near industrial-scale animal production.

Air Pollution

Community members living near industrial-scale animal operations face increased exposure to air pollution. Air emissions include particulate matter, endotoxins, volatile organic compounds, and gases such as nitrous oxide, hydrogen sulfide, and ammonia (Cambra-López 2010, Hribar 2010, Trabue 2010, Schinasi 2011, Williams 2011). These pollutants can potentially cause or exacerbate respiratory conditions including asthma (Mirabelli 2006, Heederik 2007, Cambra-López 2010, Rasmussen 2017, Loftus 2015, Loftus 2020), COPD (Borlée 2015, Van Kersen

2020); pneumonia (Smit 2012, Poulsen 2018) affect lung function (Soukup 2001, Radon 2007, Schinasi 2011, Loftus 2015, Borlée 2017, Schultz 2019, Wyer 2022); eye irritation, difficulty breathing, wheezing, sore throat, chest tightness, nausea (Heederik 2007) and bronchitis and allergic reactions (Cambra-López 2010, Schultz 2019).

Odors associated with air pollutants from large-scale animal operations have been shown to interfere with daily activities, quality of life, social gatherings, property values, and community cohesion (Heederik 2007, Donham 2007, Wing 2000, Horton 2009, Van Kersen 2020) and contribute to stress and acute increased blood pressure (Horton 2009, Wing 2013).

Potent greenhouse gases are associated with agriculture, such as methane, nitrous oxides, and carbon dioxide. It is estimated that the food system is responsible for approximately 21 to 37% of global emissions (IPCC 2019, Gržinić 2022) with 14.5% being attributed to animal agriculture production (Gerber 2013). Sejian et al., estimated that 80% of the associated food system methane emissions and 75% of nitrous oxide emissions are from the production of animal products (Sejian 2016). Food system change and the remediation of GHG emissions from animal agriculture is critical to prevent the cascading negative effects of climate change and its implications for community as well as global public health.

Contaminated Ground and Surface Water

The increased concentration and density of food animals in confined animal feeding operations over several decades has resulted in the concentration of animal waste over small geographic areas (USEPA 2013). Although animal manure is an invaluable fertilizer, waste composition and the magnitude of waste produced by IFAP operations represent a public health and ecological hazard through waste management and distribution practices resulting in the degradation of surface and ground water resources (USEPA 2013).

Manure from these operations contaminate ground and surface waters with nitrogen, phosphorus, nitrates, heavy metals, drug residues, and other chemical hazards (Spencer 2004, Showers 2008, Graham 2010, USEPA 2012, Liu 2020, Buta 2021). Studies have demonstrated that humans can be exposed to these waterborne contaminants from livestock and poultry operations through the recreational use of contaminated surface water and the ingestion of contaminated drinking water (Spencer 2004, Burkholder 2007, USEPA 2013, Graham 2010, Showers 2008, USEPA 2012). Exposure to elevated levels of nitrates in drinking water is associated with adverse health effects, including cancer (Gulis 2002, Chiu 2007, Ward, 2009, Ward 2010, Fisher 2021), birth defects and other reproductive problems (Burkholder 2007, Ward 2009, Manassaram 2006, Brender 2013), thyroid problems (Burkholder 2007, Ward 2010), and methemoglobinemia (Knobeloch 2000, Burkholder 2007).

Manure runoff from IFAP operations may introduce harmful microorganisms and antimicrobial resistant organisms into nearby surface and groundwater sources (Heaney 2015, Cao 2021). Land application of manure presents an opportunity for pathogens contained in the manure to leach

into the groundwater or run off into recreational water and drinking water sources, potentially causing waterborne disease outbreaks (USEPA 2013). This is of particular concern as many residents rely on private wells for drinking water and household use and private wells are not monitored by government agencies to ensure safe levels of chemical agents or pathogens.

Nutrient runoff (including nitrogen and phosphorus) has also been implicated in the growth of harmful algal blooms (HAB) (Heisler 2008, USEPA 2013), which have been increasing in frequency due to agricultural practices (Fraker, 2023). These HABs pose economic costs and health risks for people who live near surface water, swim or fish in recreational waters, or who consume contaminated fish and shellfish (Kouakou 2019). Exposure to algal toxins has been linked to neurological impairments, liver damage, gastrointestinal illness, severe dermatitis, and other adverse health effects (Carmichael 2001, Paerl 2001).

We hope that this description of public health concerns associated with IFAP is helpful. Through our research, we also know that communities and governmental agencies can face many barriers in addressing issues surrounding IFAP due to ineffective, absent or narrow regulations as well as due to limited resources needed to implement and monitor programs (Fry 2013, Fry 2014). Please do not hesitate to contact us if you have any questions.

Sincerely,

D'Ann L. Williams, DrPH, MS
Assistant Scientist, Environmental Health & Engineering
Johns Hopkins Bloomberg School of Public Health
Johns Hopkins Center for a Livable Future Johns Hopkins University

Robert Martin
Senior Lecturer, Environmental Health Engineering
Program Director, Food System Policy
Johns Hopkins Bloomberg School of Public Health
Johns Hopkins Center for a Livable Future Johns Hopkins University

Patti Truant Anderson, PhD, MPH
Senior Program Officer, Food System Policy
Johns Hopkins Bloomberg School of Public Health
Johns Hopkins Center for a Livable Future Johns Hopkins University

References

Amato, Heather K., Nora M. Wong, Carey Pelc, Kishana Taylor, Lance B. Price, Mark Altabet, Thomas E. Jordan, and Jay P. Graham. "Effects of concentrated poultry operations and cropland manure application on antibiotic resistant Escherichia coli and nutrient pollution in Chesapeake Bay watersheds." Science of The Total Environment 735 (2020): 139401.

APHA 2019, Precautionary Moratorium on New and Expanding Concentrated Animal Feeding Operations, Date: NOV 05, 2019, Policy Statement Number:20194. Link: https://www.apha.org/policies-and-advocacy/public-health-policy-statements/policy-database/2020/01/13/precautionary-moratorium-on-new-and-expanding-concentrated-animal-feeding-operations

Balderrama-Carmona, Ana Paola, Pablo Gortáres-Moroyoqui, Luis Humberto Álvarez-Valencia, Luciano Castro-Espinoza, Iram Mondaca-Fernández, José de Jesús Balderas-Cortés, Cristóbal Chaidez-Quiroz, and María Mercedes Meza-Montenegro. "Occurrence and quantitative microbial risk assessment of Cryptosporidium and Giardia in soil and air samples." International Journal of Infectious Diseases 26 (2014): 123-127.

Baykov B, Stoyanov M. Microbial air pollution caused by intensive broiler chicken breeding. FEMS Microbiol Ecol. 1999;29(4):389-392.

Borlée, F.; Yzermans, C.J.; van Dijk, C.E.; Heederik, D.; Smit, L.A. Increased respiratory symptoms in COPD patients living in the vicinity of livestock farms. Eur. Respir. J. 2015, 46, 1605-1614. [CrossRef]

Borlée, Floor, C. Joris Yzermans, Bernadette Aalders, Jos Rooijackers, Esmeralda Krop, Catharina BM Maassen, François Schellevis, Bert Brunekreef, Dick Heederik, and Lidwien AM Smit. "Air pollution from livestock farms is associated with airway obstruction in neighboring residents." American journal of respiratory and critical care medicine 196, no. 9 (2017): 1152-1161.

Brender JD, Weyer PJ, Romitti PA, et al. Prenatal nitrate intake from drinking water and selected birth defects in offspring of participants in the national birth defects prevention study. Environ Health Perspect. 2013;121(9):1083-1089.

Burgos J, Ellington B, Varela M. Presence of multidrug-resistant enteric bacteria in dairy farm topsoil. J Dairy Sci. 2005;88(4):1391-1398.

Burkholder J, Libra B, Weyer P, et al. Impacts of waste from concentrated animal feeding operations on water quality. Environ Health Perspect. 2007:308-312.

Buta, Martyna, Ewa Korzeniewska, Monika Harnisz, Jakub Hubeny, Wiktor Zieliński, Damian Rolbiecki, Sylwia Bajkacz, Ewa Felis, and Klaudia Kokoszka. "Microbial and chemical pollutants on the manure-crops pathway in the perspective of “One Health” holistic approach." Science of the Total Environment 785 (2021): 147411.

Cambra-López M, Aarnink AJ, Zhao Y, Calvet S, Torres AG. Airborne particulate matter from livestock production systems: A review of an air pollution problem. Environmental Pollution. 2010;158(1):1-17.

Carmichael WW. Health effects of toxin-producing cyanobacteria: "The CyanoHABs". Human and Ecological Risk Assessment: An International Journal. 2001;7(5):1393-1407.

Casey JA, Curriero FC, Cosgrove SE, Nachman KE, Schwartz BS. High-density livestock operations, crop field application of manure, and risk of community-associated methicillin-resistant Staphylococcus aureus infection in Pennsylvania. JAMA Internal Medicine. 2013;173(21):1980-1990.

Chiu H, Tsai S, Yang C. Nitrate in drinking water and risk of death from bladder cancer: An ecological case-control study in Taiwan. Journal of Toxicology and Environmental Health, Part A. 2007;70(12):1000-1004. Link: https://www.ncbi.nlm.nih.gov/pubmed/17497410

Cao, S. T., Tran, H. P., Le, H. T. T., Bui, H. P. K., Nguyen, G. T. H., Nguyen, L. T., ... & Luong, A. D. (2021). Impacts of effluent from different livestock farm types (pig, cow, and poultry) on surrounding water quality: a comprehensive assessment using individual parameter evaluation method and water quality indices. *Environmental Science and Pollution Research*, *28*(36), 50302-50315.

de Matos Nascimento, Andressa, Vanessa Romário de Paula, Edgard Henrique Oliveira Dias, Jailton da Costa Carneiro, and Marcelo Henrique Otenio. "Quantitative microbial risk assessment of occupational and public risks associated with bioaerosols generated during the application of dairy cattle wastewater as biofertilizer." Science of The Total Environment 745 (2020): 140711.

De Rooij, Myrna MT, Gerard Hoek, Heike Schmitt, Ingmar Janse, Arno Swart, Catharina BM Maassen, Marjolijn Schalk, Dick JJ Heederik, and Inge M. Wouters. "Insights into livestock-related microbial concentrations in air at residential level in a livestock dense area." Environmental science & technology 53, no. 13 (2019): 7746-7758.

Devitt, P and Tétrault-Farber G. (2021, February 20). Russia Reports world's first case of human infection with H5N8 bird flu. Reuters. Retrieved from https://www.reuters.com/article/us-health-birdflu-russia/russia-reports-worlds-first-case-of-human-infection-with-h5n8-bird-flu-idUSKBN2AK0DU

Donham KJ, Wing S, Osterberg D, et al. Community health and socioeconomic issues surrounding concentrated animal feeding operations. Environ Health Perspect. 2007:317-320.

Filice GA, Nyman JA, Lexau C, et al. Excess costs and utilization associated with methicillin resistance for patients with Staphylococcus aureus infection. Infection Control & Hospital Epidemiology. 2010;31(04):365-373.

Fisher, Jared A., Laura E. Beane Freeman, Jonathan N. Hofmann, Aaron Blair, Christine G. Parks, Peter S. Thorne, Mary H. Ward, and Rena R. Jones. "Residential proximity to intensive animal agriculture and risk of lymphohematopoietic cancers in the Agricultural Health Study." Epidemiology (Cambridge, Mass.) 31, no. 4 (2020): 478.

Fraker, Michael E., Noel R. Aloysius, Jay F. Martin, S. Conor Keitzer, David A. Dippold, Haw Yen, Jeffrey G. Arnold et al. "Agricultural conservation practices could help offset climate change impacts on cyanobacterial harmful algal blooms in Lake Erie." *Journal of Great Lakes Research* 49, no. 1 (2023): 209-219.

Fry JP, Laestadius LI, Grechis C, Nachman KE, Neff RA. Investigating the role of state and local health departments in addressing public health concerns related to industrial food animal production sites. PloS one. 2013;8(1):e54720.

Fry JP, Laestadius LI, Grechis C, Nachman KE, Neff RA. Investigating the role of state permitting and agriculture agencies in addressing public health concerns related to industrial food animal production. PloS one. 2014;9(2):e89870.

Gerber, Pierre J., Henning Steinfeld, Benjamin Henderson, Anne Mottet, Carolyn Opio, Jeroen Dijkman, Allessandra Falcucci, and Giuseppe Tempio. Tackling climate change through livestock: a global assessment of emissions and mitigation opportunities. Food and Agriculture Organization of the United Nations (FAO), 2013.

Graczyk, Thaddeus K., Ronald Knight, Robert H. Gilman, and Michael R. Cranfield. "The role of non-biting flies in the epidemiology of human infectious diseases." Microbes and infection 3, no. 3 (2001): 231-235.

Graham JP, Leibler JH, Price LB, et al. The animal-human interface and infectious disease in industrial food animal production: Rethinking biosecurity and biocontainment. Public Health Rep. 2008:282-299.

Graham JP, Evans SL, Price LB, Silbergeld EK. Fate of antimicrobial-resistant enterococci and staphylococci and resistance determinants in stored poultry litter. Environ Res. 2009;109(6):682-689.

Graham JP, Price LB, Evans SL, Graczyk TK, Silbergeld EK. Antibiotic resistant enterococci and staphylococci isolated from flies collected near confined poultry feeding operations. Sci Total Environ. 2009;407(8):2701-2710.

Graham JP, Nachman KE. Managing waste from confined animal feeding operations in the United States: The need for sanitary reform. Journal of Water and Health. 2010;8(4):646-670.

Gržinić, Goran, Agnieszka Piotrowicz-Cieślak, Agnieszka Klimkowicz-Pawlas, Rafał L. Górny, Anna Ławniczek-Wałczyk, Lidia Piechowicz, Ewa Olkowska et al. "Intensive poultry farming: A review of the impact on the environment and human health." Science of The Total Environment (2022): 160014.

Grout, Leah, Jonathan Marshall, Simon Hales, Michael G. Baker, and Nigel French. "Dairy Cattle Density and Temporal Patterns of Human Campylobacteriosis and Cryptosporidiosis in New Zealand." EcoHealth 19, no. 2 (2022): 273-289.

Gulis G, Czompolyova M, Cerhan JR. An ecologic study of nitrate in municipal drinking water and cancer incidence in Trnava district, Slovakia. Environ Res. 2002;88(3):182-187. Link: https://www.ncbi.nlm.nih.gov/pubmed/12051796

Heaney CD, Myers K, Wing S, Hall D, Baron D, Stewart JR. Source tracking swine fecal waste in surface water proximal to swine concentrated animal feeding operations. Sci Total Environ. 2015;511:676-683. Link: https://www.ncbi.nlm.nih.gov/pubmed/25600418

Heederik D, Sigsgaard T, Thorne PS, et al. Health effects of airborne exposures from concentrated animal feeding operations. Environ Health Perspect. 2007:298-302.

Heisler J, Glibert PM, Burkholder JM, et al. Eutrophication and harmful algal blooms: A scientific consensus. Harmful Algae. 2008;8(1):3-13.

Horton RA, Wing S, Marshall SW, Brownley KA. Malodor as a trigger of stress and negative mood in neighbors of industrial hog operations. Am J Public Health. 2009;99(S3):S610-S615.

Hribar C, Schultz M. Understanding concentrated animal feeding operations and their impact on communities. Bowling Green, OH: National Association of Local Boards of Health. 2010.

IPCC, Shukla PR. "Climate change and land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems." Edited by PR Shukla. IPCC: In Press. International consensus regarding land system impacts of climate change as of (2019).

Jahne MA, Rogers SW, Holsen TM, Grimberg SJ, Ramler IP. Emission and dispersion of bioaerosols from dairy manure application sites: Human health risk assessment. Environ Sci Technol. 2015;49(16):9842-9849.

Knobeloch L, Salna B, Hogan A, Postle J, Anderson H. Blue babies and nitrate-contaminated well water. Environ Health Perspect. 2000;108(7):675-678.

Kouakou, Christian RC, and Thomas G. Poder. "Economic impact of harmful algal blooms on human health: a systematic review." Journal of Water and Health 17, no. 4 (2019): 499-516.

Leaman, Susan M., Sonia Salas, Robert E. Mandrell, Trevor V. Suslow, Michele T. Jay-Russell, and De Ann Davis. "Environmental Risk Factors in the Human Pathogen Transmission Pathways between Animal Operations and Produce Crops." Food Protection Trends 42, no. 5 (2022): 362-376.

Liu, Wang-Rong, Dong Zeng, Lei She, Wen-Xing Su, De-Chun He, Gen-Yi Wu, Xiao-Rui Ma, Shan Jiang, Cai-Hong Jiang, and Guang-Guo Ying. "Comparisons of pollution characteristics, emission situations, and mass loads for heavy metals in the manures of different livestock and poultry in China." Science of the Total Environment 734 (2020): 139023.

Loftus, Christine, Michael Yost, Paul Sampson, Elizabeth Torres, Griselda Arias, Victoria Breckwich Vasquez, Kris Hartin et al. "Ambient ammonia exposures in an agricultural

community and pediatric asthma morbidity." Epidemiology (Cambridge, Mass.) 26, no. 6 (2015): 794.

Loftus, Christine, Michael Yost, Paul Sampson, Griselda Arias, Elizabeth Torres, Victoria Breckwich Vasquez, Parveen Bhatti, and Catherine Karr. "Regional PM2. 5 and asthma morbidity in an agricultural community: a panel study." Environmental Research 136 (2015): 505-512.

Loftus, Christine, Zahra Afsharinejad, Paul Sampson, Sverre Vedal, Elizabeth Torres, Griselda Arias, Maria Tchong-French, and Catherine Karr. "Estimated time-varying exposures to air emissions from animal feeding operations and childhood asthma." International journal of hygiene and environmental health 223, no. 1 (2020): 187-198.

Mackenzie, J. S., Jeggo, M., Daszak, P., & Richt, J. A. (2013). One Health: the human-animal-environment interfaces in emerging infectious diseases. (J. S. Mackenzie, M. Jeggo, P. Daszak, & J. A. Richt, Eds.) (Vol. 365). Berlin, Heidelberg: Springer Berlin Heidelberg. doi:10.1007/978-3-642-36889-9

Manassaram DM, Backer LC, Moll DM. A review of nitrates in drinking water: Maternal exposure and adverse reproductive and developmental outcomes. Environmental Health Perspectives. 2006.

Mirabelli MC, Wing S, Marshall SW, Wilcosky TC. Asthma symptoms among adolescents who attend public schools that are located near confined swine feeding operations. Pediatrics. 2006;118(1):e66-75.

Opriessnig T, Huang YW. Further information on possible animal sources for human COVID 19. Xenotransplantation. 2020;27(6):e12651. doi:10.1111/xen.12651

Paerl HW, Fulton RS,3rd, Moisander PH, Dyble J. Harmful freshwater algal blooms, with an emphasis on cyanobacteria. Scientific World Journal. 2001;1:76-113.

Poulsen, Melissa N., Jonathan Pollak, Deborah L. Sills, Joan A. Casey, Keeve E. Nachman, Sara E. Cosgrove, Dalton Stewart, and Brian S. Schwartz. "High-density poultry operations and community-acquired pneumonia in Pennsylvania." Environmental Epidemiology 2, no. 2 (2018): e013.

Poulsen, Melissa N., Jonathan Pollak, Deborah L. Sills, Joan A. Casey, Sara G. Rasmussen, Keeve E. Nachman, Sara E. Cosgrove, Dalton Stewart, and Brian S. Schwartz. "Residential proximity to high-density poultry operations associated with campylobacteriosis and infectious diarrhea." International journal of hygiene and environmental health 221, no. 2 (2018): 323-333.

Price LB, Graham JP, Lackey LG, Roess A, Vailes R, Silbergeld E. Elevated risk of carrying gentamicin-resistant Escherichia coli among US poultry workers. Environ Health Perspect. 2007:1738-1742.

Price LB, Lackey LG, Vailes R, Silbergeld E. The persistence of fluoroquinolone-resistant Campylobacter in poultry production. Environ Health Perspect. 2007:1035-1039.

Radon, K.; Schulze, A.; Ehrenstein, V.; van Strien, R.T.; Praml, G.; Nowak, D. Environmental exposure to confined animal feeding operations and respiratory health of neighboring residents. Epidemiol. (Camb. Mass.) 2007, 18, 300-308.

Rasmussen, Sara G., Joan A. Casey, Karen Bandeen-Roche, and Brian S. Schwartz. "Proximity to industrial food animal production and asthma exacerbations in Pennsylvania, 2005–2012." International journal of environmental research and public health 14, no. 4 (2017): 362.

Roberts RR, Hota B, Ahmad I, et al. Hospital and societal costs of antimicrobial-resistant infections in a Chicago teaching hospital: Implications for antibiotic stewardship. Clin Infect Dis. 2009;49(8):1175-1184.

Roof, I., van der Hoek, W., Oude Boerrigter, L., Wielders, C. C., & Smit, L. A. (2021). Use of antibiotics among residents living close to poultry or goat farms: a nationwide analysis in the Netherlands. Antibiotics, *10*(11), 1346.

Rostagno MH. Can stress in farm animals increase food safety risk? Foodborne pathogens and disease. 2009;6(7):767-776.

Rule AM, Evans SL, Silbergeld EK. Food animal transport: A potential source of community exposures to health hazards from industrial farming (CAFOs). Journal of Infection and Public Health. 2008;1(1):33-39.

Sapkota AR, Curriero FC, Gibson KE, Schwab KJ. Antibiotic-resistant enterococci and fecal indicators in surface water and groundwater impacted by a concentrated swine feeding operation. Environ Health Perspect. 2007:1040-1045.

Schinasi L, Horton RA, Guidry VT, Wing S, Marshall SW, Morland KB. Air pollution, lung function, and physical symptoms in communities near concentrated swine feeding operations. Epidemiology. 2011;22(2):208-215.

Schultz, Amy A., Paul Peppard, Ron E. Gangnon, and Kristen MC Malecki. "Residential proximity to concentrated animal feeding operations and allergic and respiratory disease." Environment international 130 (2019): 104911.

Schulz J, Friese A, Klees S, et al. Longitudinal study of the contamination of air and of soil surfaces in the vicinity of pig barns by livestock-associated methicillin-resistant Staphylococcus aureus. Appl Environ Microbiol. 2012;78(16):5666-5671.

Showers WJ, Genna B, McDade T, Bolich R, Fountain JC. Nitrate contamination in groundwater on an urbanized dairy farm. Environ Sci Technol. 2008;42(13):4683-4688.

Sejian, Veerasamy, Raghavendra Bhatta, Pradeep Kumar Malik, Bagath Madiajagan, Yaqoub Ali Saif Al-Hosni, Megan Sullivan, and John B. Gaughan. "Livestock as sources of greenhouse gases and its significance to climate change." Greenh. Gases 11 (2016): 243-259.

Smit, Lidwien AM, Femke van der Sman-de Beer, Annemieke WJ Opstal-van Winden, Mariëtte Hooiveld, Johan Beekhuizen, Inge M. Wouters, Joris Yzermans, and Dick Heederik. "Q fever and pneumonia in an area with a high livestock density: a large population-based study." PloS one 7, no. 6 (2012): e38843.
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0038843

Spencer JL, Guan J. Public health implications related to spread of pathogens in manure from livestock and poultry operations. Public Health Microbiology: Methods and Protocols. 2004:503-515.

Soukup, J.M.; Becker, S. Human alveolar macrophage responses to air pollution particulates are associated with insoluble components of coarse material, including particulate endotoxin. Toxicol. Appl. Pharmacol. 2001, 171, 20-26.

Trabue, Steven, Kenwood Scoggin, Hong Li, Robert Burns, Hongwei Xin, and Jerry Hatfield. "Speciation of volatile organic compounds from poultry production." Atmospheric environment 44, no. 29 (2010): 3538-3546.

United States Environmental Protection Agency. International journal of environmental research and public health 14, no. 4 (2017): 362.Relation between nitrates in water wells and potential sources in the lower Yakima Valley, Washington state. U.S. Environmental Protection Agency, Washington, D.C., 2012. Link: Https://Www3.epa.gov/region10/pdf/sites/yakimagw/nitrate_in_water_wells_study_9-27-2012.pdf.

United States Environmental Protection Agency. Literature review of contaminants in livestock and poultry manure and implications for water quality. July 2013:1-137.

van Dijk, Christel E., Lidwien AM Smit, Mariette Hooiveld, Jan-Paul Zock, Inge M. Wouters, Dick JJ Heederik, and C. Joris Yzermans. "Associations between proximity to livestock farms, primary health care visits and self-reported symptoms." BMC Family Practice 17, no. 1 (2016): 1-8.

Van Kersen, W.; Oldenwening, M.; Aalders, B.; Bloemsma, L.D.; Borlée, F.; Heederik, D.; Smit, L.A.M. Acute respiratory effects of livestock-related air pollution in a panel of COPD patients. Environ. Int. 2020, 136, 105426.

Ward MH. Too much of a good thing? Nitrate from nitrogen fertilizers and cancer. Rev Environ Health. 2009;24(4):357-363.

Ward MH, Kilfoy BA, Weyer PJ, Anderson KE, Folsom AR, Cerhan JR. Nitrate intake and the risk of thyroid cancer and thyroid disease. Epidemiology. 2010;21(3):389-395.

Wichmann F, Udikovic-Kolic N, Andrew S, Handelsman J. Diverse antibiotic resistance genes in dairy cow manure. MBio. 2014;5(2):e01017-13.

Williams, D., Patrick N. Breysse, Meredith C. McCormack, Gregory B. Diette, Shawn McKenzie, and Alison S. Geyh. Airborne cow allergen, ammonia and particulate matter at

homes vary with distance to industrial scale dairy operations: an exposure assessment. Environmental Health 10, no. 1 (2011): 1-9.

Wing S, Wolf S. Intensive livestock operations, health, and quality of life among eastern North Carolina residents. Environ Health Perspect. 2000;108(3):233-238.

Wing S, Horton RA, Rose KM. Air pollution from industrial swine operations and blood pressure of neighboring residents. Environmental Health Perspectives (Online). 2013;121(1):92.

Wyer, Katie E., David B. Kelleghan, Victoria Blanes-Vidal, Günther Schauberger, and Thomas P. Curran. Ammonia emissions from agriculture and their contribution to fine particulate matter: A review of implications for human health. Journal of Environmental Management 323 (2022): 116285.