FINAL PAPER

Practicum project with the Delaware Medical Academy / DPHA

ABSTRACT

A comprehensive review of Delaware's current environmental health programs and policies related to air quality monitoring, water treatment, hazardous waste management.

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Introduction

I developed a strong interest in environmental health when I took the course last semester. It fascinated me because it highlighted essential knowledge that everyone should have, to live sustainably and conserve our resources. The course made me think about various aspects of my daily life, such as where our household thrash goes, the quality of our drinking water, how hazardous materials are disposed of, and what qualifies as "hazardous". Before this course, I had not considered how much water my household used. While climate change was already familiar to me from the news, this course deepened my understanding of its broader impacts.

As my interest in environmental health grew, I decided to pursue a practicum with the Delaware Academy of Medicine/DPHA to learn more about how environmental issues impact public health. I reached out to the academy's internship coordinator and selected a project topic to focus on.

The project topic aligns well with several current initiatives and areas of focus of the Delaware Academy of Medicine / Delaware Public Health Association (DPHA). Here's how:

Community Health Worker Program: My project could complement this program by assessing how environmental health programs contribute to community health workers' efforts in improving public health.

Delaware Chronic Disease Collaborative: Since environmental factors significantly impact chronic diseases, my research could provide insights into the effectiveness of environmental policies in chronic disease prevention and management.

Delaware Mini Medical School: my findings could be valuable educational content for participants, highlighting the importance of environmental health in public health education.

Delaware Plan4Health: This initiative focuses on planning and implementing health policies. My project could offer evidence-based recommendations for policy improvements.

Immunization Coalition of Delaware: While primarily focused on immunization, this coalition could benefit from my research on environmental health, as it relates to overall public health strategies.

Student Internship: My project could provide a case study or a research opportunity for students interested in environmental health and public policy.

Lt. Governor's Wellness Leadership Challenge: my project aligns with the challenge's goal to improve the quality of life of Delawareans through innovative initiatives to support better health, which includes environmental health.

Background

Literature review

Evidence suggests that environmental factors play a crucial role in shaping public health outcomes globally (Salgado, et al., 2020). In the United States, various programs and policies have been implemented to address these issues. Locally, in Delaware, specific initiatives focus on air quality

monitoring, water treatment, and hazardous waste management to protect the health of residents. This literature review aims to evaluate the effectiveness of existing environmental health initiatives in the state and identify areas that require improvement.

Air quality issues are a global concern, with varying impacts across different regions. The World Air Quality Index (WAQI) project provides real-time or quality information for more than 10,000 monitoring stations worldwide, including Delaware. Residents can check the current air quality index (AQI) for their area, including levels of pollutants like PM2.5 and PM10. Poor air quality is associated with a range of respiratory problems, including asthma, chronic obstructive pulmonary disease (COPD), and bronchitis. Long-term exposure to pollutants like nitrogen dioxide (NO2) and particulate matter (PM2.5) can exacerbate these conditions and lead to health complications such as lung cancer and cardiovascular diseases (AQP, 2024). A study by Archer et al. found significant reductions in air pollutant levels, particularly for nitrogen dioxide (NO2) and particulate matter (PM2.5), during the lockdown period, emphasizing the need for localized monitoring (Archer et al., 2020).

Locally, the Air Quality Partnership of Delaware (AQP) collaborates with organizations such as the American Lung Association and DNREC to forecast air quality and clean air practices. The American Lung Association's 2024 State of the Air Report highlights ongoing air pollution concerns in Delaware. New Castle County, identified as having the worst air quality in the state, still experiences too many days with poor air quality, despite benefitting from the Community Housing and Empowerment Connections (CHEC) air monitoring network funded by the Environmental Protection Agency (EPA). Clearly, continued efforts are needed to address air pollution and protect public health.

The American Water Works Association's (AWWA) State of the Water Industry report highlights ongoing challenges in maintaining water infrastructure and ensuring safe drinking water (AWWA, 2023). Delaware faces similar issues, including aging infrastructure and the need for advanced treatment technologies to address emerging contaminants such as PFAS, pharmaceuticals, and endocrine disrupting compounds that threaten water quality. The Delaware Division of Public Health (DPH) oversees various programs related to water quality and treatment (DHSS, 2022)

The Delaware Department of Natural Resources and Environmental Control (DNREC) manages the state's water resources, including the Source Water Protection Program (DNREC, 2023). This program focuses on safeguarding drinking water sources from contamination. The program's success lies in its proactive approach, including stringent regulations and community engagement initiatives. However, the increasing prevalence of non-point source pollution and climate change impacts necessitate continuous adaptation and enhanced protection measures (Environmental Protection Agency, 2021).

Nonpoint source pollution refers to diffuse contamination of water that comes from multiple sources across the landscape, such as rainfall, runoff, and atmospheric deposition. For example, runoff from rain and snowmelt carries pollutants into waterways, including rivers, streams, and lakes. It is essential to take preventive measures to reduce the impact of nonpoint source pollution as it affects drinking water quality, recreation, fisheries, and wildlife (Environmental Protection Agency, 2023).

Additionally, climate change impacts, such as increased frequency and intensity of storms, rising sea levels, and prolonged droughts, exacerbate water contamination issues. Heavy rainfall and flooding can

overwhelm wastewater treatment facilities, leading to the discharge of untreated sewage into water bodies. Rising sea levels can result in saltwater intrusion into freshwater supplies, while prolonged droughts reduce the water availability and concentrate pollutants in smaller volumes of water. These factors necessitate continuous adaptation and enhanced protection measures to ensure the sustainability and safety of Delaware's water resources (DNREC, 2023).

The Delaware department of natural resources and environmental control (DNREC)'s Hazardous Waste Program exists to manage and mitigate the risks associated with hazardous material to protect public health and the environment (2024). Delaware has numerous sites across all three counties that produce hazardous waste as by-products of industrial activities, such as manufacturing plants, chemical processing facilities, and healthcare institutions. The state has 23 key sites dealing with hazardous waste, highlighting the importance of stringent management practices to prevent contamination of air, water, and soil, thereby ensuring community safety and ecological health. The program has made significant strides in regulatory compliance and site regulation.

The Delaware Department of Natural Resources and Environmental Control (DNREC) plays a crucial role in safeguarding public health by monitoring environmental conditions and addressing health concerns related to environmental hazards. DNREC's efforts are multifaceted, involving various programs, initiatives, and partnerships aimed at identifying, evaluating, and mitigating risks to human health from environmental sources. DNREC operates a comprehensive air quality monitoring network across the state. This network consists of multiple monitoring stations that measure pollutants such as ozone, particulate matter, sulfur dioxide, nitrogen dioxide, carbon dioxide, and volatile organic compounds. By continuously collecting and analyzing air quality data, DNREC can identify pollution trends, assess compliance with federal and state air quality standards, and issue timely health advisories to protect vulnerable populations. DNREC provides real-time air quality data to the public through online platforms and mobile applications. This transparency allows residents to make informed decisions about outdoor activities, especially during periods of poor air quality. DNREC conducts health impact assessments to understand the potential effects of air pollutants on public health. These assessments guide regulatory actions and the development of air quality improvement plans.

DNREC's Division of Water is responsible for monitoring and protecting the quality of Delaware's water resources, including rivers, lakes, and groundwater. The division conducts regular sampling and analysis to detect contaminants such as heavy metals, pesticides, and microbial pathogens. DNREC collaborates with the Delaware Division of Public Health to ensure that public drinking water systems meet stringent safety standards. This partnership involves routine testing, infrastructure inspections, and the issuance of boil water advisories when necessary. DNREC implements various pollution prevention programs aimed at reducing runoff from agricultural and urban areas. These programs help minimize the introduction of harmful substances into water bodies, thereby protecting aquatic ecosystems and public health (DNREC, 2023).

Managing hazardous waste is a critical part of DNREC's mission to protect public health. DNREC oversees the proper handling, treatment, and disposal of hazardous waste to prevent soil and groundwater contamination. DNREC's site Investigation and Restoration section (SIRS) identifies and remediates contaminated sites, often referred to as brownfields. These efforts involve extensive soil and groundwater testing, risk assessments, and cleanup activities to eliminate or reduce health hazards.

DNREC maintains an emergency response team trained to handle environmental incidents such as chemical spills and industrial accidents. The team works swiftly to contain and mitigate the impact of such events on public health and the environment.

Public awareness and community involvement are key elements of DNREC's approach to addressing health concerns. DNREC actively engages with communities to provide education on environmental health risks and promote healthy practices. DNREC conducts outreach programs in schools, community centers, and public forums to educate residents about environmental health issues. Topics covered include the safe use of pesticides, lead poisoning prevention, and the health impacts of air and water pollution (DNREC, 2017). DNREC supports citizen science initiatives that encourage residents to participate in environmental monitoring activities (Newman et al., 2020). By involving the public in data collection and observation, DNREC enhances community awareness and fosters a collaborative approach to environmental stewardship.

DNREC's regulatory and policy framework is designed to enforce environmental laws and standards that protect public health. The department develops and implements regulations based on scientific evidence and public health considerations. DNREC establishes health-based standards for pollutants and contaminants, ensuring that regulatory limits are protective of human health. These standards are periodically reviewed and updated in response to new scientific findings. DNREC conducts inspections and audits to ensure compliance with environmental regulations. Enforcement actions, including fines and corrective orders, are employed to address violations that pose health risks.

Wastewater surveillance has gained prominence as a valuable public health tool for monitoring the spread of infectious diseases. Wastewater contains bacteria, viruses, and pathogens excreted by humans. By analyzing wastewater samples, scientists can detect pathogens even before clinical data from doctor's offices or hospitals are reported to public health officials. This early warning system enables more timely and targeted public health responses, helping to prevent outbreaks and mitigate their impacts (UNEP, 2023).

The CDC's report on the use of wastewater surveillance during the COVID-19 pandemic illustrates the effectiveness of this approach in monitoring public health threats. Wastewater-based epidemiology (WBE) provided early warnings of SARS-CoV-2 outbreaks, allowing for timely public health interventions (Kirby, A E et al., 2021).

Delaware's wastewater surveillance adopts a similar approach to disease monitoring, leveraging wastewater analysis to track the presence and spread of infections within communities. The Delaware Public Health Laboratory (DPHL), tests samples twice a week from 12 of the treatment plants, located in New Castle, Kent, and Sussex counties. Additionally, over 100,000 private septic systems statewide benefit from these insights, enabling public health officials to provide resources and take preventative actions to control disease spread. As of December 14, 2023, the DPHL reports results for SARS-CoV-2 (COVID-19), Influenza A & B, and Respiratory Syncytial Virus (RSV), which they share with the CDC

through the National Wastewater Surveillance system. The program demonstrates a proactive measure in maintaining public health and safety through environmental monitoring (DHSS, 2024).

While Delaware has made notable progress in implementing environmental health programs and policies, significant challenges remain in enhancing air quality, upgrading water treatment infrastructure, ensuring effective hazardous waste management, and utilizing innovative surveillance methods like wastewater-based epidemiology. Learning from other states such as California and New York (EPA, 2023) that have successfully adopted advanced air quality monitoring technologies, modern water treatment facilities, stricter hazardous waste regulations, and cutting-edge epidemiological techniques can benefit Delaware. DNREC plays a pivotal role in safeguarding public health through comprehensive monitoring and management strategies, but ongoing improvement and adaptation are necessary. collaborative efforts, stringent regulatory enforcement, and robust community engagement are essential to addressing these challenges and ensuring a healthier future for all.

Theory

Public Health Theory – Social Ecological Model

The public health theory that would be relevant for this project is the Social Ecological Model, which recognizes that health and health behaviors are influenced by multiple levels of factors, including individual, interpersonal, organizational, community, and public policy. This model would be particularly relevant for this project because:

It emphasizes the importance of considering multiple levels of influence on environmental health outcomes. Environmental health issues like air quality, water treatment, and hazardous waste management are impacted by these factors.

Individual level

To effectively evaluate and improve environmental health programs and policies, recommendations may be needed at the individual level such as understanding how individuals perceive and respond to environmental health risks (e.g., awareness of air quality issues or water contamination) can inform educational initiatives and communication strategies.

Community level

Evaluating community-level factors such as the presence of green spaces, quality of local water sources, and proximity to hazardous waste sites. This involves assessing the environmental infrastructure and community resources available to mitigate health risks.

Organizational level

Analyzing how state and federal policies impact environmental health programs in Delaware. This includes reviewing regulations on air quality standards, water treatment protocols, and hazardous waste management practices. Also, considering how broader social and economic factors, such as income

inequality and access to healthcare, influence the effectiveness of environmental health programs. Policies need to address these disparities to ensure equitable health outcomes.

Environmental health considerations have been incorporated into planning projects in Delaware at various levels, such as community planning, transportation policies, and state agency collaborations. The Social Ecological Model can help analyze the interplay of these different levels. Additionally, the model can guide comprehensive data collection at multiple levels, from individual health outcomes to societal policies. This holistic approach can identify gaps and opportunities for improvement in current programs.

The model aligns with the comprehensive approach needed for this project, which involves assessing the effectiveness of programs across multiple domains (air, water, waste management), engaging with stakeholders at different levels (agencies, communities, organizations), and developing recommendations that may span individual, interpersonal, organizational, community, and policy levels.

Discussion

Environmental health programs are intrinsically linked to the field of epidemiology, which studies the distribution and determinants of health and diseases in populations. Monitoring air quality, water treatment, and hazardous waste management are crucial for identifying environmental determinants of health. For instance, air quality monitoring can help epidemiologists understand the correlation between air pollution and respiratory diseases like asthma and COPD. Studies have shown that long-term exposure to pollutants like PM2.5 and NO_2 is associated with increased mortality from cardiovascular and respiratory diseases (EPA, 2024). Additionally, epidemiological data from water quality monitoring can identify outbreaks of waterborne diseases and inform public health interventions to prevent such outbreaks.

Biostatistics

Biostatistics plays a pivotal role in analyzing data collected from environmental health programs. The statistical analysis of air quality data, water contamination levels, and the incidence of diseases can reveal significant trends and associations. For example, biostatistical methods are used to analyze the impact of air quality interventions on health outcomes. A time-series analysis can assess the effectiveness of policies aimed at reducing air pollution by comparing health outcomes before and after the implementation of these policies (Jonidi et al., 2021). Similarly, statistical models can be used to predict the spread of contaminants in water sources and the potential impact on public health.

Health Equity/Inequity

Environmental health programs are essential for addressing health equity and inequity. Poor air quality, contaminated water, and hazardous waste sites disproportionately affect low-income and marginalized communities, exacerbating health disparities. Delaware's initiatives to improve air quality, water treatment, and hazardous waste management aim to mitigate these disparities. For example, the Clean

Water Initiative for Underserved Communities specifically targets areas with inadequate access to clean water and aims to reduce health inequities by providing safe drinking water to all residents, regardless of their socioeconomic status. Ensuring equitable access to clean air and water is fundamental to reducing health disparities and promoting social justice (Braverman et al.,2011).

Health Promotion

Environmental health programs contribute significantly to health promotion by creating healthier living conditions and raising public awareness about environmental risks. Public education campaigns on the importance of air quality and safe water practices can empower communities to take proactive measures to protect their health. Health promotion efforts can include distributing information on the health risks associated with poor air quality, advocating for the reduction of emissions, and encouraging practices that protect water sources from contamination. By promoting behaviors that reduce exposure to environmental hazards, these programs help to prevent diseases and improve overall community health (EPA Progress Report, 2024).

Population Health

The concept of population health focuses on the health outcomes of a group of individuals, including the distribution of such outcomes within the group. Environmental health programs impact population health by addressing the environmental determinants that affect large segments of the population. For instance, reducing air pollution through stringent regulations can lead to widespread improvements in respiratory and cardiovascular health across the population. Effective hazardous waste management reduces the risk of chemical exposures that can lead to chronic diseases and cancers. By implementing and monitoring these environmental health programs, Delaware can achieve better health outcomes for its population, demonstrating a commitment to improving the overall health of its residents (Kindig & Stoddart, 2003).

Social determinants of health and global health.

This topic is closely tied to global health and the social determinants of health, and understanding these connections has deepened my appreciation for the complexities of public health. At its core, global health focuses on improving health outcomes and achieving equity in health for people worldwide. This means addressing not just diseases and medical conditions but also the underlying factors that contribute to health disparities.

One of the key aspects of public health is recognizing the social determinants of health, which are the conditions in which people are born, grow, live, work, and age. These determinants include factors like socioeconomic status, education, neighborhood and physical environment, employment, social support networks, and access to healthcare. During the literature search for this project, I had to study these elements, I can see how they impact health outcomes on a global scale.

For instance, my project explores how environmental health initiatives can help communities manage resources more sustainably. This directly relates to global health because environmental factors such as clean air, safe drinking water, and proper waste management are critical to preventing diseases and promoting well-being worldwide. Poor environmental conditions can lead to significant health issues, particularly in low-income countries where resources are scarce and healthcare infrastructure may be weak.

Furthermore, by examining the effectiveness of these initiatives, my project highlights the importance of addressing social determinants like education and community engagement. Educating communities about sustainable practices and involving them in decision-making processes can empower individuals and promote healthier lifestyles. This, in turn, can reduce health disparities and improve overall health outcomes.

The global health perspective also emphasizes the interconnectedness of health issues. For example, climate change—a topic I delved into during my environmental health course—poses a significant threat to global health. It exacerbates health inequities by disproportionately affecting vulnerable populations who may lack the resources to adapt to changing environmental conditions. Through my practicum, I learned that addressing climate change requires coordinated efforts across countries and sectors, reflecting the global nature of health challenges.

Conclusion

I must say that I now see the topic in a different way. I had a theoretical understanding of how these environmental health initiatives help the population, but the practicum experience provided me with practical insights that deepened my understanding. Through direct involvement I was able to observe the real-world implications and complexities that were often overlooked in academic settings.

The practicum experience highlighted several nuances of how these initiatives are beneficial to the community in a way that I had not fully appreciated before. For instance, I learned about the importance of stakeholder perspectives and how different groups are affected by these initiatives in varied ways. This experience also showed me the significance of context-specific solutions rather than one-size- fits-all approaches.

Overall, the practicum helped me to understand environmental health initiatives and policies more holistically. I gained a better appreciation for the practical challenges and the need for adaptable strategies when addressing these issues. This hands-on experience enriched my understanding and will undoubtedly influence my future work in this field.

Environmental health programs in Delaware, including air quality monitoring, water treatment, and hazardous waste management, are vital components of public health. These programs relate closely to epidemiology, biostatistics, health equity, health promotion, and population health. They provide critical data for understanding health determinants, apply statistical methods to analyze health impacts, address disparities to promote equity, educate the public to encourage healthier behaviors, and

improve the health outcomes of entire populations. Continued investment and improvement in these programs are essential for protecting public health and achieving health equity in Delaware.

Appendix 1

Annotated bibliography:

I got most of the information from primary sources like government agency sites and written articles, as not much research has been done in this field.

American Water Works Association. (2024). State of the Water Industry Report.

The "State of the Water Industry 2024" report by the American Water Works Association provides a comprehensive overview of the key issues, challenges, and trends affecting the water sector. It includes data and insights gathered from water professionals, detailing the industry's performance, infrastructure needs, regulatory landscape, and future outlook.

This report is highly relevant for water industry professionals, policymakers, and researchers. It provides a detailed analysis of current industry conditions and identifies critical areas for improvement and investment.

Air Quality Partnership of Delaware. (2024). Wilmington Area Planning Council (WILMAPCO). http://www.wilmapco.org/aqp/

This website serves as the online hub for the Air Quality Partnership of Delaware (AQP), a public-private coalition focused on improving air quality and public health in the state. The site provides information on ground-level ozone and particulate matter (PM2.5), highlighting their sources and health impacts, particularly for sensitive groups such as seniors, children, and those with respiratory issues.

American lung association. (2024). State of the Air Report

The 2024 State of the Air Report by the American Lung Association is a critical document that assesses air quality in the U.S., focusing on ozone and particle pollution based on data from 2020 to 2022. It reveals alarming trends, such as the highest spikes in particle pollution in 25 years, affecting 39% of the population. The report underscores the exacerbating effects of climate change on air quality and the heightened exposure of marginalized communities to polluted air. It calls for concerted efforts from government entities and individuals to combat air pollution and safeguard public health, emphasizing the urgency of addressing environmental and health disparities.

Archer, C.L., Cervone, G., Golbazi, M., Al Fahel, N., & Hultquist, C. (2020). Changes in air quality and human mobility in the USA during the COVID-19 pandemic. Bulletin of Atmospheric Science and Technology, 1(3-4), 491-514. https://doi.org/10.1007/s42865-020-00019-0

Bulletin of Atmospheric Science and Technology is a peer-reviewed journal that publishes original research articles, reviews, and sometimes commentaries in the field of atmospheric science. Articles in this journal are considered reliable, credible sources of information and are commonly cited in other scholarly works used to inform further research.

This article investigates the changes in air quality and human mobility across the United States during the COVID-19 pandemic and the associated lockdown measures. It highlighted significant improvements in air quality due to reduced human mobility and industrial activity. The authors underscored the potential impact of stringent emissions controls and reduced vehicular traffic on air quality, suggesting that more aggressive policies could yield substantial public health benefits, particularly in areas with historically high pollution levels.

David Kindig and Greg Stoddart, 2003: What Is Population Health?

American Journal of Public Health 93, 380_383, https://doi.org/10.2105/AJPH.93.3.380

This seminal article provides a foundational definition of population health, emphasizing the importance of addressing social determinants and health disparities through a multi-disciplinary approach. It argues for a shift in public health practice and policy to focus on broader health determinants and equitable health outcomes.

Kindig and Stoddart's work is crucial for public health professionals, policymakers, and researchers who aim to develop and implement effective health interventions that address the root causes of health disparities. The article's conceptual framework is a valuable tool for understanding and improving population health. This article significantly contributed to my understanding of population health by broadening my perspective on the factors that influence health outcomes. It underscored the importance of addressing social determinants and highlighted the need for a comprehensive approach to public health that goes beyond healthcare services alone.

Environmental Health Toxicology, Delaware Health, and social services.
https://dhss.delaware.gov/dhss/dph/hsp/eht.html accessed 23 May 24, 2024

This website provides an overview of the Environmental Health Toxicology Office (EHT) within the Delaware Division of Public Health. The EHT is responsible for preparing and responding to public health hazards, including those related to environmental factors. The site outlines the office's mission to safeguard health and save lives through a robust system for addressing public health threats. It highlights the EHT's oversight of various programs that monitor and enforce health and safety standards, as well as the prevention and control of environmental risks to human health. The website serves as an official government source, offering insights into the role and responsibilities of the EHT in managing environmental health issues in Delaware. However, it does not provide detailed information on specific programs, policies, or the effectiveness of the EHT's efforts in protecting public health.

Environmental integrity project report (2018, October 11). Three Quarters of Large U.S. Slaughterhouses Violate Water Pollution Permits. https://environmentalintegrity.org/news/slaughterhouses-violate-water-pollution-permits/

This article reports that 74 out of 98 large U.S. slaughterhouses violated their water pollution permits between 2016 and 2018. These violations include excessive nitrogen and fecal bacteria discharge, contributing to significant environmental and public health concerns, particularly in low-income and minority communities. This article is relevant to my research because it highlights the systemic issues within regulatory frameworks and the significant public health risks posed by industrial pollution.

Environmental Protection Agency. (2023). Our Nation's Air 2023.
https://gispub.epa.gov/air/trendsreport/2023/#home

The "Our Nation's Air 2023" report by the Environmental Protection Agency (EPA) presents a comprehensive overview of the air quality trends in the United States. The report details improvements and ongoing challenges in air quality, based on data collected up to 2022. It covers various pollutants, their sources, and the impact of regulatory measures on air quality. This report is crucial for environmental scientists, policymakers, and public health professionals. It provides valuable insights into

the progress and remaining challenges in managing air quality, informing future regulatory and policy decisions to protect public health and the environment.

Environmental Protection Agency. (2024). Progress Cleaning the air and Improving People's Health

https://www.epa.gov/clean-air-act-overview/progress-cleaning-air-and-improving-peoples-health

Environmental Protection Agency. (2023). Equitable development and environmental justice.

https://www.epa.gov/environmentaljustice/equitable-development-and-environmental-justice

Horney, J.A., Scales, S.E., Gangwal, U., & Dong, S. (2023). Ensuring Access to Opioid Treatment Program Services Among Delawareans Vulnerable to Flooding. Delaware Journal of Public Health, 9(2), 130-132. https://doi.org/10.32481/djph.2023.06.024

This article examines the intersection of environmental hazards, specifically flooding, and access to opioid treatment programs (OTPs) in Delaware. The authors discuss the challenges faced by individuals who rely on these services during flood events and propose strategies to ensure continued access to treatment. It highlights a critical and often overlooked aspect of disaster preparedness: ensuring continuity of care for opioid-dependent individuals during environmental crises. It is relevant to my research as the authors provide practical recommendations that could be instrumental in enhancing the resilience of health services in flood-prone areas, thus contributing to better public health outcomes in Delaware.

Jonidi Jafari A, Charkhloo E, Pasalari H. Urban air pollution control policies and strategies: a systematic review. J Environ Health Sci Eng. 2021 Oct 8;19(2):1911-1940. doi: 10.1007/s40201-021-00744-4. PMID: 34900316; PMCID: PMC8617239.

Newman, G., Shi, T., Yao, Z., Li, D., Sansom, G., Kirsch, K., Casillas, G., & Horney, J. (2020). Citizen Science-Informed Community Master Planning: Land Use and Built Environment Changes to Increase Flood Resilience and Decrease Contaminant Exposure. International Journal of Environmental Research and Public Health, 17(2), 486. https://doi.org/10.3390/ijerph17020486

The International Journal of environmental research and public health (IJERPH) appears to be a generally reputable and legitimate source. Peer-reviewed, open-access journal indexed in major databases such as PubMed and web of science. For general environmental and public health research such as this, it is a viable source.

A case study of a community master planning process in Wilmington, Delaware, that incorporated citizen science data and aimed to increase flood resilience and reduce contaminant exposure through land use and built environment changes. The authors describe the collaborative approach involving researchers, community members, and local stakeholders. Study demonstrates a novel approach to community planning that leverages citizen science, environmental data, and participatory processes to develop interventions that address multiple environmental health concerns, including flood risk and air pollution exposure.

Offutt-Powell, T.N, Parykaza, M, Caputo, C., & Perkins, R. (2017). Health data for Delaware: The path towards creating Delaware's Environmental Public Health Tracking Network. Delaware Journal of Public Health, 3(5), 32-41. https://doi.org/10.32481/djph.2017.10.007

The Delaware Journal of Public Health is a peer-reviewed journal published by the Delaware Academy of Medicine/DPHA. It is freely available to the public and indexed in PubMed. It is a legitimate and useful source for public health research and information specific to Delaware, especially for local practitioners, policy makers, and community members. Its affiliation with the state's public health association gives it credibility within its intended scope.

This article describes the efforts of the Delaware Division of Public Health (DPH) to develop an Environmental Public Health Tracking Network (EPHTN) for the state. The authors highlight the connection between environmental factors and health outcomes, and the need for communities to have access to relevant data on their local environments. The article provides background on the National Environmental Public Health Tracking Program, a CDC-funded initiative to create surveillance networks for environmental hazards, exposures, and health outcomes.

The article, though not recent, is relevant to this research as it provides a thorough overview of the EPHTN development process, including practical insights and lessons learned. The emphasis on collaboration and data integration offers valuable guidance for other regions looking to develop similar systems.

"Welcome to Air quality partnership of Delaware". Air Quality Partnership of Delaware. http://www.wilmapco.org/aqp/ accessed 23 May 24, 2024.

This website serves as the online hub for the Air Quality Partnership of Delaware (AQP), a coalition of businesses, agencies, and individuals focused on raising awareness about practices that can improve air quality and public health. The site clearly outlines the AQP's mission and provides educational resources on ground-level ozone and particulate matter (PM2.5), and highlights the health risks associated with these pollutants, particularly for sensitive groups like seniors, children, and those with respiratory issues. The AQP website serves as a valuable resource for Delaware residents, offering educational materials, practical tips, and tools to stay informed about air quality issues and take action to improve local air quality. Its user-friendly design and diverse range of partners contribute to its credibility and potential impact on raising public awareness and promoting positive behavioral changes.

World's air pollution: real-time air quality index. https://waqi.info/

Appendix 2: Work Plan / Logic Model

Goal	*objective*	*Activity*	*Timeline*	*Resources*
Assess Effectiveness of Environmental Health Programs.	1. Evaluate air quality monitoring programs.	1.Review data, compare to health outcomes.	June 2024	1. Air quality data, h
	2. Assess water treatment programs.	2.Analyze data, evaluate compliance.		2. Water quality rep
	3. Evaluate hazardous waste management.	3.Review policies.		3. Policy documents
Identify Areas for Improvement.	Identify gaps in air quality monitoring.	Compare with best practices, gather feedback.	July 2024	Best practice guidelin
	Highlight deficiencies in water treatment.	Identify contaminants, suggest improvements.		Contaminant data, tre methods.
	Pinpoint weaknesses in hazardous waste management	Assess disposal methods, review protocols		Emergency response c
Communicate Findings and Recommendations.	Develop comprehensive reports.	Compile data, create visual aids.	July/August 2024	. Reporting tools, data software.