2025 DC Public Health Case Challenge

Strengthening Health Resilience for Chronic Disease in the District of Columbia through Technology and Data Solutions

NATIONAL ACADEMY OF MEDICINE

NATIONAL ACADEMIES Sciences Engineering Medicine

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Acknowledgments

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Disclaimer

All characters and organizations described in the case are fictional and do not reflect the views of actual organizations or individuals. The case scenario is complex and does not necessarily have a single correct or perfect solution, thus encouraging teams to devise a variety of creative, interdisciplinary, and evidence-based approaches across the Social Ecological Model (SEM). The authors have provided essential data and information in the text and appendixes with additional resources and references to help teams develop their solutions. The data are drawn from independent sources and clearly cited so teams can verify and use them as appropriate and relevant to their approach to the case. Teams are responsible for justifying the accuracy and validity of all data and calculations in their presentations and supporting their assertions in front of a panel of subject matter experts who will serve as judges representing different stakeholders.

Instructions

Task: Develop a feasible and innovative proposal of an approach to address disproportionate environmental impacts and strengthen resilience in chronic disease prevention in Washington, DC using data and technology tools. Present your proposed solution(s) to address the challenge at the Case Challenge competition to be held on October 17, 2025.

Scope: The proposal is limited to a budget of $1.5 million USD to be used over a 3-year period. Your proposal and presentation should specify which sector(s), groups of people (including age range), and/or organizations your intervention(s) will engage in developing and implementing the proposed approach and provide justification for these selections. Staff salaries for the intervention should be covered in the allowed budget. All preparatory and intervention activities should happen within the 3-year funding period.

Outside resources: Teams should also consider outside resources for a deeper understanding of the problem and to develop a stronger proposal. However, team members must generate the case solution independently. Faculty advisors and other individuals who serve as a resource should not generate ideas for the case solutions but may provide relevant supportive information, guide students to resources, and offer feedback on students' ideas and proposals for case solutions and recommendations and on draft slides/practice presentations.

Judging: Refer to the judging rubric (see Appendix E) for the criteria on which you will be assessed. Judges are drawn from organizations working with Washington, DC residents, academic and clinical medicine, and other nonprofit organizations.

If you have questions about the case, please e-mail Maggie Anderson (maanderson@nas.edu) before 9:00 am on Thursday, October 16, 2025. She will forward your question and the answer to all participating teams.

On the day of the presentation, October 17, please remember the following:

- Arrive at the National Academy of Sciences building (2101 Constitution Avenue, NW, Washington, DC; entrance on C Street) between 8:00 am and 8:30 am.
- The security guard will ask to see your ID and direct you Room 125 to check in.
- Bring a copy of your presentation in PowerPoint format on a flash drive and give it to the Case Challenge organizers in Room 125 by 8:30 am (you may also email it to maanderson@nas.edu by 8:30, but bring a backup on a flash drive and check in in Room 125).
- Your presentation should be no longer than 15 minutes and will be followed by 10 minutes of Q&A from the judges.
- Dress professionally, as you are representing your school in front of an audience. However, please do not wear anything that would identify your school. Team members may identify their field of study if desired.

For more information on the Case Challenge guidelines and logistics, refer to the guide in Appendix G for student teams and faculty advisors.

We are looking forward to hearing your ideas for contributing to a thriving Washington, DC community. Thanks for participating, and have fun!

Case

Strengthening Environmental Health Resilience for Chronic Disease in the District of Columbia Through Technology and Data Solutions.

Funding Announcement and Specific Case Challenge

The DC Technology in Environmental Health Justice Foundation (DC-TEHJF) is excited to announce a request for proposals (RFP) for organizations working to improve the environmental health of all DC residents. It is looking to fund evidence-based, innovative proposals that are designed to implement data and technology tools to address uneven environmental burdens linked to chronic disease in Washington, DC. The grant is $1.5 million over 3 years.

Recognizing that many possible subpopulations could benefit from this grant, proposals that clearly use data-driven strategies to identify the setting for their interventions and particular group(s) within the diverse Washington, DC population will be prioritized. DC-TEHJF is interested in funding solutions that work to address at least one element of primordial, primary, or secondary prevention at the broad community health level using data and technology tools and are not solely limited to the clinical environment or personal health care space. Solutions should focus on chronic diseases, such as cardiovascular, respiratory, neurologic, and metabolic conditions, but *not* cancer. DC-TEHJF is not accepting cancer-focused proposals. Proposals that include strategies geared to address two or more levels of the SEM will be prioritized. Proposals that include cross-sector collaborations will be viewed favorably.

The Challenge

You are a team at an organization or coalition in Washington, DC focused on addressing environmental health disparities. Your team is going to submit an innovative proposal for a sustainable, feasible solution using data and technology to address environmental health disparities in the prevention of chronic diseases within a population of people living in Washington, DC. Chronic disease prevention should focus on primary or secondary levels of intervention. In consultation with your organization's leadership, and with their support, your team should come together to compete for the grant and submit the application in approximately 2 weeks and no later than 8:30 am on October 17, 2025.

Problem Statement

Environmental health disparities are a persistent and evolving threat to public health globally and domestically. According to the World Health Organization (WHO), 23% of global deaths and 26% of deaths among children under 5 are attributable to preventable environmental factors (Prüss-Ustün et al., 2016). However, environmental risks are not equitably distributed, with disadvantaged populations—particularly those affected by poverty, geographic isolation, or marginalization—facing 5–10 times greater exposure to harmful environmental hazards than other groups within their countries (WHO, 2023). These global patterns are mirrored in the United States (U.S.), where "racial and ethnic minorities and members of low socioeconomic groups, are disproportionately burdened by harmful exposures in their homes, workplace, and neighborhood environments" (Beard et al., 2024). These conditions directly impact their long-term health and well-being and contribute to higher prevalence of chronic disease (Beard et al., 2024; Benavidez et al., 2024). Moreover, aspects of harmful environmental conditions may be exacerbated by global climate change, with ever-worsening effects on human health, as discussed later.

The built and natural environments represent fundamental determinants of health, structuring risks and resources over the course of life and across generations (Bernardo, 2024). The built environment describes the human-made or modified structures where people live, learn, work, or play, encompassing housing, transportation, and utility distribution elements (EPA, 2025a). The natural environment encompasses everything else, including air, soil, water, and living organisms (IOM, 2002). Both the built and natural environments can impact health.

Natural environmental threats to health stem from a range of sources, including air and water pollution, land use patterns, and climate change (Prüss-Ustün et al., 2016). Exposure to these hazards has been shown to increase the development of a wide range of chronic health outcomes, including respiratory illnesses, cardiovascular disease (CVD), certain cancers, and heat-related conditions (Brusseau et al., 2019; US GCRP, 2016). Other, less-visible exposures may still contribute meaningfully to chronic disease risk. National data demonstrate that seasonal exposure to tree, grass, and weed pollen is associated with increased physician visits and medication use for allergic disease, particularly in urban areas with limited allergen-buffering infrastructure (Saha et al., 2021). Casey et al. (2017) also found that Black, Hispanic, and lower-income populations experience higher ambient noise exposure across the contiguous United States, a factor linked to CVD, stress, and impaired sleep. Thus, structural conditions, zoning, greenspace access, and transportation associated with the urban landscape can have large and often underestimated effects on the health of populations. Furthermore, worsening climate change could interplay with the built and natural environments to exacerbate health risks due to environmental hazards across this spectrum (USGCRP, 2016). These impacts are not just increasing the risk of physical ailments; growing data indicate that climate change has a detrimental impact on risks for depression, anxiety, and suicide as well (Cunsolo et al., 2020).

Despite growing evidence linking environmental exposures to chronic disease, those exposures remain under-integrated into public health frameworks and health care delivery systems (Sears & Genuis, 2012). Based on a 2018 survey of 489 cities across the globe, 54% reported that they anticipated climate change significantly compromising their current public health infrastructure, and only 69% indicated that they were planning or having a climate change risk or vulnerability evaluation (Watts et al., 2019). However, emerging tools offer new opportunities to address these gaps. Technologies such as environmental monitoring, GIS-based risk mapping, and health informatics can help identify high-risk neighborhoods, inform place-based interventions, and support community-driven action. The increasing availability of digital tools also makes it easier to address disparities in health information and resource access. When effectively integrated into health care systems, these innovations can help improve the “Iron Triangle” of health care, enhancing access, reducing costs, and improving quality (Carroll, 2012). These strategies align with *Healthy DC 2030*, the district’s health plan for tackling structural determinants of chronic disease and advancing environmental health equity (DC DOH, 2024).

Reducing chronic disease in Washington, DC requires a bold, resilience-focused approach that directly addresses the worsening environmental conditions contributing to poor health. This could include investing in green infrastructure (systems that reduce pollution and support public health), heat mitigation, regulatory enforcement, and public access to localized environmental data, grounded in both national best practices and DC-specific evidence (EPA, 2025b).

Key Terms and Definitions

Resilience	
Health resilience	"Positive adaptation after stressful situations and it represents mechanisms of coping and rising above difficult experiences (i.e., the capacity to successfully adapt to change, resist the negative impact of stressors, and avoid significant dysfunctions)" (Babić et al., 2020).
Community health resilience	"The ability of a community to use its assets to strengthen public health and health care systems and improve its physical, behavioral, and social health to withstand, adapt to, and recover from adversity" (ASPR, n.d.).
Community resilience	"The ability of a community to prepare for anticipated natural hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions" (FEMA, n.d.).
Climate resilience	The ability to prepare for, withstand, recover from, and adapt to impacts ranging from severe weather to drought to extreme temperature (Center for Climate and Energy Solutions, 2019).
Climate Change	
Climate impact preparedness	A proactive, localized approach to anticipate and prepare for "inevitable shifts" in the global climate, including strengthening "homes, communities, and systems to withstand the increasing pressures" (Sustainability Directory, 2025).
Climate change mitigation	"Any action taken by governments, businesses, or people to reduce or prevent greenhouse gases or enhance carbon sinks that remove them from the atmosphere" (UNDP, 2024).
Climate change adaptation	"Actions that help reduce vulnerability to the current or expected impacts of climate change, like weather extremes and hazards, sea-level rise, biodiversity loss, or food and water insecurity" (UNDP, 2024).
Prevention Levels	
Primordial prevention	"Risk factor reduction targeted towards an entire population through a focus on social and environmental conditions… "targeting the underlying social conditions that promote disease onset" (Kisling & Das, 2023).
Primary prevention	"Measures aimed at a susceptible population or individual. The purpose is to prevent a disease from ever occurring, so the target population is healthy individuals" (Kisling & Das, 2023).

Secondary prevention	"Emphasizes early disease detection, and its target is healthy-appearing individuals with subclinical forms of the disease (pathologic changes but no overt symptoms diagnosable in a doctor's visit)" (Kisling & Das, 2023).
Tertiary prevention	"Targets both the clinical and outcome stages of a disease. It is implemented in symptomatic patients and aims to reduce the severity of the disease and any associated sequelae" (Kisling & Das, 2023).
Quaternary prevention	"An action taken to protect individuals (persons/patients) from medical interventions that are likely to cause more harm than good" (Martins, Godycki-Cwirko, et al., 2018).
Environmental Justice and Health Equity	
Environmental justice	"The fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, in developing, implementing, and enforcing environmental laws, regulations, and policies" (EPA, 2010).
Health equity	"The state in which everyone has a fair opportunity to attain full health potential and well-being, and no one is disadvantaged from doing so because of social position or any other socially defined circumstance. Achieving health equity requires valuing everyone equally with focused and ongoing societal efforts to address avoidable inequalities and historical and contemporary injustices and eliminate health and health care disparities due to past and present causes" (NASEM, 2023).

Illustrative Case Scenarios

The scenarios are meant to illustrate some types of environmental hazards and health conditions that communities within Washington, DC are likely to experience. These scenarios are not representative of all populations in the region.

Scenario 1: Ava is a 9-year-old student living in Ward 4, a community experiencing unseasonably high temperatures in April, with daily highs into the mid-90s for several weeks. Ava's commute to school involves walking to a bus stop with no shade and then sitting on an idling school bus for up to an hour due to heavy traffic. The bus windows are open, exposing the children to hot, stagnant air and tailpipe emissions from surrounding vehicles. Upon arrival at school, Ava and several classmates are frequently observed coughing and experiencing labored breathing, symptoms that worsen throughout the school day. The school nurse notes a recent uptick in students presenting with asthma-like symptoms and that most of them live along the same bus route. The local health department recently issued an air quality alert, but the school system has not implemented any specific measures to protect students during their commute.

Scenario 2: Alex is a 50-year-old living in Ward 8. They just had a check-up with their doctor, who said they were at risk of metabolic syndrome. Their doctor recommended walking more and increasing their consumption of fresh fruits and vegetables. Unfortunately, Alex's neighborhood

lacks sidewalks for safe walking, and the nearest grocery store with affordable, fresh produce is a 45-minute bus ride away. Alex recently lost their job, which provided not only access to an onsite gym but also comprehensive health insurance that covered the majority of their medical expenses. Alex is now facing significant financial strain and is worried about affording follow-up care and the cost of healthy food. Physical activity seems like a luxury, given other challenges.

Scenario 3: Civil unrest has led to widespread disruptions in several wards, closing essential services. James and Donna, a married couple in their late 30s, both manage chronic conditions—James has Type II diabetes, and Donna has hypertension—and are particularly affected. The local food pantry where they source most of their meals is closed, and the community health clinic where they receive regular check-ups and medication refills is inaccessible. James's insulin supply is running low, and Donna is starting to experience more frequent headaches, a known symptom of her high blood pressure. Without basic medical services, they are unable to monitor their conditions or access the medications they rely on to prevent acute complications. The unrest has also caused significant stress, which is known to worsen both diabetes and hypertension.

Scenario 4: Ronaldo is a 74-year-old man who lives in a multi-unit apartment complex in Ward 3. He has been diagnosed with congestive heart failure, a chronic condition that requires strict daily management. He relies on daily medication, a low-sodium diet, and a medical device (a remote patient monitoring system) to track his weight and other vital signs; it sends data to his health care team. A severe storm has caused widespread flooding and power outages in his neighborhood. A downed tree limb has severed a power line, leaving his apartment complex without electricity, which deactivated his remote device, cutting off the crucial data flow to his cardiologist. Furthermore, he is unable to properly store his low-sodium frozen meals, which are a cornerstone of his dietary management. He is experiencing significant stress from the storm and the fear of his condition worsening. The dangerous driving conditions and flooding prevent him from seeking medical care or fresh supplies. Ronaldo is worried about fluid retention, a dangerous complication, and feels completely disconnected from his health care support.

Climate Change Preparedness/Resilience

Climate change increases the risks to population health. The United States has already experienced increased rates of extreme weather events—such as severe flooding, heat waves, droughts, and wildfires (including those that spread to urban settings)—and worsening air quality, increased disease transmission through food, water, and disease vectors, and increasing impacts to mental and physical health due to climate change (USGCRP, 2016). To effectively respond, jurisdictions will require community-specific data and advanced modeling to address current impacts and enhance resilience to future climate-related threats.

Community resilience is commonly described as a positive attribute that enables coping with hazards effectively (FEMA, n.d.). At a global level, the International Consortium for Organizational Resilience provides a framework for overall community resilience (ICOR, 2016). It posits that every resilient community has five key systems: a healthy environment, responsible governance, strong economy, prepared system, and high quality of life (ICOR, 2016).

Environmental Justice and Health

In the United States, particularly in urban centers, like Washington, DC, health risks are amplified by historical differences in investment and infrastructure that shape the distribution of environmental hazards (Beard et al., 2024).

In DC, environmental conditions, such as degraded air and water quality, extreme heat, allergen exposure, and ambient noise, are concentrated in underresourced neighborhoods (APHA, 2018). These overlapping exposures disproportionately affect low-income communities and communities of color, compounding their vulnerability to chronic disease and contributing to enduring health disparities (ODPHP, 2024). Certain wards and neighborhoods face the city's highest levels of $PM_{2.5}$ (fine particulate matter less than 2.5 microns in diameter) exposure and heat stress from urban heat island effects, stemming from disinvestment and discriminatory planning (Basescu, 2024; Castillo et al., 2021; Smith, 2017). $PM_{2.5}$ is an air pollutant that can penetrate deep into the lungs and bloodstream, increasing the risk of CVD, stroke, and asthma (EPA, 2025c). At the national level, studies have demonstrated that long-term $PM_{2.5}$ exposure significantly increases the risk of ischemic heart disease and stroke (Alexeeff et al., 2021). Castillo et al. (2021) found that Black residents and lower-income neighborhoods in DC bear a disproportionate burden of $PM_{2.5}$-attributable health outcomes, including stroke and lung cancer. Additionally, urban heat risks in DC are high, and historically redlined areas face greater health burdens from temperature extremes due to limited green space and aging infrastructure (Basescu, 2024; Smith, 2017). These findings reflect broader environmental patterns nationwide.

Similarly, water quality disparities have been documented nationwide. One study reported that systems serving low-income and minority communities were more likely to incur repeated drinking water violations (McDonald & Jones, 2018). DC has experienced inequities in lead pipe removal that it has endeavored to remedy in recent years (American University, 2020).

Chronic Diseases: Cardiovascular, Respiratory, Neurologic, and Metabolic Disorders

Chronic diseases represent a significant health care burden across the United States overall and DC specifically. Among adults in DC aged 18–64 in 2023, nearly half (48.5%) reported at least one chronic health condition and 7.3% had three or more (KFF, 2023). These figures are similar to the country overall, where 54.3% of adults 18–64 reported any chronic health condition and 10.1% had three or more in 2023 (KFF, 2023). Environmental health threats increase chronic disease risk, and climate change exacerbates this (USGCRP, 2016).

CVD tends to impact the heart's ability to pump blood and the blood vessels' capability to circulate blood efficiently. It remains the leading cause of death in the United States (AHA, 2025). Research has shown that various features of the environment influence CVD risk, progression, and (Bhatnagar, 2017). Evidence supports how ecological features, such as sunlight exposure; geographic characteristics of the natural environment, such as altitude, latitude and greenspaces; and diurnal cycles of light and day impact risk (Bhatnagar, 2017). Heart disease was the leading cause of death in DC in 2022, and the age-adjusted rate of CVD was 357.8 per 100,000 for 2000–2022 (CDC, 2022, Hashemian et al., 2025). While CVD-specific mortality in DC declined consistently 2000–2020 among White residents, it plateaued 2011–2020 for Black residents (Hashemian et al., 2025). It also starkly increased among male people in DC 2011–2020 compared to a gradual increase among female residents during this time (Hashemian et al., 2025). In this DC-specific analysis spanning 2000 to 2020, risk factors for CVD, including

hypertension, smoking, obesity, and diabetes, also showed persistent racial disparities, with higher prevalence in Black than White residents (Hashemian et al., 2025).
Respiratory disease, such as asthma, chronic obstructive pulmonary disease (COPD), and pneumonia, can all be influenced by the quality of the environment. For example, childhood asthma can be caused by long-term exposure to air pollutants (Lee et al., 2021). It is also known that reducing air pollutants, both indoors and outdoors, can lower the risk of asthma- and COPD-associated symptoms (ODPHP, n.d.-a). Chronic lower respiratory diseases were the eighth leading cause of death in DC in 2022, and the age-adjusted rate of chronic lower respiratory diseases was 31.7 per 100,000 for 2000–2022 (CDC, 2022; Hashemian et al., 2025).

Neurologic disorders consist of a range of diseases that negatively affect the nervous system, including stroke, dementia, Alzheimer's and Parkinson's diseases, muscular dystrophy, and epilepsy. Emerging evidence suggests air pollution increases the risk of several neurological disorders (Shi et al., 2020). For example, a scoping review found evidence that PM exposure was associated with increased risk and severity of both ischemic and hemorrhagic strokes (Louis et al., 2023). The prevalence of dementia in DC was estimated at 13% in 2020 (Power et al., 2020) but differed by ward, with Ward 2 estimated at 8% and Ward 5 at 16.8% (Power et al., 2020). This report also highlights racial, ethnic, and ward-specific differences in modifiable risk and protective factors for cognitive decline and dementia (Power et al., 2020). The age-adjusted rate of Alzheimer's disease 2000–2020 in DC was 23.6 per 100,000 (Hashemian et al., 2025).

Metabolic disorders, including obesity, metabolic syndrome, and diabetes (Type I and II), all have been observed to be associated with environmental pollutants, although further research is needed to uncover the direct mechanisms involved. Researchers have asserted that "[a]ll of the major pollutants are considered to be endocrine disruptors because of their interactions with various transcription factors, receptors, and tissues that result in alterations of metabolic function" (Khalil et al., 2023: 1). In 2022, diabetes was the seventh leading cause of death in DC (CDC, 2022). About 42,900 adults (7.8%) in DC have diagnosed diabetes, and an estimated 3,300 adults are diagnosed each year (ADA, 2024). Nearly 134,500 adults in DC (24.3%) have obesity (ADA, 2024).

Chronic Disease Prevention

Chronic disease prevention can occur at various levels (see Key Terms and Definitions section). Improving access to an urban neighborhood to safe sidewalks to promote physical activity is an example of primordial prevention. Tobacco cessation programs are an example of primary prevention. Blood pressure screening is an example of secondary prevention. These levels of prevention are the focus of this case challenge.

Tertiary and quaternary prevention are not a focus of this brief. Cardiac rehabilitation in patients recovering from a myocardial infarction is an example of tertiary prevention. Quaternary prevention protects individuals from medical intervention that may cause more harm than good (Martins et al., 2018).

DC has multiple programs focused on chronic disease prevention, including the Asthma, Diabetes Control and Prevention, and Cardiovascular Health Programs and Brain Health Initiative (Government of the District of Columbia, n.d.-a, n.d.-b, n.d.-c, 2023). The DC Department of Health (DOH) has a Chronic Disease State Plan for the District that offers more information on prevention efforts (DC DOH, n.d.).

DC-Level Environmental Health and Chronic Disease Goals

Emphasizing the importance of environmental health and chronic diseases, DC DOH has set multiple Healthy DC 2030 and Sustainable DC 2.0 Goals focused on environmental health and chronic diseases related to the environmental health threats detailed here (DC DOH, 2024). A leading Healthy DC 2030 indicator directly focuses on environmental contaminants: "reduc[ing] the amount of toxic pollutants released into the environment" (DC DOH, 2024). Sustainable DC 2030 indicators include "audit[ing] and eliminat[ing] environmental health threats (mold, lead, and carbon monoxide) in 100% of Washington DC's public housing," "develop[ing] an interagency heat management strategy to minimize the injury rate associated with extreme cold and heat temperature days," and "improv[ing] population health by systemically addressing the link between community health and place, including where we are born, live, learn, work, play, worship, and age" (DC DOH, 2024). Healthy DC 2030 goals focus on physical activity and nutrition—important precursors to chronic disease—and directly on chronic diseases, including stroke; diabetes; and heart, respiratory and kidney disease (DC DOH, 2024). These resources are grounded in cross-government interactions and hint at the need for ever-greater coordination and collaboration within government and with nonprofit and private-sector organizations.

Worsening Impacts of Built and Natural Environments on Chronic Disease Development

Both the built and natural environments shape the physical, social, and economic conditions that influence behavior, exposure to harmful agents, and physiological stress responses. These environmental contexts actively exacerbate or mitigate health risk, and impacts are growing as the effects of climate change intensify. At the population level, the design and maintenance of neighborhoods, accessibility of public transport, quality of housing, and ecological surroundings dictate how individuals engage with both health-promoting resources—including access to and costs of health care—and harmful exposures, often in ways that are unevenly distributed across race, income, and geography. Some examples of the interplay between the built and natural environments and chronic diseases in the context of worsening climate change are included next.

Built Environment

The built environment is central to this landscape of chronic disease risk through aspects like transportation infrastructure, walkability, housing quality, food and health care access, land use planning, and green space access. It is increasingly impacted by climate effects and a key target for resilience efforts to protect human health.

Transportation and Walkability

Walkable neighborhoods—those designed with safe sidewalks, mixed land use, and public transit—are linked to lower rates of obesity, hypertension, and diabetes (Makhlouf et al., 2023; Yang & Wang, 2025). Yet walkability remains unequally distributed, particularly in low-income and predominantly Black neighborhoods, where disinvestment has limited access to health-promoting infrastructure (Yang & Wang, 2025). Walkable infrastructure also increasingly needs to be assessed and adapted due to climate change impacts, like flooding, extreme heat, sea-level rise, drought, extreme cold, and landslides (C40 Cities Climate Leadership Group, 2020). As transportation is a key contributor to climate change, increasing and protecting walkability (and cycling and public transit infrastructure) can have multiple benefits, including increasing health behaviors, environmental health, and community resilience (IPCC, 2023). A lack of reliable transit—influencing access to medical care, nutritious food, and essential services—has been shown to worsen disease management and health outcomes, particularly in rural and underserved

areas (Smarsh et al., 2025). Yet individuals living below the poverty line, Medicaid recipients, Hispanic individuals, and people with functional limitations—some of those with the highest health needs—are significantly more likely to report difficulty accessing health care due to lack of transportation, even after controlling for other factors (Wolfe et al., 2020). Climate change impacts—particularly heat, coastal flooding and sea-level rise, and heavy precipitation—are increasingly imperiling the national infrastructure (C40 Cities Climate Leadership Group, 2020; Jacobs et al., 2018). These effects not only decrease safety and reliability of transportation but also impact efforts to move toward environmentally sustainable changes, like walking and cycling (C40 Cities Climate Leadership Group, 2020; IPCC, 2023; Jacobs et al., 2018).

Housing Quality, Indoor Environments, and Energy Insecurity

Indoor air quality—affected by contaminants like mold, lead, particulate matter, and allergens—is associated with adverse respiratory and other health effects (USGCRP, 2016). Key contributors include inadequate ventilation and indoor dampness, which contributes to mold and microbial growth, and volatile organic chemical release from furnishings and building materials (IOM, 2004). Additionally, in Washington, DC, approximately 61% of occupied homes are rented. This can serve as an additional barrier for the majority of residents, who may need to rely on the building owner or manager to resolve indoor environmental issues (EPA, 2025e).

Increasingly frequent storms and flooding due to climate change create ideal conditions for mold and microbial growth more often (Climate Central, 2023). Children exposed to high levels of visible mold in the home during infancy were found to be seven times more likely to have a positive asthma predictive index by age 3 compared to those with no exposure (Iossifova et al., 2009). A long-term simulation of climate change effects on indoor climate found that the risk of mold, particularly in poorly insulated houses, will increase with anticipated warming and increased humidity (Zhao et al., 2024). Lead exposure, often from deteriorating lead-based paint or contaminated dust, poses serious risks to early childhood development. Although research has linked elevated blood lead levels to cognitive deficits and poor academic outcomes, recent findings have strengthened the evidence connecting lead exposure to clinically diagnosed developmental disabilities, particularly intellectual disability and developmental delay (Delgado et al., 2018). Climate change–induced warmer temperatures increase lead dust mobilization inside homes as hotter weather leads to more frequent opening and closing of windows, paint abrasion, and home renovation activities, all of which elevate children's exposure (Attar, 2021).

Household energy insecurity—characterized by poor housing quality, unreliable temperature regulation, and unaffordable utility costs—is an increasingly urgent public health concern, especially in the context of a changing climate (Siegel et al., 2024; USGCRP, 2016). Recent research has identified a state-level association with diabetes prevalence, suggesting that limited access to safe, temperature-regulated environments may contribute to metabolic dysfunction and chronic disease risk (Saelee et al., 2024). Periods of extreme heat and cold and increasing weather events impacting energy infrastructure contribute to increased health risks for energy-insecure populations (USGCRP, 2016). The financial burden of energy costs and instability of housing access contribute to heightened levels of anxiety and depression, effects that fall disproportionately on low-income and racially marginalized communities, compounding existing health disparities (Siegel et al., 2024).

Natural Environment

Interactions between the natural and built environments shape chronic disease risk, often through more diffuse but consequential pathways. Climate affects the natural environment, including increasing temperatures and humidity, changing precipitation and seasonal weather patterns, increasing frequency and intensity of extreme weather events, and rising sea levels and temperatures, which can lead to a myriad of adverse health outcomes, including increased cardiovascular, respiratory, gastrointestinal, and heat-related illnesses, worsening mental health, and premature deaths (USGCRP, 2016). Therefore, both changing natural environmental conditions and social vulnerability must be integrated into chronic disease prevention and resilience planning.

Air Pollution

Climate change worsens smog and boosts pollen production, increasing risks to respiratory health (Knowlton, n.d.). Long-term exposure to air pollution—particularly $PM_{2.5}$, nitrogen dioxide (NO_2), ozone, and pollen—has been robustly linked to CVD and respiratory disease, even at concentrations below current regulatory thresholds (Basith et al., 2022; Wang et al., 2024). These exposures are uneven; despite national declines in air pollution over recent decades, racial and ethnic minority groups continue to bear disproportionately high burdens, pointing to the enduring legacy of structural environmental injustice (Liu et al., 2021). If it were a state, DC would have the highest percentage of people living in counties with pollen-producing ragweed and unhealthy smog days due to ozone, with 100% of residents potentially exposed (NRDC, n.d.).

Neighborhood Geography

The physical placement of neighborhoods in relation to beneficial or hazardous natural environments is a critical determinant of health. Emerging research suggests that considering neighborhood health context can help clinicians identify environmental contributions to illness and better target prevention or intervention efforts (IFM, 2024). Communities near high-traffic roadways are routinely exposed to elevated levels of airborne pollutants, contributing to long-term respiratory and cardiovascular risks (HEI Panel on the Health Effects of Traffic-Related Air Pollution, 2010). Individuals living within one mile of industrial complexes, hazardous waste sites, high-traffic corridors, or pesticide-treated agricultural land face significantly elevated risks of asthma, congenital anomalies, low birth weight, and childhood leukemia (Brender et al., 2011). Limited availability of green spaces, like parks, coupled with safety concerns that discourage their use, has been associated with higher rates of hypertension, especially among Black residents (Kjelstrom et al., 2023). Natural features, such as green space and shaded shelter, can mitigate environmental stressors and reduce chronic disease risk, but only when they are accessible, safe, and equitably distributed (Rojas-Rueda et al., 2019). Extensive research has linked green space exposure to improvements in mental health, immune and metabolic function, pregnancy outcomes, CVD, and premature mortality (Rojas-Rueda et al., 2019).

Extreme Weather Events

Extreme heat events, exacerbated by urban heat islands, are associated with increased cardiovascular mortality, especially in areas with dense infrastructure and limited green cover. Those with pre-existing asthma, COPD, diabetes, CVD, mental illness (due to medication-induced increased sensitivity to heat stress), and obesity are more vulnerable to heat stress and related conditions (USGCRP, 2016). Climate change is “expected to increase the frequency and severity of extreme heat events and overall average temperatures across seasons” (USGCRP,

2016). These risks are amplified for low-income populations, who may lack adequate housing insulation, air conditioning, or access to cooling centers (CDC, 2025; Hsu et al., 2021). Recent evidence also indicates that medically vulnerable individuals, those with chronic diseases or disabilities, have significantly lower perceived preparedness for large-scale disasters, suggesting a critical gap in adaptive capacity during climate-driven emergencies (Barbato et al., 2022).

Chronic diseases do not arise in a vacuum; they are at least in part produced and exacerbated by built and natural environmental factors at every level. Addressing these multifaceted and evolving determinants is essential for not only reducing disease prevalence but also advancing health equity.

Examples of How Environmental Health Factors Impact Chronic Disease Development Across Socioecological Levels

The SEM (**Appendix A**) is a framework that explains how different levels of influence shape health outcomes and behaviors of individuals. It can be integrated with models like the Building Resilience Against Climate Effects (BRACE) Framework (**Appendix A**) to create interventions focused on improving public health that prepare for and address additional health impacts associated with climate change. Next are the examples that from the five levels of the framework, with climate change considerations for each.

SEM Level	Example	Climate Change Impact(s)
Individual	Air pollutants, such as nitrogen dioxide, can lead to various long-term cardiovascular and respiratory problems (Basith et al., 2022).	Climate changes (i.e., rising temperatures, altered precipitation patterns, & wildfires) increase risk of respiratory and cardiovascular issues and resultant deaths (USGCRP, 2016).
Interpersonal	Exposure to environmental issues, such as extreme weather events, can cause extreme anxiety and stress levels (USGCRP, 2016). Populations with pre-existing mental health concerns are most vulnerable.	Extreme weather events (e.g., hurricanes, floods), increasingly common due to climate change, increase depression and general anxiety due to loss of life, resources, social support, or social networks (USGCRP, 2016).
Organizational/Institutional	Low-quality school infrastructure can make children spending a lot of time in school more susceptible to environmental hazards, like lead paint, and increase their	Climate-induced temperature and air quality impacts increase exposure to both indoor and outdoor air pollutants, increasing respiratory, allergic,

	risk of developing respiratory conditions (Attar, 2021).	cardiovascular, and other risks (USGCRP, 2016).
Community	Certain coastal populations, including communities of color, older adults, children, low-income populations, and some occupational groups, are more vulnerable to health impacts of coastal flooding (USGCRP, 2016).	Climate change will increase coastal flooding risk through higher frequency and intensity of adverse weather events (e.g., hurricanes, heavy rainfall) and sea-level rise due to these and warming (USGCRP, 2016).
Policy/ Society	Government-mandated vehicle emissions testing programs, like those required under the Clean Air Act, help lower population-level air pollution exposure and chronic respiratory and cardiovascular disease risk, particularly in urban communities (EPA, 2025d).	If climate change progresses and conditions become more conducive to ozone formation, any given regulatory approach to reduce ozone will become less effective (USGCRP, 2016).

Leveraging Data and Technology Tools to Increase Environmental Health Resilience

By integrating health technology (i.e., wearable sensors, artificial intelligence (AI)–informed electronic health records) with environmental data systems (i.e., GIS tools, climate indexes), interventions can be designed that target root causes and create community health resilience. While advances in mobile technology, software, and statistical modeling have increased the scientific rigor of health research and improved our understanding and accessibility of real-time health data, there are emerging challenges and ethical considerations of using these tools, explored next.

Tool	Description	Examples
Wearable technology and mobile applications	Track individual health and environmental exposures—like heart rate during heat waves or pollution-triggered asthma events—while connecting users to care and education.	Fitness: Noom, Fitbit, Oura Ring Environmental: The OASH-NIOSH Heat Safety Tool (U.S. DOL et al., n.d.)

Artificial intelligence (AI) and machine learning (ML)	Focused on creating machines that can perform tasks that typically require human intelligence, like problem-solving, learning, and decision-making. ML is a subset of AI that enables systems to learn from data without explicit programming, improving their performance over time.	Chronic disease management and prevention: ML predictive modeling (e.g., neural networks, decision trees, association analysis) used to analyze disease outcomes and progression (Cartier, 2025) Quality of care: Natural language processing models (e.g., support vector machines, Bayesian networks) to answer questions, generate text support, and analyze large amounts of electronic health record data to help patients and providers improve quality chronic disease prevention and management
GIS mapping and dashboard tools	Integrate geographic, environmental, health, and demographic data to visualize spatial patterns of risk, identify vulnerable communities, and guide place-based interventions and policy. These tools support decision-making by overlaying climate hazards, health burdens, and infrastructure needs.	Climate Vulnerability Index (CVI): Aggregates 184 datasets to assess U.S. census tract-level vulnerability based on health, environment, and climate projections (Environmental Defense Fund, 2025) Climate and Economic Justice Screening Tool: Identifies disadvantaged communities to guide federal investments under the Justice40 Initiative (CEJST, n.d.) EJScreen: Developed by United States Environmental Protection Agency to combine environmental and demographic data for mapping overburdened communities, aiding screening and advocacy (Public Environmental Data Partners, n.d.)

Biosensors	Analytical tools that are used in the environmental health field to detect pollutants with high sensitivity and specificity. They rely on biological or chemical recognition elements to identify contaminants such as microbes, heavy metals, and enzymes. Applications range from environmental monitoring to real-time personal exposure assessment.	Environmental monitoring: Microbial biosensors detecting heavy metal ions (e.g., lead, cadmium) in water or soil Air quality: Electrochemical sensors for real-time detection of volatile organic compounds or particulate matter Personal exposure: Wearable biosensors detecting sweat biomarkers (e.g., pH, glucose, metal exposure)
Advanced modeling approaches	Advanced modeling approaches include using various software, such as R, SAS, and DAGitty, to understand and measure complex associations and causal inference and can be used in prediction (DAGitty, n.d.; Textor et al., 2016).	Simulation modeling: a digital representation of a real-world system to study its behavior and evaluate different scenarios; involves building a mathematical or logical model of a system and using software to run simulations to analyze its performance (Kim, 2024) System dynamics modeling: understands and analyzes complex systems by focusing on the interrelationships between different parts and how these change over time (Homer & Hirsch, 2006)

Ethical Use of Data and Technology Tools in Public Health

While data and technology tools hold immense promise in public health, there are important ethical implications to consider. For example, increasingly used across public health and medicine, AI offers some benefits (e.g., potential increased efficiency, rapid integration of multiple data inputs) but also raises important ethical concerns. The WHO (2021) identified six core principles to promote the ethical use of AI: "(1) protect autonomy; (2) promote human well-being, human safety, and the public interest; (3) ensure transparency, explainability, and intelligibility; (4) foster responsibility and accountability; (5) ensure inclusiveness and equity; (6) promote AI that is responsive and sustainable." CDC identified four key ethical considerations for AI in health: (1) ethical frameworks; (2) privacy and confidentiality; (3) decision making; and (4) community engagement (Dankwa-Mullan, 2024). Both emphasize the importance of oversight, policy, and ethical social responsibility (Dankwa-Mullan, 2024; WHO, 2021). Large language models (LLMs) like ChatGPT raise additional ethical challenges because

training data may be biased or used without consent (WHO, 2021). Furthermore, LLMs may fail to protect sensitive data, generate inaccurate, misleading, or potentially harmful information, or be misused with malicious intent for mis- and disinformation (WHO, 2021). The misuse or unethical use of AI can increase disparities and worsen adverse outcomes for disadvantaged populations, underscoring the importance of responsible use in public health and medicine (Dankwa-Mullan, 2024).

Many other data and technology tools may suffer from similar sources of bias, including experience and expertise, exclusion, environment, empathy, and evidence biases. For example, data quality can be shaped by the expertise of those collecting, labeling, and inputting the data. Bias can also arise from missing or underrepresented information—often due to unequal access to health care or systemic biases in data collection. Failure to consider socioenvironmental factors, an overreliance on quantitative data, and publication bias toward positive findings can further distort results (Dankwa-Mullan, 2024).

In the context of using data and technology, including AI, to address environmental health issues, two types of bias are particularly relevant. Environment bias occurs when these tools fail to adequately account for the social determinants of health, physical environment, and complex links between the environment and health outcomes. Another problem is empathy bias, which happens when the tools do not fully consider subjective human experiences and elements that are difficult to measure (Dankwa-Mullan, 2024).

Addressing sources of bias in data and technology tools is crucial and may be achieved through measures such as active bias mitigation, diverse funding, ethical data use, diverse data collection integrating social determinants, interdisciplinary collaboration, inclusive data practices, public and professional education, and continuous monitoring and evaluation (Dankwa-Mullan, 2024).

Environmental Impacts of AI Use

Large-scale data and technology tools carry their own significant carbon footprint and therefore environmental risks (Geneva Environment Network, 2025). A 2019 Shift Project study found that “the world’s collective digital carbon footprint accounted for nearly 3.7% of all greenhouse emissions, which is comparable to aviation industry emission levels” (Geneva Environment Network, 2025). Furthermore, this impact is expected to grow, as digital technology’s energy consumption increased by nearly 70% between 2013 and 2020 (Geneva Environment Network, 2025). Digital technology use is multifaceted and expanding, and its environmental impact should be considered in ethical use.

The impact of AI or other big data tools is primarily linked to their data centers (UNEP, 2024). Microchips powering AI need rare earth minerals, often mined in environmentally destructive ways, and produce electronic waste containing heavy metals, like mercury and lead, among other hazards. Using fresh water to construct and cool these centers is especially fraught. One estimate found that global AI-related infrastructure may soon consume six times more water than a country of 6 million people at a time when a quarter of humans lack access to clean water and sanitation (UNEP, 2024). These data centers additionally use large quantities of energy to run, much of which still comes from fossil fuels. Global data are lacking, but the International Energy Agency estimated that data centers in Ireland may account for 35% of the country’s energy use by 2026 (UNEP, 2024). Contributing to environmental risks is the speed of scale-up in big-data-

driven technologies and a general lack of regulation on the use of AI or its environmental impacts.

Additional resources on health resilience and data technology tools can be found in **Appendix B**.

Appendix A: Key Framework

BRACE Framework

The BRACE Framework offers a model for public health organizations to prepare for and address health impacts associated with climate change (CDC, 2024a; Marinucci et al., 2014). CDC originally developed it in 2012 to help local health organizations make actionable plans for climate effects—which can be diverse, geographically specific, and seemingly beyond organizational capacity. BRACE guides users to assess climate and vulnerabilities, project health implications through modeling, assess potential interventions, implement a developed plan, and systematically evaluate activities. Table A-1 offers a description of each of the five steps, and Figure A-1 shows the framework. Throughout the cyclical process, key elements are applied, such as engagement of vested people and groups, long-term planning, and adaptive management. Since its development, various U.S. public health agencies have implemented this adaptive evidence-based method to prioritize climate interventions and protect the health of their most vulnerable community members. More in-depth information and an animated video describing the framework are available from Marinucci et al. (2014) and CDC (2024e).

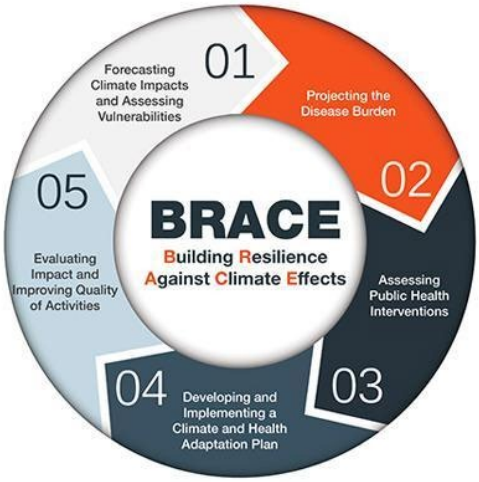

Figure A-1. BRACE Climate Health Framework.
SOURCE: CDC, 2024a.

CDC and the American Public Health Association have created a comprehensive playbook designed to supplement the BRACE framework to incorporate justice, equity, diversity, and inclusion into climate and health adaptation planning efforts (APHA & CDC, 2025).

Table 1. BRACE Climate Health Framework

Step #	Step Details	Description
Step 1	Anticipate climate impacts, and assess vulnerabilities.	Identify the scope of climate impacts, associated potential health outcomes, and populations and locations vulnerable to these health impacts.
Step 2	Project the disease burden.	Estimate or quantify the additional burden of health outcomes associated with climate change.

Step 3	Assess public health interventions.	Identify the most suitable health interventions for the identified health impacts of greatest concern.
Step 4	Develop and implement a climate and health adaptation plan.	Develop a written adaptation plan that is regularly updated. Disseminate it, and oversee its implementation.
Step 5	Evaluate impact, and improve quality of activities.	Evaluate the process. Determine the value of information attained and activities undertaken. Further resources on climate and health evaluation are available from CDC (CDC, 2024c).

SOURCE: Table created using content from CDC (2024a).

Multisolving describes the interconnected nature of health solutions and how you can do one thing to solve multiple health problems. This idea can be used to target multiple chronic diseases or disease at multiple socioecological levels using carefully considered, interconnected solutions (Climate Interactive, 2025).

Social Ecological Model (SEM)

The SEM is a conceptual model that identifies a variety of influences that impact a person's health and well-being. It consists of five spheres of influence: individual, interpersonal, institutional, community, and public policy. Successful public health interventions consider multiple levels of influence when designing programs and strategies to improve the health and well-being of their target population. See Table A-2 and Figure A-2 for more information.

Table A-2. Social Ecological Model

Level	Description	Interventions
Individual	Individual demographics, personal experiences, knowledge, attitudes, beliefs, and behaviors	Often emphasize educational strategies to improve knowledge, change attitudes, and increase self-efficacy
Interpersonal	Relationships with others, including family members, peers, and social networks	Often aim to influence and facilitate behavior change through a focus on shifting social and cultural norms, with a particular focus on the closest social network (e.g., mentoring or peer-to-peer support program)
Institutional	Local health departments, community organizations, health care systems, law	Often aim to influence people who are impacted by a particular institution (e.g., patients of health care systems) and focus on

	enforcement, faith-based organizations, etc.	expanding access to resources or programs, improving service quality, and advocacy
Community	The role of community organizations, relationships between them, and/or the settings in which social relationships occur (e.g., schools, workplaces, neighborhoods)	Often focus on improving the physical and social environment in these settings (e.g., creating safe places where people can live, learn, work, play, and pray), addressing other conditions that give rise to poor health outcomes (e.g., neighborhood poverty, housing inequality), and motivating a community and its relevant stakeholders to work together and address an issue and/or raising awareness and changing community norms
Public Policy	The influence and role of local, state, and federal governments to support and enact policies and laws to improve public health	Often involve advocacy and focus on creating supportive conditions (legislative and otherwise) that allow laws to pass (impactful changes often address the root causes of and factors that systematically lead to issues, such as homelessness, social support)

SOURCE: Table created using content from Aronica et al. (2019).

Figure A-2. Social ecological model.
SOURCE: Aronica et al. (2019).

The Social Determinants of Health (SDOH)

SDOH are the nonmedical factors and conditions that influence health outcomes (CDC, 2024d)—the conditions in the environment where people are born, live, learn, work, play,

worship, and age that affect a wide range of health and well-being outcomes and quality of life (CDC, 2024d). SDOH are categorized into five broad domains (ODPHP, n.d.-b):

1. Economic Stability,
2. Education Access and Quality,
3. Health Care Access and Quality,
4. Neighborhood and Built Environment, and
5. Social and Community Context.

Examples include access to transportation; safe housing; safe neighborhoods; educational attainment and income level; job opportunities; language and literacy skills; access to affordable nutrient-dense foods; access to affordable and quality physical and mental health care; and racism, discrimination, and violence (CDC, 2023). The uneven access to SDOH contributes to a wide range of health disparities, which make them critical to address.

The Public Health Approach

The public health approach uses a science-based, multidisciplinary model to maximize benefits for the largest number of people. This model draws on knowledge from several disciplines, including epidemiology, psychology, sociology, medicine, criminology, education, and economics, to guide several public health interventions, including those that address chronic disease (CDC, 2024b). The following four steps make up the public health approach, accompanied with guiding questions (see Table 3).

Table 3. Guiding Questions for Using the Public Health Approach

The Public Health Approach	
Steps	**Guiding Questions**
1. Define and monitor the problem.	• What problem do I want to prevent? • What data are available to describe the scope and burden of the problem? • How many people are affected by the identified problem? • Who is experiencing the problem? • When and where is the problem occurring?
2. Identify risk and protective factors.	• What are risk factors for the problem? • What are protective factors for the problem?
3. Develop and test prevention strategies.	• Are there existing, effective strategies based on the best available evidence? • If none exist, what resources are needed to develop a new strategy based on what was learned in the previous steps? • What potential research partners can help evaluate the selected strategy?

	• Is the strategy effective? Did it do what it was intended to do?
4. Assure widespread adoption.	• Who would benefit from this strategy (parents, educators, policy makers, etc.)? • What strategies can be used to assure it reaches the people who need it? • What resources exist to support the implementation and evaluation of this strategy?

SOURCE: Table created using content from CDC (2024b).

Appendix B: Additional Resources

F.H. Faunteroy Community Enrichment Center (FCEC)

The **FCEC** is a community-serving facility founded in 2013 and operated by the Rockson Community Development Corp., a 501(c)(3) nonprofit organization in Ward 7, Washington, DC. Its mission is to "embolden self-determination and agency in the community" by providing consistent, high-quality programming for all generations through a racial equity lens.

The FCEC's Resilience Hub proposal is a key part of this mission. The proposal outlines a plan to transform the center into a hub that can support residents before, during, and after a crisis, such as a climate-related emergency. Key aspects of the proposal include the following:

- **Resilient Energy:** The center is developing a microgrid system that combines solar power and battery storage. This will provide clean backup power during grid outages, allowing the center to offer essential services, like charging cell phones and refrigerating medications.
- **Comprehensive Programming:** The hub's programming is designed to operate in all conditions. During normal times, it will offer services focused on workforce development, health and wellness, and community engagement. During an emergency, these services will pivot to meet immediate needs, providing a central point for residents to gather information and access critical resources.
- **Community-Led Approach:** The project is a community-led partnership between the FCEC and Ward 7 Resilience Hub Community Coalition. The community is actively involved in the design and decision-making process to ensure the hub's services are tailored to local needs and priorities.

PATH

PATH’s mission is to transform lives by advancing scientific research, engineering technologies, and developing policies to address global health challenges. The organization's work is structured around three core areas:

- **Product Development and Access:** Creating affordable medical devices, diagnostics, and vaccines.
- **Health and Disease Management:** Focusing on key areas, like maternal, newborn, and child health, noncommunicable diseases, and infectious diseases.
- **Health Systems Strengthening:** Improving health infrastructure and systems through advocacy, policy development, and the use of digital technology and data.

The "Climate x Health" initiative is a specific example of how PATH is applying this broader mission to a critical modern challenge. It specifically highlights how PATH uses data and technology to build health system resilience in the face of climate change, such as through AI-based early warning systems for disease outbreaks and solar-powered cold chains for vaccines.

Pillars of Governmental Environmental Public Health Guidebook

A new, comprehensive guide from the National Environmental Health Association provides evidence-based recommendations for building and sustaining effective environmental public health programs at the local level. Developed through extensive research with hundreds of environmental public health professionals across 45 states, this framework identifies 11 priorities

essential for protecting community health—from food safety and water quality to lead prevention and emergency preparedness.

Download a copy of the guide at https://www.neha.org/PDFs/2025-Pillars-of-EH_FINAL.7.20.25.pdf

Appendix C: Acronyms and Abbreviations

AI	artificial intelligence
APHA	American Public Health Association
BRACE	Building Resilience Against Climate Effects
CDC	Centers for Disease Control and Prevention
CEJST	Climate and Economic Justice Screening Tool
CHF	congestive heart failure
COPD	chronic obstructive pulmonary disease
CVD	cardiovascular disease
CVI	Climate Vulnerability Index
DC	District of Columbia
DC DOH	DC Department of Health
DC-TEHJF	DC Technology in Environmental Health Justice Foundation
EHR	Electronic Health Record
EJScreen	Environmental Justice Screening and Mapping Tool
EPA	Environmental Protection Agency
FCEC	F.H. Faunteroy Community Enrichment Center
GIS	Geographic Information Systems
LLM	large language model
ML	machine learning
NIOSH	National Institute for Occupational Safety and Health
NO_2	nitrogen dioxide
ODPHP	Office of Disease Prevention and Health Promotion
OSHA	Occupational Safety and Health Administration
PM	particulate matter
RFP	request for proposals
SDOH	social determinants of health
SEM	Social Ecological Model
USD	U.S. dollar
WHO	World Health Organization

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Appendix E: Judging Rubric

These criteria will be considered collectively through a facilitated judging discussion to determine the overall grand prize winner and category prizes. The table presents the criteria contributing to the category prizes listed: **Grand Prize; Practicality Prize; Interprofessional Prize; Wildcard Prize.**

	Poor	Accept-able	Very Good	Out-standing	Comments
Analysis of Problem/Challenge					
• Astute synthesis of problem • Identification of key issues	☐	☐	☐	☐	
Appropriateness/Justification of Solution					
• Justification of chosen priorities • Justification of chosen intervention(s) • Evidence to support likely effectiveness • Fit to Washington, DC context • Cultural/political/social factors • Resourcefulness in gathering information	☐	☐	☐	☐	
Acceptability/Uptake of Solution					
• Acceptability to relevant DC-area stakeholders • Cultural acceptability • Social/behavioral considerations	☐	☐	☐	☐	
Implementation Considerations					
• Implementation plan • Timeline and budget • Feasibility (budget and other resources, time frame, leverages local partners/resources, logistical/infrastructure constraints) • Monitoring and evaluation plan	☐	☐	☐	☐	

Potential for Sustainability					
• Addresses/considers root causes & structural factors that lead to disparities in health outcomes (institutional racism, social/economic/physical conditions, etc.) • Long-term maintenance and growth (feasibility, funding)	☐	☐	☐	☐	
Interdisciplinary/Multisectoral					
• Use of collaborations/interactions among disciplines and/or sectors	☐	☐	☐	☐	
Teamwork					
• Engagement of whole team in preparation and/or presentation • Clear team understanding and use of each other's roles and expertise	☐	☐	☐	☐	
Presentation Delivery					
• Clarity of content and logic of flow • Time management • Audience engagement • Visual aesthetic • Professionalism, poise, and polish	☐	☐	☐	☐	
Questions and Answers					
• Clarity and thoughtfulness of responses • Ability to draw from evidence	☐	☐	☐	☐	

Appendix F: Case-Writing Team Biographies

Each year, students from local universities work together to write this background document for the competing teams, including identifying the specific topic to be addressed.

Teresa Russell, M.S. (Co-Case Lead) is a Ph.D. candidate in public health at the Uniformed Services University of the Health Sciences who works as a research associate II at the Henry M. Jackson Foundation for the Advancement of Military Medicine; she supports the Center for Health Services Research's project on fetal alcohol spectrum disorders, focused on understanding and improving care for children across the military health system. Her dissertation focuses on examining the effect of access to care on severe maternal morbidity in both civilian and military-affiliated pregnant populations. She participated in the DC Public Health Case Challenge in 2023 and 2024 and the Emory Morningside Global Health Case Competitions in 2024 and 2025, placing second in 2025 at Emory.

Remle Scott, Ph.D., M.P.H. (Co-Case Lead) is a recent graduate and assistant professor at the Uniformed Services University (USU), Department of Pediatrics. Her dissertation focused on understanding the intersection of infectious and noncommunicable diseases and studying multimorbidity among people living with HIV in sub-Saharan Africa. After receiving her M.P.H. from George Washington University with a concentration in epidemiology, she continued to conduct epidemiological research with the National Center for Complementary and Integrative Health. She was a member of the USU grand prize–winning team in the 2021 DC Public Health Case Challenge and placed in the top three at the 2022–2023 Emory Morningside Global Health Case competitions.

Anisa Amiji, M.P.H., M.S.H.S., PA-C (Case Writer) is a recent graduate of George Washington University's joint degree physician assistant/master of public health program, with an M.P.H. concentration in maternal and child health. She was a member of the George Washington University team that received the Practicality Prize at the 2024 DC Public Health Case Challenge. This fall, she will begin her clinical career as a physician assistant at Boston Health Care for the Homeless Program.

Shadan Rahmani (Case Writer) is a graduate of American University with a B.S. in public health. This is her second year participating as a case writer. She participated in the Tenth Annual DC Public Health Case Challenge addressing the health of women experiencing homelessness in DC. She is volunteering as a mental health counselor and gaining clinical experience by working with medical professionals.

Morgan Crotta (Case Writer) is a recent graduate of George Washington University's M.P.H. program, with a concentration in global environmental health and policy. Her work has centered on the intersection of climate change, chemical exposures, and health equity, including leading a research project examining global pathways of toxic exposures in the context of climate change. She has contributed to governance and policy analyses for the Unlocking Public Health Protection Initiative and serves as a research to action fellow with the International Society for Children's Health and the Environment, where she collaborates with partners in Latin America to advance children's environmental health and chemical safety. She was also a member of the GW team that received the Practicality Prize at the 2024 DC Public Health Case Challenge.

Elaine Meredith (Case Writer) is a program coordinator with Howard University's M.P.H. program, with experience in both community and academic settings. Her work has included providing nutrition care, supporting public health initiatives, and contributing to program evaluation efforts. In her role, she enjoys working closely with students, faculty, and staff. She especially appreciates opportunities to learn about culture, environment, public health, and any of the ways they intersect. This is her first time participating as a case writer.

Appendix G: Guide for Student Teams and Faculty Advisors

The National Academies of Sciences, Engineering, and Medicine (NASEM) will host the eleventh annual DC Public Health Case Challenge on Friday, October 17, 2025, to promote interdisciplinary, problem-based learning for the betterment of our DC-area community. Teams will be asked to approach a realistic public health issue facing the DC area community and to develop a multi-faceted plan to address it. A panel of expert judges will watch student presentations and pick the winning solutions.

Organizers

NASEM Health and Medicine Division (HMD) Staff
Point of Contact: Maggie Anderson (maanderson@nas.edu)
Amy Geller (ageller@nas.edu)
Alina Baciu (abaciu@nas.edu)

Case Writing Team
Remle Scott (Uniformed Services University)
Teresa Russel (Uniformed Services University)
Anisa Amiji (George Washington University)
Morgan Crotta (George Washington University)
Shadan Rahmani (American University)

Theme

This year's case will focus on "Harnessing Data and Technology to Build Health Resilience in Washington, DC" with a more specific topic to be announced when the case is released October 3rd, 2025.

Overview

- **Universities form a team** of 3-6 graduate and/or undergraduate students representing **at least three disciplines, schools, or majors**. The case will require a comprehensive solution, and teams should be comprised of students representing a variety of disciplines or subjects (health, nursing, public health, law, business, communications, engineering, IT, gender studies, anthropology, economics, sociology, etc.). Teams are encouraged to include both undergraduate and graduate students.
- An orientation **webinar** will be offered to all students who will be competing (advisors are also welcome to tune in). The purpose of the webinar is to provide a primer on **upstream, evidence-based policy solutions for public health issues**, an overview of the Case Challenge process, and Q&A. The webinar will take place from 12:00 to 1:00pm ET on Friday, October 3rd.
- **Student teams** will be provided with a case that is based on a real-life public health challenge faced by communities and organizations in the DC area. Teams will be given approximately two weeks to **develop comprehensive recommendations** to **present to a panel of expert judges**. The presented recommendations will be judged on criteria such as content, creativity, feasibility, interdisciplinary nature, and strength of the evidence base. The case will include more detailed information on the judging criteria.

- Information from the 2013-2024 DC Case Challenge events is available at http://nam.edu/initiatives/dc-public-health-case-challenge/

Prizes/Incentives for Student Teams

- Experience working with people from multiple disciplines to tackle a multi-faceted public health challenge.
- Practice for Emory University's International Global Health Case Competition.
- Press release announcing the winning solution through the National Academy of Medicine (NAM) and the Health and Medicine Division of the National Academies.
- Publication by NAM summarizing each team's solution written by team members (team members listed as authors). Past publications are available at https://nam.edu/initiatives/dc-public-health-case-challenge/.
- Breakfast, lunch, and a small reception will be provided.
- FREE registration to attend the NAM annual meeting on **Monday, October 20th** (in person or virtually) for ALL interested team members and advisors.
    - Attending the NAM annual meeting is an exciting opportunity to meet and connect with leaders in the fields of health, medicine, policy, and beyond. See https://nam.edu/events/ for more information.
    - ***We strongly encourage that at least one team member be available on October 20th to present at a poster session at the meeting (times forthcoming)—contact National Academies staff with any questions.***
    - *Advance registration for the NAM meeting is absolutely required for those interested in attending (to register, use team form at the end of this document).*
- **Prize money**
    - Grand Prize: $3,000
    - 3 "Best in Category" Prizes: $1,800
        - Interprofessional Prize
        - Practicality Prize
        - Wildcard Prize
- **Payment**
    - In order to receive the payment for the cash prize, students must have one of the following: SSN, SSN Type 2, or ITIN (tax ID), or the University must be able to accept the prize on a student's behalf.

Timeline

Please note that the timelines are firm

- **Wednesday, September 10**: Deadline for universities to confirm participation (please email Maggie Anderson at maanderson@nas.edu).
- **Thursday, September 25 (COB)**: Deadline to submit the team roster ***(use the form on the last page of this guide)***:
    - Team member names with areas of study and email addresses for final team registration.
    - IMPORTANT NOTE:
        - **This is a FIRM deadline, and we will NOT accept a roster OR any changes beyond this deadline** (except extreme circumstances; contact the organizers if an issue arises).

- **Friday, October 3 from 12:00 to 1:00pm:** A one-hour informational webinar for competing students (and advisors) will take place before the case is released. The webinar will be recorded and posted online, so any students who are not available at this time can view the recording after. Students (and advisors) are welcome to email questions in advance. The purpose of the webinar is to provide a primer on upstream, evidence-based policy solutions for public health issues, an overview of the Case Challenge process, and Q&A.
- **Friday, October 3 at 1:00pm:** Case is released.
- **October 3 – October 16**: Teams develop their solution to the case.
- **Wednesday, October 15**: Teams must submit poster for NAM annual meeting by COB, ***unless*** you plan on printing your own poster.
- **Friday, October 17**: Teams present their solutions to a panel of judges. Presentations will be followed by an awards ceremony. The event will take place from approximately 8:30am to 5:00pm; we will let you know the exact times once we know the number of participating teams. Breakfast, lunch, and a reception will be provided.
- **Monday, October 20**: NAM annual meeting where all teams will have the opportunity to attend the meeting (if they registered with us in advance) and present their solutions at a poster session.

Getting to the National Academy of Sciences Building

The National Academy of Sciences (NAS) building is located at **2101 Constitution Avenue, NW, Washington, DC** and is accessible by car or metro.

Driving to the NAS building: Limited visitor parking is available within the NAS building's main parking lot. To park for free, tell the garage attendant that you are participating in the Case Challenge and provide your name and license plate number. Street parking is also available at normal DC rates.

Taking the Metro: The closest metro station is Foggy Bottom, located along the blue and orange lines. Upon exiting the metro, head South on 23rd Street, NW. Walk for about half a mile. Turn left onto C Street, NW (before Constitution Avenue, NW) and walk on the side of C Street opposite the State Department. The NAS Building will be the second on your right, after you pass 22nd St NW, which is closed to traffic.

Upon entering the building, you will need to present a photo ID to the guard at the front desk. Proceed to Room 120 to check in and receive further instructions.

Case Challenge Guidelines and Rules

Suggested Team Preparation:

Teams are encouraged to meet several times before they receive the case in order to get to know each other, look at examples from previous case competitions (available at https://nam.edu/initiatives/dc-public-health-case-challenge/), and loosely plan an approach. It may be helpful for team members to agree on communication strategies and time commitments for the two weeks during which they will be developing the case solution.

Developing the Case Solution:

- Designated members of the case writing team will be available to respond via email to questions and requests for clarification during the two weeks while teams prepare their solutions (contact details will be provided with the case). To ensure that all teams have access to all information about the case, all teams will receive a copy of the question and the response within 24 hours of receipt. Questions will NOT be accepted after 9:00am on Thursday, October 16.
- Teams should not discuss their case presentations or case content with other teams during the case challenge period (October 3 - October 16) until the judges have completed final scoring.
- Teams can access and use any available resources for information and input, including both written resources (publications, internet, course notes/text, etc.) and individuals within and outside of the team's university. Students are encouraged to ground their solutions in public health theory, particularly the social-ecological model of health.
- This is a student competition and should reflect the students' ideas and work. The case solution must be generated by the registered team members. Faculty advisors and other individuals who serve as a resource should not generate ideas for case solutions, but are permitted to guide students to relevant resources, provide feedback on ideas and proposals for case solutions and recommendations generated by the students, and provide feedback on draft/practice presentations.
- Participants may not speak individually with the judges about their case solution until judging has concluded on October 17. Please help the organizers by adhering to this rule during breaks.

<u>Faculty Advisors:</u>
Each team must have at least one faculty advisor. The faculty advisor(s) will serve as a point of contact with the Case Challenge organizers. The faculty advisor will also ensure that the team is made up of only undergraduate and graduate students in their university and that the team has representatives from at least three disciplines. Faculty advisors can also help student teams prepare for the competition within the following parameters:

- Faculty advisors **CAN**:
    - Ensure that the case is grounded in public health theory, in particular the social-ecological model of health
    - Assist teams with practice sessions or practice review of sample cases in the weeks preceding the release of the case
    - Suggest resources relevant to the case
    - Provide feedback on ideas for case solutions and recommendations generated by the students
    - Provide feedback on draft/practice presentations
    - Communicate with the Case Challenge organizers about Case Challenge guidelines and logistics
- Faculty advisors **CANNOT**:
    - Generate ideas for case solutions and recommendations
    - Communicate about the case with faculty advisors and students from other competing teams

* Faculty advisors should contact the Case Challenge organizers if they have any questions or concerns about accessibility issues (for example, people with physical disabilities), we will do everything we can to accommodate. The Keck Center has many accessibility and inclusion

features (such as ramps/elevators, assistive hearing devices, lactation room, gender neutral bathrooms, etc.).

Presentations:

- Presentation time: Each team will have a total of 25 minutes (note: there will be 5 minutes of transition time between presentations).
    - 15 minutes are allotted to present analysis and recommendations.
    - 10 minutes are allotted for Q&A with judges.
    - Timing will be strictly enforced.
    - Any leftover time will be utilized at the discretion of the judging panel.
    - Teams may not view other teams' presentations until they have delivered their own presentation.
    - Handheld wireless microphones and a podium with a microphone will be available.
    - Team members will advance their own slides with a wireless clicker.
    - Hardcopies of each team's PPT will be provided to judges by staff. If desired, teams may bring a hard copy of any additional materials to distribute to the judges.
- Format:
    - Analysis and recommendations should be presented in Microsoft PowerPoint.
    - Presentations will be loaded onto the computer and projection screen for you by a Case Challenge organizer. Teams will have an opportunity to check the compatibility of their file in advance of the presentation.
    - Judges will receive a black and white printout of each team's slides.
    - Teams are encouraged to build appendix slides to help answer questions that they anticipate from the judges.
    - Judges will not know the university affiliation of teams until after judging is completed. The names of team members can be included in the presentation, but **DO NOT** include the university name or any identifying information in your presentation (e.g., school mascot).

- Presenters:
    - As many team members can participate in the presentation as the team sees fit. All team members should stand at the front of the room during the Q&A session at the end of the presentation.
    - It is allowable for the team to share their areas of study (but not the specific program/university)
- Dress code:
    - Competing teams are encouraged to present their case solution in business attire. The teams will not be identified by university to the judges, so students should not wear or carry any identifying logos, insignias, etc.
- Deadline to turn in completed case:
    - To ensure that each team has an equal amount of preparation time, each team's final presentation should be loaded onto the presentation computer **by 8:30AM on Friday, October 17**. Failure to submit the presentation on time will result in disqualification from the competition. No changes can be made to presentations

after that time and teams should not continue to work on their case solution and presentation while they are awaiting their presentation time.

Judging:

- The judges have agreed to participate in this event as volunteers. The judges will be announced approximately one week before the event, and biographical sketches of the judges will be available to student teams at that time.
- In evaluating the proposed case solutions, judges will consider the following:
    - Rationale/justification for strategies proposed
    - Specificity and feasibility
    - Interdisciplinary nature of the solution
    - Creativity and innovation
    - Clarity and organization
    - Presentation delivery
    - Teamwork
    - Ability to respond to questions
- Detailed judging criteria will be provided with the case when it is released on October 3.

Resources

Information on the DC Public Health Case Challenge is available here:
https://nam.edu/initiatives/dc-public-health-case-challenge/

The following links provide information and examples from public health case competitions at other universities. Note that most of these cases focus on an international issue; the DC Case Challenge will address a local public health issue. These are just examples—please use your own knowledge, creativity, and community resources to come up with a unique and compelling presentation!

Emory Global Health Case Competition:
http://globalhealth.emory.edu/what/student_programs/case_competitions/index.html

Triangle Global Health Case Competition: http://triangleghcc2013.wordpress.com/

Yale Global Health Case Competition presentations:
http://www.slideshare.net/yaleglobalhealthcc

Appendix H: Presentation Day Agenda

October 17, 2025
National Academy of Sciences Building | 2101 Constitution Avenue, NW, Washington, DC

8:00–8:30am	**Arrival and Registration** *(outside of Room 125; breakfast available outside of Room 120)*
8:30am	**Deadline to Turn in Presentation** *(Room 125)* *Please take your flash drive to the Case Challenge staff member at the computer. This is when teams draw a number for presentation order.* **Judges Check In** (*Front of Room 125*)
8:45am	**Welcoming Remarks** *(Room 125)* *Victor J. Dzau* *President, National Academy of Medicine*
8:55am	**Logistics** *(Room 125)*
9:00am–1:00pm	**Presentations** *(Room 125)* *All but the first team should leave and go to Room 120 or 114. Return to Room 125 when it is your team's turn to present. After your team has presented, you may remain in Room 125 to watch the remaining presentations, Rooms 120/114, or the cafeteria on the lower level. During the morning, an organizer will gather each team to take a photo in the front lobby—see schedule in the section below.*

9:00–9:30	Team 1
9:30–10:00	Team 2
10:00–10:30	Team 3
10:30 – 10:45	**Break**
10:45–11:15	Team 4
11:15–11:45	Team 5
11:45-12:00	**Break**
12:00–12:30	Team 6
12:30–1:00	Team 7

9:00-10:30am	**Team Photo Times** *(meet at registration table outside of Room 125; bring your numbered folder with you)*

	Teams 3-5: **9:05am** Teams 6-7: **9:40am** Teams 1-2: **10:05am**
1:00–1:45pm *(students)*	**Lunch (***Food available outside Room 120)*
1:00–3:20pm *(judges)*	**Judges' Deliberations** *(pick up lunch from outside Room 120 and reconvene in Board Room at 1:20)*
1:45pm	**Group Photo with Students and Advisors** *(Outside)*
2:00–2:45pm	**Team Solutions Recap** *(Room 125)* *Each team will provide an overview of their solutions (5 min each) so everyone can hear how other teams approached the challenge. There will be time for discussion after.*
2:45–3:00pm	**Expert Presentation** *(Room 125)* *Jessica Marx* *Senior Program Officer, National Academy of Medicine*
3:00–3:15pm	**Expert Presentation** *(Room 125)* *Guru Madhavan* *Senior Program Director and Augustine Senior Scholar, National Academy of Engineering*
3:15–3:40pm	**Discussion**
3:40–4:00pm	**Awards Ceremony** *(Room 125)*
4:00–5:00pm	**Reception** *(Room 120)*