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Engaging academia to advance the science and practice of environmental public health tracking

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ABSTRACT

Public health agencies at the federal, state, and local level are responsible for implementing actions and policies that address health problems related to environmental hazards. These actions and policies can be informed by integrating or linking data on health, exposure, hazards, and population. The mission of the Centers for Disease Control and Prevention's National Environmental Public Health Tracking Program (Tracking Program) is to provide information from a nationwide network of integrated health, environmental hazard, and exposure data that drives actions to improve the health of communities. The Tracking Program and federal, state, and local partners collect, integrate, analyze, and disseminate data and information to inform environmental public health actions. However, many challenges exist regarding the availability and quality of data, the application of appropriate methods and tools to link data, and the state of the science needed to link and analyze health and environmental data. The Tracking Program has collaborated with academia to address key challenges in these areas. The collaboration has improved our understanding of the uses and limitations of available data and methods, expanded the use of existing data and methods, and increased our knowledge about the connections between health and environment. Valuable working relationships have been forged in this process, and together we have identified opportunities and improvements for future collaborations to further advance the science and practice of environmental public health tracking.

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1. Introduction: the mission

The prevention and mitigation of health problems related to biological, chemical, or physical hazards in the environment are important functions of public health (Thacker et al., 1996). Such functions are supported through surveillance, the ongoing systematic collection, analysis, and interpretation of outcome-specific data used to plan, implement, and evaluate public health practice (Buehler, 2012; Thacker and Berkeman 1988). In 2000, the Pew Commission identified gaps in environmental health data and information hindering these functions in the United States (Pew Commission, 2000). They described a lack of data for the leading causes of mortality and morbidity, a lack of data on exposure to hazards, a lack of environmental data with applicability to public

health, and barriers to integrating and linking existing data. Without these data, public health agencies cannot fulfill their primary responsibility which includes implementing actions and policies that increase the information available to the public and decision makers, protect people from harm, promote health, and create environments that support healthy behaviors (Frieden, 2013).

The ability of public health agencies to implement data-driven actions and policies in environmental health would improve with (1) enhancements in methods and tools to better use existing data to track the association between health and environment for small areas over time; (2) an understanding of how the characteristics of the data and methodological decisions impact results; (3) advanced methods to address ecological bias, control for confounders and effect modifiers, and improve exposure characterization aimed at the gaps in available data; and (4) recommendations and techniques for improving the data collected including the identification of key missing data and data elements and creation standards for data collection and reporting (Elliott and Wartenberg, 2004; Jarup, 2004; Litt et al., 2004; Mather et

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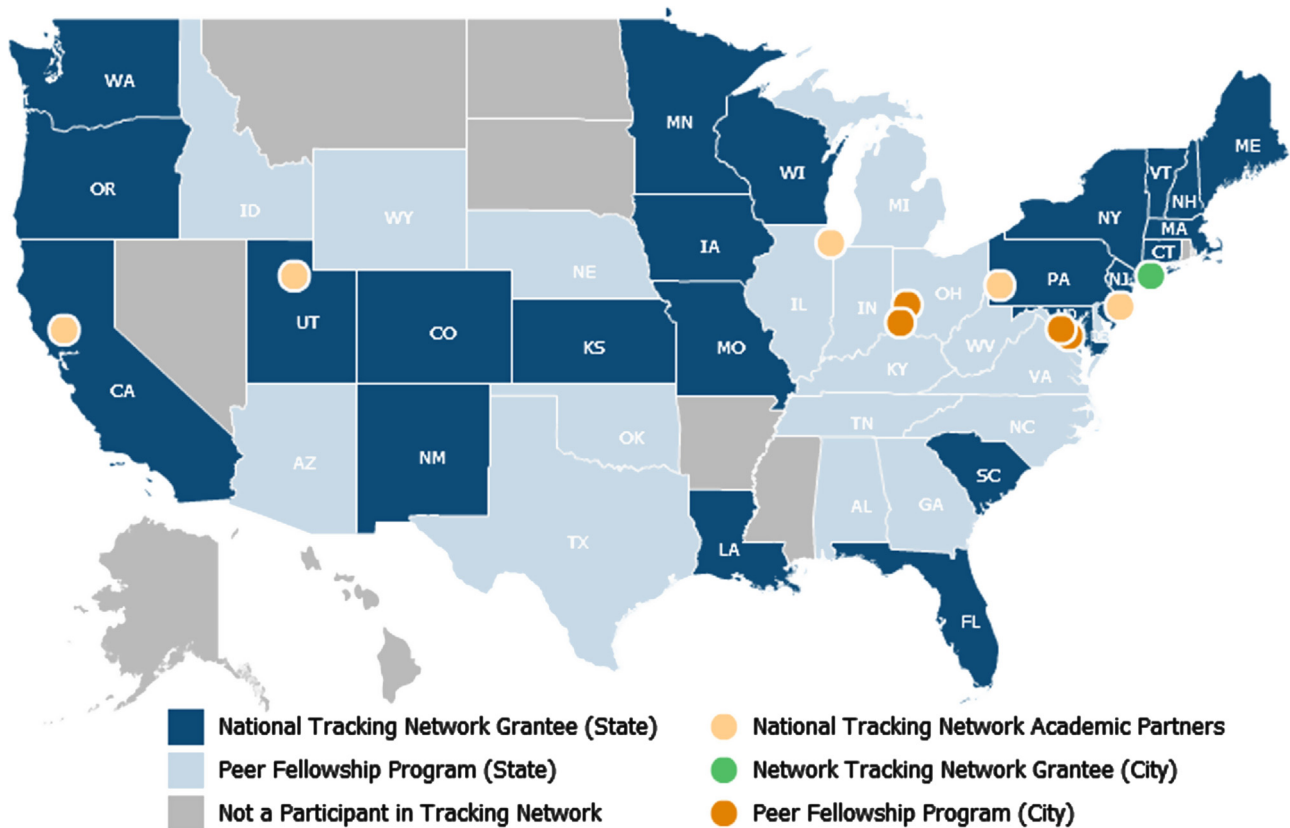


Fig. 1. Tracking grantees and partners (intended for color reproduction on the Web) <http://www.cdc.gov/nceh/tracking/flashmap.html>.

al., 2004; Ritz et al., 2004). Continued improvements in the understanding of the relationship between the environment and health through epidemiologic and toxicological studies would help identify what should be tracked and how it should be tracked (Thacker et al., 1996). Further, better integrated research, surveillance, and practice would help address the challenges and needs of state and local public health agencies (Beale et al., 2008; Kyle et al., 2006).

Since 2002, the Centers for Disease Control and Prevention's (CDC) National Environmental Public Health Tracking Program (Tracking Program) has collaborated with state and local health departments, academic partners, other federal agencies, and non-government organizations (Fig. 1) to address the challenges identified by the Pew Commission and to implement a nationwide network of integrated health and environmental data that can drive actions to improve the health of communities. Environmental public health tracking combines traditional public health surveillance of health outcomes with the collection, integration, analysis, and dissemination of data from environmental hazards (chemical, biological, or physical) and population exposure monitoring (McGeehin et al., 2004). These data are linked, spatially and temporally, to detect and monitor trends in disease burden and the associations between health outcomes and hazards, provide information to the public, and evaluate our progress in protecting the public's health. These data linkage projects can also inform public health action and policy by identifying areas or populations at risk, highlighting sources of exposure to an environmental hazard, or demonstrating the contribution of environmental hazards to adverse health outcomes within the population. Such projects can facilitate the generation of hypotheses regarding etiology (Ritz et al., 2004). However, confirming etiology from data linkages is not easily achieved and often depends on the characteristics of the data and our current understanding of the relationship between the hazard, exposure, and health outcome under investigation.

2. Tracking: the early years

The Tracking Program initially collaborated with federal, state, local, and academic partners to identify priority environmental health issues, develop a vision and strategic plan, build partnerships, and conduct pilot linkage projects (Litt et al., 2004; Mather et al., 2004; McGeehin et al., 2004; Ritz et al., 2004). Together, we have identified data requirements, developed data standards, enhanced workforce capacity, and built the technical infrastructure to manage and disseminate data, analyses, and relevant public health information that we have synthesized (Bekkedal et al., 2008; Charleston et al., 2008; Li and Dawson, 2008; Love et al., 2008; Malecki et al., 2008; McGeehin, 2008; Patridge and Namulanda, 2008). That technical infrastructure is the National Environmental Public Health Tracking Network (Tracking Network), a Web-based, distributed surveillance system of secure and public portals at federal, state, and local levels (<http://www.cdc.gov/nceh/tracking/>). The Tracking Network contains standardized health, exposure, environmental, and population data and provides interactive tools for data exploration and visualization. Through its public portals, the Tracking Network disseminates county level data for many environmental health topics including air quality, contaminants in the community water system, childhood lead poisoning, birth defects, cancer, reproductive and birth outcomes, asthma, heart attacks, heat stress and carbon monoxide poisoning. In addition, more spatially and temporally resolved data has been integrated into the Tracking Network for use by Tracking Program's scientific experts at federal, state, and local levels.

Using the Tracking Program's data and technical infrastructure, we have collaborated to select, integrate, and analyze health, exposure, hazard, and population data to inform public health actions and policies in several key areas. Tracking Program partners have evaluated the association between ambient levels of ozone and $PM_{2.5}$ and traffic density with short-term asthma-

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