CHILDREN'S ENVIRONMENTAL HEALTH INDICATORS

A SUMMARY & ASSESSMENT

January 25, 2018

CHILDREN'S ENVIRONMENTAL HEALTH NETWORK

CONTENTS

INTRODUCTION

Children's environments, where they live, learn, and play, have a significant impact on their health. More specifically, housing conditions (children living in poor housing may be exposed to harmful contaminants such as lead and mold); the quality of the air they breathe and the food and water they consume; the health and safety of their schools and child care facilities; and access to safe opportunities to play are all aspects of children's environments that affect their health. Infants and children are more vulnerable to harm from toxic exposures than are adults--with potentially lifelong consequences to their health and development.

Unfortunately, despite improved understanding of the connection between environment and health and the unique vulnerabilities of children to these impacts, the health of children today is no better than it was a decade or more ago. Furthermore, poor children and children of color are known to experience many health stressors and exposures, and as a result they are more likely to suffer poor health outcomes. Today, autism and other neurodevelopmental disorders are on the rise, child obesity has reached epidemic levels, and impacts from climate changes and severe weather are cause for serious concern.

STATE OF CHILDREN'S HEALTH IN THE U.S. TODAY

- In 2015, 1 in 12 children had asthma (Environmental Protection Agency [EPA], 2017a); Black children have nearly two times the rate of asthma as White children (EPA, 2017b).
- The percentage of children with obesity in the United States has more than tripled since the 1970s. Approximately 1 in 5 school-aged children (ages 6–19) are obese (Centers for Disease Control and Prevention [CDC], 2017a).
- One in 10 (more than 5.9 million) children in the United States are estimated to have attention deficit/hyperactivity disorder (ADHD), and 1 in 68 have an autism spectrum disorder (based on 2010 reporting data) (Project TENDR, 2016). One in 42 8-year-old boys have autism; the role of environmental factors in autism is greater than previously thought (National Institute of Environmental Health Sciences [NIEHS] and EPA, 2017).
- The number of children diagnosed with leukemia has increased by 35% in the past 40 years (NIEHS and EPA, 2017).
- Approximately 16,000 premature births each year are attributable to air pollution (NIEHS and EPA, 2017).
- Children in 4 million U.S. households may be exposed to high levels of lead (NIEHS and EPA, 2017).

Protecting children from harm is society's moral and ethical responsibility; children must be at the center of decisions around policy and investment. To create a movement to put children front and center, CEHN developed *A Blueprint for Protecting Children's Environmental Health: An Urgent Call to Action* (Children's Environmental Health Network [CEHN], 2017). W.K. Kellogg is instrumental in offering leadership and funding toward "putting children first" and provided key funding to CEHN for the development of the blueprint as well as putting its recommendations into action.

From a practical perspective, protecting children from exposure to environmental hazards requires a better understanding of the relationship between environmental conditions and health outcomes as well as the ability to track and measure the effectiveness of protections and policies intended to improve these conditions. Nearly 20 years ago, the need to bridge the gap between environmental conditions and adverse health outcomes was brought to the forefront as a national need through a pivotal report, *America's Environmental Health Gap: Why the Country Needs a Nationwide Health Tracking Network* (Pew Environmental Health Commission, 2000). In 2004, the Institute of Medicine (IOM) of the National Academy of Sciences held a workshop that produced the report *Environmental Health Indicators: Bridging the Chasm of Public Health and the Environment* (IOM, 2004). These two reports provided the foundation to build an environmental health monitoring and surveillance system in the United States. Much progress has been made in environmental health monitoring and surveillance and the development of environmental health indicators in the United States since these signature reports. However, gaps and challenges still exist—for example, there is no comprehensive system to assess and track conditions in schools—and new areas and challenges, such as climate change, have emerged.

REPORT AIM

In keeping with its commitment to creating action and movement around children's environmental health (as outlined in the blueprint and key recommendations and priority actions), CEHN, with support from the Passport Foundation, offers this report on children's environmental health indicators.

The report reviews and discusses existing indicator efforts, including the agencies that are leading these efforts, indicators relevant to children's environmental health, the contributions and challenges associated with each effort, potential gaps, and the purpose and intended use (e.g., to inform policy or decision making, to identify trends, or to raise awareness).

ABOUT INDICATORS

An indicator identifies and communicates a system's status. An environmental public health indicator (EPHI) provides information about a population's health status with respect to environmental factors. It can be used to assess health, or a factor associated with health (i.e., risk factor, intervention), in a specified population through direct or indirect measures (Council of State and Territorial Epidemiologists [CSTE], 2017).

Why are indicators important? To help monitor trends in the state of the environment in order to identify potential risks to health ♦ to monitor trends in health resulting from exposures to environmental risk factors in order to guide policies ♦ to compare areas in terms of their environmental health status to help target action where it is most needed ♦ to help allocate resources ♦ to monitor and assess the effects of policies or other interventions on environmental health ♦ to help raise awareness about environmental health issues ♦ to help investigate potential links between environment and health as a basis for informing health interventions and policy.

"Indicators" are useful instruments in measuring and evaluating progress, identifying areas where more work is needed, and determining effectiveness. Metrics in general are useful and necessary for evaluations.

The indicator must be:

- simple—measuring only one item;
- measurable—comparable and quantifiable;
- understandable—comprehensible to policymakers and the public;
- defensible—supporting a relationship between environmental factors and health status;
- credible, relevant, and able to be acted on;
- responsive to local needs; and
- reflective of societal values with respect to environment and health (IOM, 2004).

Type of indicator: The type of indicator describes how the indicator "fits" within the EPHI framework. An indicator will be categorized as a hazard, exposure, health effect, or intervention (IOM, 2004).

Hazard Indicators	Exposure Indicators	Health Effect Indicators	Intervention Indicators
Conditions or activities that identify the potential for exposure to a contaminant or hazardous condition	Biological markers in tissue or fluid that identify the presence of a substance or combination of substances that could harm an individual	Diseases or conditions that identify an adverse effect from exposure to a known or suspected environmental hazard	Programs or official policies that minimize or prevent an environmental hazard, exposure, or health effect

PRIORITY ISSUES AND CONDITIONS

When thinking about indicators relevant to children's health and the environment, it is important to understand the issues and conditions for which indicators may be needed. Conditions include those that occur in all environments and stages of development that influence a child's health, from home, to child care and school settings, to places of recreation and play. Examples include:

The Importance of Learning Environments

➲Children spend a significant amount of time indoors (American's in general spend ~ 90% of their time indoors (EPA, 2017c)) and much of that time is spent at school; 90% (approximately 50 million) of children in the U.S. attend public schools (Paulson & Barnett, 2010).

➲In 2014, in a survey by the National Center for Education Statistics more than one-half of U.S. schools have been reported to have problems related to indoor air quality; further many schools are in poor condition and considered unhealthy environments (Fisk, Paulson, Kolbe, & Barnett, 2016).

➲There is no system that tracks or captures the conditions of schools; such a system is greatly needed (Healthy Schools Network, Inc., 2016).

➲School environments and their conditions are a longstanding civil rights issue; this issue was the impetus for Brown v. Board of Education (Brown v. Board of Education, 1954).

➲The poorest children often attend facilities that are in the poorest conditions; these children are more vulnerable to potential adverse health effects than their peers (Trousdale, Martin, Abulafia, Barnett, & Westinghouse, 2010).

- Pollution in the environment (environmental conditions) such as air pollution (indoor and outdoor), drinking water contamination, chemicals in food, and contaminated land.
- The presence of toxicants (such as lead, mercury, pesticides, phthalates, and cotinine) through biomonitoring in children and in women who are pregnant or may become pregnant.
- The incidence of adverse health outcomes including asthma, poor birth outcomes, childhood cancers, neurodevelopmental effects such as autism and ADHD, and obesity.
- Children's increased susceptibility to many of the potential harmful effects of climate change, such as air pollution, flooding, and heat. (Children are reliant on adults for their daily routines and safety, and any disruptions to these supports because of climate change may create further stress for children.)
- Access to safe places to learn, play, recreate, and spend time outside and in nature, along with ample opportunities for physical activity.
- The importance of poverty and other social determinants of health with respect to the health of families, infants, and children. These determinants, although not specific to children's environmental health per se, are important and include income and social status, social support networks, education, employment/working conditions, social environments, physical environments, personal health practices and coping skills, healthy child development, gender, and culture (CDC, 2017b).

INFORMATION GATHERING

Information about children's environmental health indicators was gathered in two ways: a search and review of literature and key informant interviews.

LITERATURE SEARCH

A literature search was conducted to identify efforts and studies on children's environmental health indicators. Literature and reports from 2000 to the present were collected and reviewed.

Articles and gray literature were also identified by reviewing bibliographies, through the key informant interviews, and through general Google searches.

Articles and reports were included if they were relevant to the topic; focused on the United States, Europe, or Australia; and peer reviewed (for published studies).

Efforts that were too niche or specific and outside the identified geographic areas were excluded.

(A standard literature search was conducted. Databases searched include ProQuest, the Environmental Sciences and Pollution database, the ProQuest Science database, ProQuest Health and Medical Complete, and the Nursing and Allied Health Database. Web of Science, PubMed, PsycINFO [Ovid], and Google Scholar were also searched. Search terms included children, environmental, health, measures, and indicators.)

KEY INFORMANT INTERVIEWS

Experts were interviewed about children's environmental health indicators. The interview items and questions were intentionally broad and included the following:

1. Provide your overall perspective on children's environmental health indicators in the U.S.
2. Is there a set of established indicators? By consensus?
3. How are children's environmental indicators used? By whom? For what?
4. What is missing/needed?
5. What are the challenges?

FINDINGS

LITERATURE REVIEW

The literature search resulted in the identification of over 50 articles. Most of the more useful resources and efforts (presented here) are those related to governmental efforts around children's environmental health indicators. Many of the resources found through the literature search were too niche or outside the specified geographic areas. In addition, many of the older articles provided information on the development of the governmental indicators highlighted below. These articles were considered unnecessary to include.

Various governmental efforts related to children's environmental health indicators exist—there are several international or global efforts and several federal-level efforts. There are also state-specific efforts and some local efforts. In addition, there are efforts around specific or emerging issues such as climate change, neurodevelopmental issues, and the built environment.

No collective assessments of these indicators/efforts or evaluations of their usefulness were found through the literature search. Nor was there evidence of a complete "set" of indicators that have been adopted by and can be used across all levels of government.

The following summary does not include all the indicator efforts that exist, as there are too many to reference within the scope of this report. Instead, notable examples are offered to give a sense of the state of children's environmental health indicators: the efforts that exist, their intended purpose and audience, and their impact.

GLOBAL

There are several global efforts related to children's environmental health indicators. One global initiative launched by the World Health Organization in 2002 resulted in Using Indicators to Measure Progress on Children's Environmental Health: A Call for Action (World Health Organization [WHO], 2003). The purpose of this effort is to increase the use of indicators, to improve ways to assess children's environmental health and monitor progress, and to promote policies that benefit children's health.

These indicators address global children's health issues including perinatal diseases, respiratory diseases, diarrheal diseases, insect-borne diseases, and physical injuries.

This effort offers an excellent model, explanation, and examples of the use of children's environmental health indicators as a policy tool and how that can lead to investment and intervention.

Through several regional pilot efforts, lessons, and recommendations for future planning, 10 key recommendations were generated for moving forward (WHO, 2009). One of the recommendations was to develop a core set of indicators for compatibility across regions and efforts. Unfortunately, no action was taken to move these recommendations forward.

As part of the global initiative, the governments and public health organizations of Canada, Mexico, and the United States released *Children's Health and the Environment in North America: A First Report on Available Indicators and Measures* (Council of the Commission for Environmental Cooperation of North America, 2006). The report outlines 13 children's environmental health indicators in three categories: asthma and respiratory disease, lead and other chemical exposures, and waterborne diseases. The indicators are based on children's environmental health priorities and available data. The goals of the report are to raise awareness about children's environmental health, to inform policymakers and the public, and to track and measure progress.

One challenge identified in the report was the lack of data in some countries or comparable data for a specific indicator (e.g., data on lead exposure in homes are not comparable across countries). In addition, in some cases child-specific data are not available, and instead national estimates are used.

> *"The considerable reporting gaps that the report highlights are perhaps the most informative outcomes in terms of environmental health."* (Lancet, 2006)

Although the percentage or number of children living in poverty was not identified as an indicator, the report author notes that poverty is an especially important determinant of health. Children living in poverty are more likely to encounter multiple exposures and do not have access to the services or support they need to be healthy.

U.S.

GOVERNMENTAL

FEDERAL

Several national-level efforts exist that are led by federal agencies; these efforts differ in their scope and purpose.

Healthy People 2020 (HealthyPeople, 2017a) outlines the nation's goals and objectives to achieve health for all Americans. It is organized by topic—environmental health; tobacco use; respiratory disease; maternal, infant, and child health; nutrition and weight status; and physical activity—and contains 1,200 objectives within 42 separate topic areas. Leading health indicators (LHIs) have been selected to communicate high-priority health issues and actions that can be taken to address them. The LHI for environmental health is an Air Quality Index.

The data for the indicators come from several credible national data sets.

Objectives specific and relevant to children's environmental health fall under the environmental health topic area. There are six themes within that topic area: outdoor air quality, surface and ground water quality, toxic substances and hazardous wastes, homes and communities, infrastructure and surveillance, and global environmental health. Within each of these themes are specific objectives (a total of 58). In addition, a special section on emerging areas such as climate change, nanotechnology, and the built environment is included. There is also special attention paid to blood lead levels.

Healthy People 2020 contains a health disparities tool and widget that allows users to view the data and indicators by population, race/ethnicity, income, and other socioeconomic factors. It also includes state-specific maps for some objectives. Both features have data gaps and will continue to be improved and updated.

The development of Healthy People 2030 is under way. Many recommendations are being made regarding goals and objectives for 2030, including the recommendation to expand on how healthy learning environments and children's environmental health are benchmarked (Healthy Schools Network, Inc., 2016).

The EPA's *America's Children and the Environment* (ACE) report is the most extensive national effort focused specifically on indicators related to children's health and the environment (EPA, 2017b). The third edition of ACE was published in 2013, and in August of 2017 several indicators were updated on the EPA's website.

ACE provides national-level indicators and trends in three areas: environments and contaminants, biomonitoring, and health. Supplemental indicators are included for birth defects and contaminants in schools and child-care facilities. In addition, at the time the third edition was released, an indicator for climate change was under development; the status of this indicator is unknown.

The purposes of ACE are to compile data from a variety of sources for quantifiable indicators, to provide information to policymakers and the public for informed discussions, and to track trends in children's environmental health (and minimize harmful exposures).

The topics and indicators included in ACE were selected based on a variety of factors, including relevance, data quality and availability, ongoing data collection, and ability to stratify data.

Several ACE indicators align with Healthy People 2020 objectives; a summary is presented in Appendix C of the ACE report (EPA, 2017b).

The EPA also produces the *Report on the Environment* (ROE) (EPA, 2017c). The ROE has 85 indicators across issues directly linked to EPA's mission to protect human health and the environment (air, water, land, human exposure and health, and ecological conditions). The indicators are very high level, are updated frequently, and are important to the agency in determining trends over time. Several indicators are specific to children's environmental health (e.g., blood lead levels and childhood cancers). These indicators and data sources align with ACE.

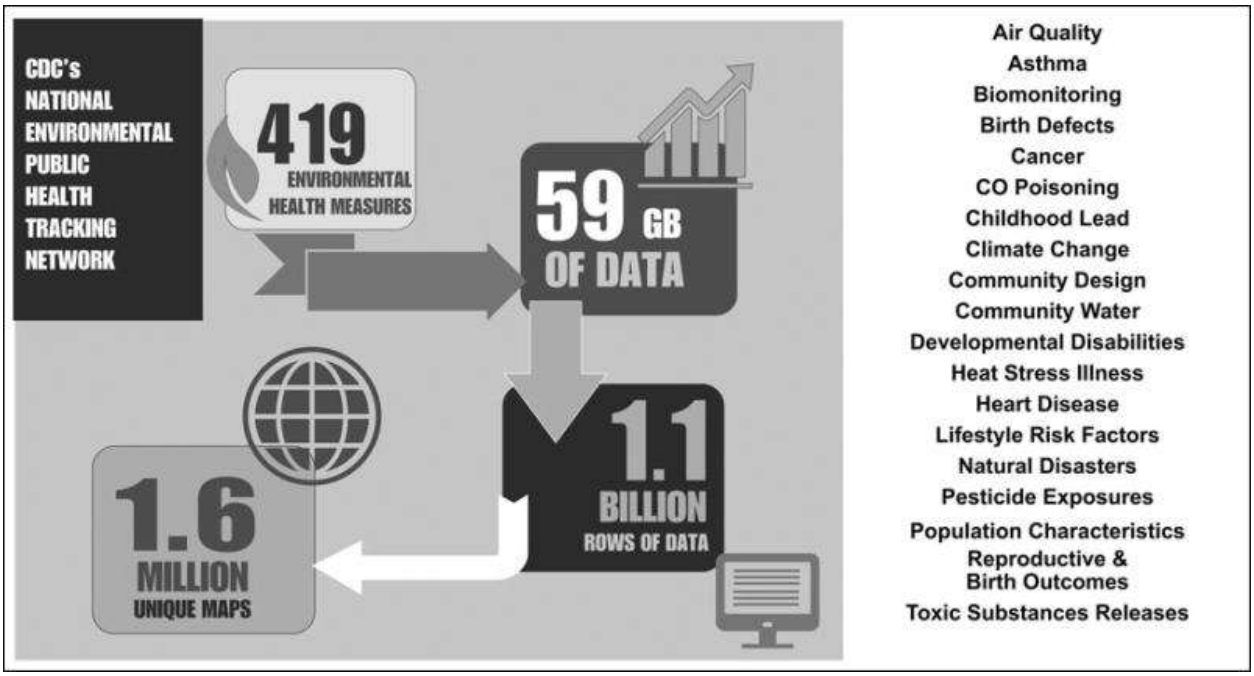
The EPA also maintains EJSCREEN, an environmental justice screening and mapping tool (EPA, 2017d). EJScreen includes 11 environmental and six demographic indicators. The indicators are combined to create EJ indexes. The purposes of EJSCREEN are to help identify minority and/or low-income populations and potential environmental quality issues in the United States. The tool can also be used to raise awareness among stakeholders and community members about potential issues and areas of concern. Several indicators are specific and relevant to children's health (e.g., lead paint and housing issues, the age of the population, and income levels).

America's Children: Key National Indicators of Well-Being is another source for children's health indicators (Federal Interagency Forum on Child and Family Statistics, 2015). The purposes of this compendium are to improve reporting of data, make easily accessible data and indicators available, and inform and aid discussions with policymakers and the public. The effort involves 23 federal agencies and includes 41 indicators associated with the health of children across seven domains: family and social determinants, economic circumstances, health care, physical environment and safety, behavior, education, and health. Indicators specific to children's environmental health are found in the physical environment and health domains. Several of these indicators align with ACE indicators. For example, the indicators for criteria pollutants,

asthma prevalence, and drinking water quality are the same. Furthermore, the same data are used for the second-hand smoke indicator and blood lead levels.

The CDC's Environmental Public Health Tracking Network is a multi-tiered web-based surveillance system that brings together environmental exposure and hazard data and health outcome data into one platform. The program began in early 2000 and has since matured considerably. It has been successful in breaking down data silos and has made significant advancements in the collection and analysis of data, in technology, and in building capacity at the state and local levels (Wilson & Charleston, 2017).

CDC Tracking Today



Note: Image from (Wilson & Charleston, 2017)

The purpose of the program is to "deliver information and data to protect the nation from health issues arising from or directly related to environmental factors." The program is a national effort and currently funds 25 states and one city to develop and support a local tracking program. The data collected from these networks feed into the national network (CDC, 2017c).

Children's environmental health is a focus of the program; the network includes children's environmental health indicators associated with asthma (asthma prevalence among children, hospitalization rates), biomonitoring (levels of chemicals in blood and urine), lead exposure (blood lead levels, housing age), childhood cancers (incidence of acute myeloid leukemia or brain and nervous system cancers), developmental disabilities (number of children receiving special needs services, estimated prevalence of autism), and other associated factors or population and socioeconomic characteristics (CDC, 2017d). The network also contains indicators relevant to obesity such as physical activity levels and community design elements that support walking and biking.

> *"The Tracking Program strives to achieve its vision of Healthy Informed Communities by empowering environmental and public health practitioners, healthcare providers, community members, policy makers, and others to make information-driven decisions that affect their health" (CDC, 2017c).*

These data are available at the state and county levels and, in some cases, the census tract level. The tracking program worked closely with its state and local programs to identify a core set of standardized data and measures for the tracking network.

The state programs are required to disseminate these standardized data and measures and are encouraged to share data that are all different and unique to the issues of the state.

STATE

As noted, 25 states and one city have an environmental health tracking network. To assist states without a network (i.e., those states not funded), CDC has set up a peer-to-peer exchange program. An interactive Tracking in Action map provides links to state networks. Each state network is different and evaluates and presents data differently. In general, the state networks can provide additional information at a more specific geographic level (e.g., public health district, county, zip code level) (CDC, 2017e).

> ***Maine tracking promotes early detection and prevention of Lyme disease***
>
> *In Maine, Lyme disease is on the rise and is a growing concern for state residents and the health community. The Maine tracking program (with the Maine CDC) was able to improve tracking of Lyme disease cases. The program then widely publicized the availability of Lyme disease data to the public, health professionals, and local officials. Raising public awareness of Lyme disease risk and promoting prevention and early detection can reduce the number of Lyme disease cases and associated health effects* (National Association of Chronic Disease Directors and CDC, 2014).

In addition, some but not all states and territories use Healthy People as a guide to improve the health of their population. According to Healthy People 2020, every state has a healthy people

coordinator (HealthyPeople, 2017b). In line with Healthy People, states also have data on children's environmental health indicators. Some states have data at the county or even community level.

The Council of State and Territorial Epidemiologists (CSTE), through the State Environmental Public Health Indicators Collaborative, has developed a set of state-level environmental health indicators for air quality, asthma, and climate change (Council of State and Territorial Epidemiologists [CSTE], 2017). Within these areas are indicators that are relevant to children's environmental health such as asthma and exposure to air pollution by age group. The CSTE has developed 24 climate and health indicators (including policy and investment indicators) that, although important and useful, are not specific to children.

The purpose of this effort is to provide a set of indicators that all states can use (i.e., indicators with "universal applicability"). All states should be able to replicate the indicators. The CSTE website provides detailed instruction on how to develop the indicators, what data sets to use, and more.

COMMUNITY

Given that environmental conditions and exposures differ and can be unique across regions, counties, and even communities, indicators at this degree of specificity are important and can be the most meaningful for those working at the local level. Several studies from the early days of tracking report the importance of and difficulties with local- and community-level data (Ali, Wheitner, Talbott, & Zborowski, 2007).

Today, some of CDC's state programs have indicator data at the community level that are proven to be useful. For example, Louisiana's tracking program was able to identify and map critical information (evacuation zones) during a disaster event in the spring of 2016 (Wilson & Charleston, 2017). In Imperial County, California, community members and their partners, including the California tracking program, have launched an air monitoring website to address the alarmingly high air pollution and asthma rates (children have among the highest rates of asthma-related emergency room visits and hospitalizations) in the state (Public Health Institute, 2017).

There are likely many additional community-level indicator efforts that are not part of the literature pool and therefore were not identified. For example, the Allegheny County, Pennsylvania, health department developed and maintains a set of community health indicators (Allegheny County Health Department, 2017). Many of these indicators are specific to children's environmental health, such as asthma and obesity rates and potential lead exposures.

Environments where children learn are especially important when considering their health given the amount of time children spend at school, including kindergarten and early learning programs. The condition of learning environments differs across states, regions, and communities, and, as noted, learning environments in poor communities are often in poor condition. Evidence shows that academic performance and attendance improve in healthy learning environments and schools. The EPA and several other organizations promote healthy school environments (EPA, 2017e).

NONGOVERNMENTAL

Nonprofits and advocacy groups often use indicators and measures to highlight an issue of concern, to raise awareness of and attention to the issue, and to spur action. This is certainly true of children's environmental health issues. Several examples are provided here.

The County Health Rankings and Roadmaps (Building a Culture of Health County by County, a program of the Robert Wood Johnson Foundation) system ranks the health of communities by health outcomes and health factors. Health outcome measures include length of life (or premature death) and quality of life (with low birth weight as a measure). Health factors are found in four categories: health behaviors, clinical care, social and economic factors, and physical environment. Although these measures are not specific to children's environmental health (several are specific to children's health), they are very relevant and help provide an understanding of the environment in which a child lives, learns, and plays. The program generates State Health Gap reports, which provide information about gaps and how to close them (County Health Rankings, 2017).

Every year, the American Lung Association releases the *State of the Air Report* (American Lung Association, 2017). The report ranks states and cities according to their air quality (e.g., high ozone days and air pollution). It also provides information on groups at risk in the area (e.g., number of pediatric asthma cases or cases among children under 18).

In much the same way as the *State of the Air Report*, the *State of Obesity: Better Policies for a Healthier America* report of the Trust for America's Health ranks states according to obesity rates (for adults as well as children (Trust for America's Health, 2017). The report and associated site link obesity with contributing factors such as poor nutrition and lack of physical activity and provide policies and programs to improve childhood obesity.

The Healthy Schools Network (and its partners in the Coalition for Healthier Schools) publishes Towards Healthy Schools: Reducing Risks to Children (Healthy Schools Network, Inc., 2016). This report, which is the fourth in a series of triennial state of the states' reports, assesses state-by-state environmental health hazards at schools and provides the data needed to evaluate the subsequent impact on children's health. This recent report dives deeper into specific issues

such as asthma, fracking, and well water; federal poverty statistics (e.g., the number of children in a school eligible for free or reduced-price meals) are used as a proxy for poverty and to highlight inequities and injustices. State programs and the contribution of greener, cleaner, healthier schools to promoting attendance and achievement are highlighted as well. The report also offers recommendations regarding healthy schools, including improvements in data monitoring and tracking and the need for federal and state-level leadership and commitment.

The Healthy Schools Network also coordinates the Coalition for Healthier Schools. The coalition's work group on metrics, research, and monitoring wrote a white paper on healthy schools in the fall of 2013. Several findings and recommendations from the white paper are important to the issue of healthy schools; notably, there is no system designed to identify, prevent, or assess risks to children's environmental health or evaluate schoolchildren with suspected exposures. The paper states that problems with children's health in schools are seldom tracked or summarized and even less frequently reported to a central authority, such as a state agency, or coordinated with the child's physician. Furthermore, there is no one agency that is responsible for children's health in schools. Although large data sets exist to, for example, assess children's environmental health in general or metrics used to certify green, high-performance buildings, none of these data sets allow an examination of the relationship between healthy and safe buildings and children's environmental health and learning outcomes (Coalition for Healthier Schools, 2013).

HIGHLIGHTS AND THEMES FROM THE INTERVIEWS

1. Children's environmental health indicator efforts are disparate; there is not one set of indicators that can be used by all. Different efforts have different audiences and intended uses in mind.
2. Children's environmental health indicators can be very useful in helping to provide an understanding of where there are issues, trends, and gaps and in establishing a basis for action.
3. There are significant data-related challenges (e.g., accessibility, limited capacity and resources to maintain and evaluate data).
4. Several interviewees said there was utility in children's environmental health indicators. Specifically:
    - ACE serves as an excellent resource for national assessment and conversation. (A significant concern/challenge with ACE

As noted by one interviewee, "ACE serves as the basis for a national conversation about children's environmental health."

is the uncertainty of its future and the ability of the EPA to continue to update data and provide subsequent editions.)

- Although the CDC tracking network is an important tool for states and counties, it is limited in that not all states have a network. If the program is to be truly nationwide and effective, every state should have funding to develop a local tracking network. Increased investment is needed.

5. Issues, exposures, and conditions are different across regions, counties, and locales. County- and community-level information is critical for proper intervention and prevention strategies.
6. Performance and investment measures are also very important in evaluating children's environmental health. One interviewee stated that workforce capacity and infrastructure measures are critical to ensuring that children are protected from environmental health threats: "It is one thing to determine health outcomes and trends, it is another to know that in some areas of the country there is limited or in some cases no adequately trained workforce to address the issues." Furthermore, in many counties, as demonstrated by the Flint, Michigan, water crisis, poor infrastructure is a significant concern in terms of the health of children and prevention efforts.
7. There are concerns with the sustainability of federal indicator efforts given external and political factors.

CONCLUSIONS

1. Various health indicator efforts exist at the global level and in the United States. Although there are significant overlaps, each has its own scale, scope, and intended purpose.

2. The use of indicators is necessary in all global and national-, state-, and local-level conversations and decisions about policies and investments toward children's health.

3. The only effort specific to children's environmental health is the EPA's ACE. ACE is especially helpful in identifying national-level trends and issues and policy implications.

4. CDC's tracking network is the most extensive surveillance system linking environmental exposures with health outcomes, including those associated with children and the environment. The program has matured significantly since its inception more than a decade ago. One limitation of the program is that not all states have a local tracking network.

5. The literature suggests that efforts at more specific geographic levels are limited and challenged. It was beyond this assessment to identify all the possible local efforts. Since exposure and intervention occur at the community level, information at this level is exceptionally meaningful and critical.

6. Learning environments are of special importance to the health of children for many reasons. Addressing the disparities in and poor conditions of schools and child care facilities in lower income neighborhoods is critical. Greener, cleaner, healthier schools and child care settings improve academic performance and benefit health. There is no national or state system to track and assess learning environments and children's health. Federal and state leadership is needed in this area.

7. Significant challenges exist with the development, use, and maintenance of children's environmental health indicators, including lack of available and comparable data, lack of resources and capacity to maintain and evaluate data, and more.

8. Performance and investment (infrastructure, workforce, policy) indicators and metrics that are relevant to children's environmental health are also important measures (although beyond the scope of this report). Important questions to consider in evaluating performance toward children's environmental health protections may include:

- Are investments being made in infrastructure (e.g., removal of lead service lines) to protect children and prevent harmful exposures?
- Is there an adequately trained and qualified workforce to protect children?
- Are there policies in place that are protective of children's health?
- Are learning environments, especially in poor and underserved areas, safe and healthy? How do we know?
- Importantly, are policy decisions being made with children's health in mind?

Issues regarding children's environmental health indicators, their utility, and what to use and when are complicated. A reader of this report may ask: What does this mean to me? What indicators will be helpful or useful in my system or world of influence? The answers to these questions are complicated and depend on the area of need; the questions, decisions, and issues under consideration; and the scale or scope of the issue(s) at hand. The hope is that the information in this report will help provide a better understanding of the use and importance of indicators, the types of indicators relevant to children's environmental health, and the challenges and gaps that exist.

REFERENCES

Ali, R. M., Wheitner, D. M., Talbott, E. D., & Zborowski, J. P. (2007). Connecting Environmental Health Data to People and Policy: Integrating Information and Mobilizing Communities for Environmental Public Health Tracking. *Journal of Community Health*, 357-374.

Allegheny County Health Department. (2017, October 30). *Allegheny Community Indicators*. Retrieved from http://www.achd.net/aci/

American Lung Association. (2017, October 25). *State of the Air* . Retrieved from http://www.lung.org/our-initiatives/healthy-air/sota/

Brown v. Board of Education, 347 U.S. 483 (U.S. 483 1954).

Centers for Disease Control and Prevention [CDC]. (2017a, October 18). Childhood Obesity Facts. Retrieved from https://www.cdc.gov/healthyschools/obesity/facts.htm

CDC. (2017b, October 30). *Social Determinents of Health: Know What Effects Health*. Retrieved from https://www.cdc.gov/socialdeterminants/cdcprograms/index.htm

CDC. (2017c, November). *About Tracking Program*. Retrieved from https://ephtracking.cdc.gov/showAbout.action

CDC. (2017d, October 24). *Children's Environmental Health, Children's Environmental Health Indicators Available on the Tracking Network*. Retrieved from https://ephtracking.cdc.gov/showChildEHIndicators

CDC. (2017e, November). *State and Local Tracking Programs*. Retrieved from https://ephtracking.cdc.gov/showStateTracking.action

Children's Environmental Health Network [CEHN]. (2017, November 14). *A Blueprint for Children's Environmental Health: An Urgent Call to Action.* Retrieved from Children's Environmental Health.

Coalition for Healthier Schools. (2013). *Collaborative Work Group on Metrics, Research, and Monitoring. White paper.* Retrieved from http://www.healthyschools.org/documents/CHS_White_Paper_Gaps_in_Information_Put_Children_at_Risk-2_2014.pdf

Council of State and Territorial Epidemiologists [CSTE]. (2017, October 30). *Environmental Health: Indicators*. Retrieved from http://www.cste.org/group/Indicators

Council of the Commission for Environmental Cooperation of North America. (2006). *Children's Health and the Environment in North America: A First Report on Available Indicators and Measures.* Retrieved from Commission for Environmental Cooperation: http://www.cec.org/background-materials/childrens-health-and-environment-north-america

County Health Rankings. (2017, November 2). *How Healthy is Your Community*. Retrieved from http://www.countyhealthrankings.org/

Environmental Protection Agency [EPA]. (2017a, May). *Asthma Facts.* Retrieved from https://www.epa.gov/sites/production/files/2017-08/documents/2017_asthma_fact_sheet.pdf

EPA. (2017b, October 24). *America's Children and the Environment (ACE)*. Retrieved from EPA: https://www.epa.gov/ace

EPA. (2017c, October 25). *Report on the Environment (ROE)*. Retrieved from https://cfpub.epa.gov/roe/about.cfm

EPA. (2017d, November 15). *EJSCREEN: Environmental Justice Screening and Mapping Tool*. Retrieved from https://www.epa.gov/ejscreen

EPA. (2017e, December 28). *Why Healthy School Environments are Important.* Retrieved from EPA: https://www.epa.gov/schools/why-healthy-school-environments-are-important

Federal Interagency Forum on Child and Family Statistics. (2015). *America's Children: Key National Indicators of Well-Being.* Washington, DC: U.S Government Printing Office.

Fisk WJ, Paulson J, Kolbe LJ, & Barnett, C. (2016). Significance of the school physical environment-a commentary. *Journal of School Health*, 86(7):483-487.

Healthy Schools Network, Inc. (2016). *Toward Healthy Schools: Reducing Risks to Children.*

HealthyPeople. (2017a, October 24). *HealthyPeople 2020.* Retrieved from https://www.healthypeople.gov/2020/About-Healthy-People

HealthyPeople. (2017b, October 25). *State and Territorial Healthy People Plans*. Retrieved from https://www.healthypeople.gov/2020/healthy-people-in-action/State-and-Territorial-Healthy-People-Plans

IOM. (2004). *Environmental Health Indicators, Bridging the Chasm of Public Health and the Environment. Workshop Summary.* Washington: National Academies Press.

Lancet. (2006). Editorial: Environmental Influences on Children. *The Lancet*, 369.

National Association of Chronic Disease Directors and CDC. (2014). *Tracking in Action. Success Stories from CDC's Environmental Public Health Tracking Network.*

National Institute of Environmental Health Sciences [NIEHS] and EPA. (2017). *NIEHS/EPA Children's Environmental Health and Disease Prevention Research Centers Impact Report, Protecting Children's Health Where They Live, Learn, and Play. EPA/600/R-14/407.*

Paulson, J. & Barnett, C. (2010). Who's in Charge of chuldren's environmental health at school? *New Solut.*, 20(1). 3-23.

Pew Environmental Health Commission. (2000). *America's Environmental Health Gap: Why the Country Needs a Nationwide Health Tracking Network: Technical Report.* Baltimore: Pew Charitable Trust.

Project TENDR. (2016). Targeting Environmental Neurodevelopmental Risks: The TENDR Consensus Statement. *Environmental Health Perspectives*, 358.

Public Health Institute. (2017, November 2). *Imperial County Community Members Launch Air Monitoring Website.* Retrieved from http://www.phi.org/news-events/1107/imperial-county-community-members-launch-air-monitoring-website

Trousdale K., Martin J., Abulafia L., Barnett, C & Westinghouse, C. (2010). Children's environmental health: the school environment. *American Journal of Intellectual and Developmental Disability*, 48(2) 135-144.

Trust for America's Health. (2017, October 25). *The State of Obesity Better Policies for a Healthier America.* Retrieved from http://healthyamericans.org/reports/stateofobesity2017/

Wilson, H., & Charleston, A. (2017). Environmental Public Health Tracking Program Advances and Successes: Highlights from the First 15 Years. *Jounral of Public Health Management and Practice*.

World Health Organization [WHO]. (2003). *Children's Environmental Health*. Retrieved from Children's Environmental Health Indicators: http://www.who.int/ceh/indicators/en/

WHO. (2009). Children's environmental health indicators. Retrieved from Children's Environmental Health: http://www.who.int/ceh/publications/CEHI_summary.pdf?ua=1

ACKNOWLEDGMENTS

The following people and organizations deserve acknowledgment for their support and contribution to the development of this report:

The Passport Foundation (for funding); CEHN staff Kristie Trousdale, Nsedu Obot Witherspoon, and interns; Tracy Kolian (healthy policy consultant and primary author); experts interviewed; and reviewers (Claire Barnett, Joy Carlson, Leyla McCurdy, Daniel Axelrad, Heather Strosnider, and CAPT Fuyuen Yip).

EXPERTS

David Dyjack, DrPH, CIH, Executive Director, National Environmental Health Association

Daniel Axelrad, MPP, Environmental Science, Office of Policy, U.S. EPA

Jack Rayburn, Senior Government Relations Manager, Trust for America's Health

Heather Strosnider, MPH, Epidemiologist, and CAPT Fuyuen Yip, MPH, PhD, Acting Branch Chief, Environmental Health Tracking Branch, Division of Environmental Hazards and Health Effects, National Center for Environmental Health, CDC

Maida Galvez, MD, MPH, Associate Professor in the Departments of Environmental Medicine and Public Health and Pediatrics, Icahn School of Medicine at Mount Sinai; Director, Region 2 Pediatric Environmental Health Specialty Unit (New Jersey, New York, Puerto Rico and U.S. Virgin Islands); Member, CEHN Board

Jerry Paulson, MD, FAAP, Principal, EnviroHealthDoctor, LLC; Consultant, Medical Director for the Pediatric Environmental Health Specialty Unit-East Program at the American Academy of Pediatrics and the AAP's Climate Change Initiative; Emeritus Professor of Pediatrics at the George Washington University School of Medicine & Health Sciences; and Emeritus Professor of Environmental and Occupational Health at the GW Milken Institute School of Public Health