Draft CSTE Brief:
Establishing a National School-Based Children's Environmental Health Tracking Network

Norman Anderson, MSPH
Environmental Public Health Consultant
June 14, 2018

Contributors and Reviewers

Claire Barnett, Healthy Schools Network
Kim Gaetz, North Carolina Department of Health and Human Services
Deborah Gentile, MD, Pediatric Alliance, Pittsburgh, PA
Michele Herdt, New York State Department of Health
Meredith Jagger, Texas Department of State Health Services
Melissa Jordan, Florida Department of Health
Hayleigh McCall, CSTE
Eyal Oren, San Diego State University
Maria Patselikos, CSTE

Executive Summary

1. Scope and Context
2. Partners and Collaborators
3. Environmental health threats facing children in schools
4. Assessment findings
5. Priority School Environmental Health Indicators
6. Establishing Guidance Criteria
7. Pilot Projects
8. Initiating a Tracking Network
9. Conclusions and Next Steps

References

Executive Summary

With this brief, the Council of State and Territorial Epidemiologists (CSTE) intends to initiate a process whereby we translate the documented concerns regarding the environmental health factors affecting children in our nation's schools into a national tracking network. This tracking network should be viewed as part of an environmental investments strategy that is critical to ensuring that our children have the best opportunities for healthy and productive lives.

This strategy should be focused on the precautionary principle, especially given our knowledge and concern regarding low level and cumulative effects. There is increasing evidence that pollutants have effects at levels previously considered safe and even that pollutants have harmful effects that were not previously recognized. Further, they can interact with various other environmental and social determinants of health to produce harmful outcomes. Using the precautionary approach, we focus on ways to minimize or prevent exposures from occurring in the first place.

We have summarized key findings from past reports and conferences and have also provided a public health framework for advancing this initiative. Consistent with good public health practice, we have conducted an initial needs assessment of health department activities in environmental public health surveillance and have begun to identify our public health partners. We have also identified potential pilot projects that could advance our overall goal of establishing a comprehensive environmental health in schools tracking network.

As a springboard document, this paper identifies many of the elements of an eventual tracking network but does not fully develop them. These include: 1) an initial list of partners and collaborators; 2) the status of our understanding regarding the environmental health threats in school environments; 3) the identification of initial indicators and the criteria for measuring and evaluating them; and 4) the initial strategy for creating an Environmental Health in Schools Tracking Network.

The essential finding from this brief is that while systematic efforts around environmental health surveillance in schools are not occurring, there is much ongoing activity and interest in establishing a national network. Through assessment and outreach efforts, we have begun to organize the critical elements necessary for a successful tracking program. Moving forward, there are several priority actions:

- First, it is important to establish some organizing entity, such as a Steering Committee, under the auspices of CSTE. This committee could inform the agenda of the Environmental Health in Schools Workgroup by building on both the partnerships and the activities identified through this brief and the information gathered from an ongoing assessment of state activities.
- Further, this committee could play a central role in advancing a national tracking network, including efforts to build an initial tracking network around lead, radon, and products containing toxic substances; the coordination of an annual summit; and the expansion of outreach and engagement activities.
- The committee could also continue the needs assessment activities, begun through the Environmental Health in Schools Workgroup. The continuation of these assessment activities involves the following:
    - Further engage CSTE environmental health points of contact;
    - Expand the needs assessment to include other entities involved in school environmental health activities (e.g., school districts, education departments, school nurse organizations);

    - Expand the assessment tool to include child care centers, which are beyond the scope of this paper.
    - Further examine existing indicators of a healthy school environment
- Finally, CSTE is recommending the consideration of pilot project efforts as a means to further develop new and refine existing environmental public health indicators. These indicators represent areas that are important to track but for which there is currently an insufficient basis for their incorporation into a national system.

1. Scope and Context

The aphorism ***you can't manage what you can't measure*** is particularly important when applied to places charged with the care of our children. The environmental health at schools brief focuses on a specific element of environmental health issues concerning school buildings and their operations. It is built on previous assessments, particularly the two workshops coordinated by the Healthy Schools Network (Healthy Schools Network, 2015, 2016). It is part of a broader policy conversation prioritizing children's health and the environment (APHA, 2017a).

We want to emphasize this larger context at the outset and the strength of the literature on how school physical environments affect children's health, learning, thinking and behavior. In this regard, this paper intends to contribute to the interconnectivity between its specific focus on the well documented health impacts of school facilities on children and other public health programs involving children's health. These inter-connections can even span beyond environmental health concerns per se into areas of socio-economic disparities, civil rights and environmental justice. According to a recently adopted APHA policy statement, for example, the unequal conditions of school buildings were the initial impetus for Brown v. Board of Education (APHA. 2017b).

- Most manifestations of health and disease are caused by a dynamic interaction among genetic, social, and environmental determinants. The specific role of the school environment is just one of those long-ignored influences.
- As public health professionals, we are interested in the sum total of external influences (social, behavioral, environmental) that affect health. As such, we view environmental factors as being integral to any comprehensive strategy to improve children's health.
- Similarly, while it is often difficult to dissect school-related health outcomes from those of the community, it is also true that the conditions of school buildings often reflect the socio-economic conditions of the communities in which they are located.
- In addition, the school building is not only an environment that affects children. It also affects the people who work in those buildings as well as those who use the buildings for purposes other than children's education (e.g., after school programs, emergency shelters, etc.).

- Moreover, school facilities can serve a wide variety of functions (e.g., cafeteria, arts/industrial arts, gymnasium, athletic fields, ADA) and include multiple types of structures (e.g. portable classrooms). Each of these functions and facility types is associated with its own set of environmental concerns.
- Public authority over schools is delegated across a variety of agencies at federal, state, and local levels. Further, the extent which public agencies can exert control varies (public schools, private schools, home schooling, child care).
- There are limits to public authority regarding schools, warranting combinations of voluntary partnerships with schools (e.g., Tools for Schools, Green Schools). Consequently, many environmental health programs may be occurring in schools that are not tracked by public agencies.

In light of all these circumstances, we consider all children at risk for additional health and learning problems due solely to the unexamined and unaddressed environmental health risks in their schools and the lack of public health services for children at risk or with exposures in these settings.

It is important that we provide sound public health practice recommendations that recognize the broader health context at the same time. Below are two foundational facts (Eliminating Lead Risks in Schools and Child Care Facilities, 2018 http://healthyschools.org/eliminating_lead_in_schools_and_childcare.pdf).

- There are approximately 74 million children in the US under the age of 18,
- Of the 74 million children, approximately 50 million attend public schools; 5 million are in private schools.[1]

To focus our efforts, we are placing the emphasis here on public school facilities. This is not to imply that other settings are unimportant. Rather, we understand that all states require children to attend school and all states have a K-12 systems of public education. Also, historically, public schools represent an important point of departure regarding how to best manage environmental health risks in a where children spend most of their time outside of the home (HSPH, 2017), especially their waking hours.

Specifically, there are opportunities to develop standardized environmental health tracking measures of school children's health, and for school facilities, to help ensure that school buildings are safe and healthy places for students to occupy. We further believe that the framework developed here can be applied with some basic adjustments to other settings, such as child care centers.

[1] Apart from K-12 schools, approximately 11 million children attend child care centers. The environmental conditions of child care centers are not included in this paper. They have a different set of administrative considerations than K-12 schools. Moreover, we lack much of the data on these facilities necessary for inclusion in an environmental public health tracking system. Further complexity is caused by the fact that Childcare programs, such as Head Start and Early Head Start, may be co-located with schools or operated out of school buildings, causing challenges with applying consistent safety and sanitation rules.

While outside the scope of this paper, it is important to note that according to the Eliminating Lead Risks in Schools report, 6 million faculty and staff that work in school buildings. There are important ancillary reasons for including the adult population within the broader orbit of concern relative to children's environmental health. First, there are the adverse developmental impacts associated with parental exposures to environmental toxins, such as could occur with school faculty and staff. While much study has concerned maternal exposures, there is emerging evidence that paternal exposures can also adversely affect child development, possibly through epigenetic mechanisms. Also, environmental conditions in schools that affect children's ability to learn also affect the performance of teachers and other school staff. These two general areas of environmental health concern are not well addressed through current occupational health protections.

Finally, it is important to point out that environmental health concerns are nothing new. Beyond the Brown v. Board of Education case, there has been ongoing national attention given to the condition of our nation's schools. Hallmark works such as the General Accounting Office's Condition of America's Schools brought attention to the poor environmental quality of our nation's schools in the 1990s (GAO, 1995). More recently the American Society of Civil Engineers gave our nation's schools a D+ grade in 2017, noting that over 50% of our schools needed improvements to reach "good" condition. https://www.infrastructurereportcard.org/wp-content/uploads/2017/01/Schools-Final.pdf.

2. Partners and Collaborators

With K-12 public education being such a fundamental and historically local component of American society, it is understandable that several entities could have some involvement in school environmental health. At the state level, the two agencies most directly concerned are typically the health and the education departments. As such, they often comprise the major sources of information on children's health and school facilities.

In order to achieve the goal of establishing a national tracking network, however, CSTE must engage beyond state health and education departments and involve federal agencies, national/regional organizations, and academic institutions. Key known and potential partners include the following:

- Alliance of Nurses for a Healthy Environment
- American Public Health Association
- American School Facilities Managers Association
- Centers for Disease Control and Prevention, including Environmental Public Health Tracking Program, Asthma Program, Lead Program, Healthy Schools Program, Agency for Toxic Substances and Disease Registry
- Children's Environmental Health Network
- Harvard School of Public Health

- Healthy Schools Network
- Learning Disabilities Association
- National Association of City and County Health Officials
- National Association of School Nurses
- National Council on School Facilities
- National Environmental Health Association
- National Institute for Environmental Health Sciences
- National Institute for Occupational Safety and Health
- Parent Teacher Association
- Pediatric Environmental Health Specialty Units
- School Based Health Alliance
- Society for Public Health Education
- State Directors of Special Education
- Women for a Healthy Environment

As has been stated above, it is important to place a children's environmental health in schools initiative within a broader environmental and social context (see also, HSPH, 2017). Its success will ultimately depend on the degree to which it is able to find common cause with other stakeholders concerned about children's health. Consequently, this list may expand significantly to include those entities concerned about civil rights, environmental justice, social equality, and climate change, among other critical needs.

3. Environmental health threats facing children in schools

The environmental quality of a school building can affect children's health, learning, thinking and behavior in complex ways, many of which are still poorly understood. There are essentially three categories of health effects to consider: 1) immediate health effects; 2) longer term health effects, including latent effects; and 3) modifying effects of environmental conditions on performance, learning, and productivity. While the environmental exposures leading to these effects occur in nearly every environment, it is important to recognize that they **do** occur in school physical environments and need to be addressed.

Moreover, we are far from understanding the total picture regarding environmental determinants of health.

- First, there is a general trend towards discovering that pollutant health impacts occur at levels previously considered safe. Witness, for example, the history of the national ambient air and drinking water standards, as well as reference blood lead levels. Also, there is recent evidence that carbon dioxide, a pollutant considered just to be an indicator of ventilation and other

innocuous, can actually affect cognitive function at levels frequently found inside classrooms. (Allen et al,, 2016)

- There is no safe level of exposure to carcinogens such as radon, asbestos, or polychlorinated biphenyls (PCBs).
- There are also other pollutant exposures that have not been adequately characterized or controlled in terms of their potential health impacts (e.g., asthmagens and asthma triggers, noise, lighting, electromagnetic radiation). Conversely, there are health promotion factors such as daylighting and biophilic design that also need to be considered.
- Finally, and potentially most important from a children's health perspective, are the long term developmental effects associated with the still developing organ systems (e.g., nervous, respiratory, endocrine, and immune systems).

An environmental health tracking system in schools must be robust enough to monitor and to allow for timely onsite interventions to prevent further harm to school children from the variety of current and emerging environmental health risks. These challenges cover a diversity of health endpoints and hazards, and with exposure durations as variable as acute poisoning episodes to longer exposures involving cancer risks from substances such asbestos, radon, or PCBs. This call for action is not to be viewed through the lens of existing school budgets, many of which are grossly inadequate to meet current facility and educational needs. Rather, it is to be viewed with the ultimate goal of promoting health and learning. Without a means to track the relationships among environmental conditions, health, and performance, we have no sound way of estimating the social costs of poor environmental quality in schools. Conversely, we also have no meaningful way of estimating the social benefits produced by measures to improve school environments.[2] Even within the context of school budgets, however, an effective children's environmental health tracking system is critically important. The diversity of environmental hazards plus the diversity of adverse health outcomes have often created much discord among administration, staff, and parents when potentially serious problems arise. In many cases, this discord may result from the lack of a common shared understanding regarding the

[2] A 2013 report by the Healthy Schools Network noted specifically that there were "in-depth studies that looked at environmental contaminants and children's health as well as national data and many studies that examined children's learning. None of this data or these studies, however, considers the relationships between school building environmental conditions, children's environmental health outcomes, and learning outcomes." http://www.healthyschools.org/documents/CHS_White_Paper_Gaps_in_Information_Put_Children_at_Risk-2_2014.pdf Without such linkages, social cost assessments cannot be adequately undertaken.

environmental risks and the actions that should be taken to address them. An effective environmental management system limits such discord. It can also save the time and expense of unnecessary environmental testing, which can often lack the means to interpret the findings. It can also bolster community trust so that when unexpected situations do arise, they can be more effectively resolved.

In essence, this brief is calling for an environmental investments strategy focused on protecting the present and future health of our children. As with any public health program, this strategy begins with a tracking system from which effective interventions can be developed or refined, implemented, and evaluated. The concept is not a new one – it is a fundamental part of public health practice.

a. Immediate effects

Immediate health effects and concerns associated with school environments have been well documented (e.g., PEHSU, 2017). They largely concern effects on respiratory health, such as sensitization from asthmagens or asthma exacerbations from exposure to mold, particles, and chemical irritants. Others are more specific, like poisonings from carbon monoxide, lead, or pesticides. Characterizing these immediate effects is beyond the scope of any single database or source of information. Rather, we must rely on a variety of sources tracking health outcomes and environmental hazards.

Environmental Measures

First, there are environmental circumstances that may pose the risk of imminent harm, warranting preventive actions before human health is impacted. Tracking these occurrences is important even when they originate off school property, as they may require that actions be taken by school authorities to prevent harm to building occupants.

- Spills/Emergency Response
- Mold/moisture damage
- Air pollution episodes/industrial accidents
- Natural air quality events (aeroallergens, dust)
- Nearby construction/demolition

Spills, such as mercury or fuel oil may occur on school grounds or be brought in by natural or man-made disasters. Moisture damage to facilities can also cause serious respiratory problems if not immediately addressed with proper precautions to prevent mold growth within 24-48 hours. Moreover, many schools are at risk of exposure to toxic substances through accidental releases from neighboring industrial sources. This latter possibility is more than a theoretical problem: a recent study found that nearly 10% of school children attend one of the 12,000 schools that are located within one mile of a dangerous chemical facility (Center for Effective Government, 2016). (NOTE: this estimate does not include the thousands of other schools located within a mile of a freight rail line or pipeline.) Furthermore, construction and/or demolition projects next door or nearby may create air quality

concerns or other dangerous exposures that migrate onto school grounds and into school buildings. Finally, air pollution episodes affecting schools may result from even routine releases from facilities due to adverse meteorological conditions or where regulations are inadequate (such as shale gas extraction operations). They may also occur through exposures from our natural environment – mold, pollen, dust – exposures that are expected to increase in intensity and duration as a result of climate change.

Health Measures

Health data sources provide another means of detecting emerging environmental health threats.

- Situational awareness/Syndromic Surveillance (ED/Hospitalizations for environmentally sensitive conditions, poisonings, student and staff absenteeism)
- Health reports/symptom complaints to the school nurse
- Reports of unusual or irritating odors eliciting subjective symptoms
- Clinical tests, such as pulmonary function

The term *situational awareness* is generally applied in public health practice to obtain an understanding of health risks as close to real time as possible. These sources of information include syndromic surveillance data submitted by hospitals to health departments, based on chief complaints, as well as calls to poison control centers. Additional sources of information could be obtained from hospitalization and Emergency Department data, and possibly electronic medical records from physician practices. Still another potential situational source of information could include data on student and staff absenteeism.

Another potential source of information includes health complaints recorded by the school nurse or reports of odor complaints to school administrators. Finally, another potential source of information could include clinical testing, such as pulmonary function testing. While pulmonary function tests are widely used as a health surveillance measure in occupational environments, they are not routinely conducted elsewhere. One exception might be their use in air pollution studies, including studies on children, where decreases in pulmonary function have been found to be sensitive indicators of harm from ozone and other pollutants.

b. Longer term effects

Due to the multi-factorial nature of most longer term effects, specific attributions to school environments are quite difficult to determine. Further, attempts to do so can become counter-productive if they take away from a priority focus on primary and secondary prevention strategies. Rather, the focus on addressing longer term health hazards in school environments should be viewed within the context of comprehensive disease prevention and control strategies. Examples of this include the Eliminating Lead Risks in Schools and Child Care Facilities document (cited above), as well as the 2010 President's Cancer Panel on reducing environmental cancer risks (USDHHS, 2010).

Environmental Measures

Examples of environmental factors in schools associated with longer term health risks in children are the following:

- Lead (dust and water, soil, products)
- Radon (air, possibly water if groundwater systems are used)
- PCBs (e.g., caulking, lighting fixtures)
- Moisture/Mold
- Air and Noise Pollution
    - Indoors
    - Outdoors

Adverse health effects from longer term pollutant exposures are more difficult to track than acute impacts. This is particularly true regarding pre-natal and early childhood exposures, when many organ systems are in early critical stages of development. Specific concerns in this regard are respiratory effects (such as asthma), childhood cancers (notably, childhood leukemia), and neurodevelopmental effects (such as those resulting from lead exposures).

Environmental monitoring protocols have been established for schools, such as through Tools for Schools programs, although they are inconsistently implemented and not systematically gathered, stored, and analyzed. Even with established monitoring protocols, like childhood blood lead, most of the monitoring is restricted to infants and toddlers. There is no consistent elevated blood lead level screening of older children or mothers.

Improper moisture control is a pervasive problem in many school buildings. Mold problems indoors occur not only as a result of leaks or accidents, but also as a result of inattention to air flow and relative humidity control within buildings. Though mold issues are serious, testing for mold is not recommended as a routine tracking measure. Rather, protocols have been developed by NIOSH and other organizations that can assess the extent of moisture damage for the prevention of mold growth.

Indoor Air and noise pollution is not routinely monitored in schools. While outside of the control of schools to intervene at the source, ambient pollution can also have significant impacts on children's health. Near roadway pollution, for example, have been linked to asthma incidence, and there is increasing evidence that fine particulates are as well.

Health Measures

Currently, there is limited information about children's environmental health that can be tracked from health databases.

- Childhood cancer

- Asthma mortality, health care utilization
- Asthma registries and surveys
- Routine pulmonary function testing

Cancer registries are the most robust and time honored sources of information in this regard.

Data are available on asthma mortality, hospitalizations, and emergency department visits. Survey information, from sources such as the Behavioral Risk Factor Survey, the Youth Risk Behavior Survey, and the National Health Interview Survey are available on asthma prevalence. Unfortunately, these data may not be sufficient to provide spatial resolution for many of the school environmental health challenges we are facing. Alternative approaches, such as school-based asthma registries and other validated asthma survey tools to estimate asthma prevalence in children are also available. Ideally from an environmental health perspective, data on asthma incidence would be critical in terms of understanding the temporal and spatial relationships between asthmagen exposure and asthma onset. (Note: the Pittsburgh area pilot project, described below, includes ways to assess asthma among school children.)

Beyond asthma, however, there are more global respiratory health considerations to track. Pollutants such as ozone have long been shown to slow lung development. Yet, while not clinically relevant from a disease perspective, it is nonetheless important that we track environmental influences such as air pollution on lung growth. Although many environments could be factors in lung development, the potential importance of the school environment cannot be dismissed.

Despite the alarming increases in autism spectral disorders over the past several decades, we still lack an effective means of tracking neurodevelopmental effects associated with environmental toxins. The reasons behind this absence are complex and beyond the scope of this paper. They are not, however, due to the lack of recognition regarding the importance of environmental factors in the development of these disorders. Indeed, the 2000 Pew Commission report calling for the establishment of an environmental public health tracking network, as well as the CDC tracking network itself, have emphasized the importance of this important indicator.

c. Effects on performance, learning and productivity

Poor health is a major factor to consider with regard to performance, learning, and productivity (HSPH, 2017). Childhood blood level levels have long been associated with decrements in cognitive development and function, for which there is no safe level. Also, it is widely acknowledged that asthma is the leading cause of school absenteeism among chronic conditions. Even when not affecting absenteeism, asthma has been associated with diminished performance in the form of “presenteeism,” where an individual’s performance in school or work setting can be impaired because of illness. Short of indirect consequences of ill health, however, there are a variety of environmental and subjective measures to consider with respect to school environments.

- Carbon dioxide
- Volatile Organic Compounds(VOCs)
- Heat and Humidity
- Moisture damage (extent, severity, odor)
- Noise, lighting
- Subjective symptoms (fatigue, headache, nausea, poor attention)

While not strictly health effects, the impacts of the school environment on teaching and learning can be very critical for school administrators to consider regarding the environmental quality of their buildings. Studies have found that exposure to mold gases and VOCs can affect cognitive function and even students' grades. Moreover, carbon dioxide levels, previously considered to be just indicators of poor ventilation, are now shown to affect cognitive function at levels commonly found in schools (e.g., 1500-2000 ppm) (Allen et al, 2016). Such effects may be related in part to the Sick Building Syndrome reports of unusually high prevalences of subjective symptoms among building occupants, often associated with poor ventilation. Poor indoor air quality may also be associated with the phenomenon of "presenteeism" among individuals with chronic conditions such as asthma. In presenteeism, individuals may not miss work but nonetheless function at a lower level of capacity potentially due to their environment. Finally, heat is another factor that can negatively affect performance and productivity when temperatures and humidity rise above normal comfort levels, even if not causing any heat-related illness.

4. Assessment Findings

To date, the CSTE Environmental Health in Schools Workgroup has received 24 responses from its assessment. Thirteen of those 24 respondents indicated some type of environmental health monitoring. Of those reporting some environmental health related tracking, monitoring lead in drinking water was the most common response. Five respondents reported monitoring lead in drinking water, with one state (Illinois) also reported monitoring lead in paint and materials.

Respondents to the CSTE in Schools Environmental Health Assessment		
Some EH Surveillance Reported		No EH Surveillance Reported
Colorado		Alabama
Connecticut		Arizona
Delaware		Florida
Illinois		Georgia
Indiana		Guam
Maryland		Mississippi
New York City		Montana
North Carolina		New Mexico
Oregon		Northern Mariana Islands
Texas		Pennsylvania
Tennessee		Utah
Vermont		
Virginia		

Lead in Drinking Water: Illinois, New York City, North Carolina, Oregon, Virginia

Lead in Paint/Materials: Illinois

Radon: Colorado

Bacteria: North Carolina

Asbestos: Illinois

Complaints: Texas, Delaware

Reporting of Sentinel Health Events: Texas

Reporting of Incident Reports on Evacuations: Texas

Indoor Environmental Quality: Indiana

Reporting of basic indoor environmental data: Vermont (for schools participating in Envision walkthroughs)

Potential future monitoring activities: Texas, Tennessee (Lead in Drinking Water); Delaware (Indoor environmental quality); Vermont, Connecticut (Radon)

These findings provide evidence of a wide variety of environmental health tracking activities throughout the country. They also point to important areas for follow-up and continued dialogue. For example, Illinois has reported a relatively broad range of environmental health tracking activities that could be a model for other state programs. It has also established a lead in drinking water action level of 5 parts per billion for notification purposes, which is lower than the standard criterion of 15 parts per billion (from the EPA's Lead and Copper Rule (https://www.epa.gov/dwreginfo/lead-and-copper-rule) .[3] In addition, the impacts of disseminating lead in water test results on school web sites can be further explored. Further follow up is indicated regarding proposed indoor environmental quality programs and details regarding complaints, sentinel events, and incident reports on evacuations. Finally, the CSTE workgroup can further engage with those states that are contemplating additional environmental public health tracking activities. Collectively, these activities can be further developed under the auspices of a CSTE-sponsored Steering Committee.

Beyond the environmental health tracking activities, though, the assessment did identify significant interest on the part of the respondents to further engage with CSTE. Many respondents (listed below) volunteered to review the assessment findings, this brief, or both.

Review of Assessment Findings: Connecticut, North Carolina, Delaware, Virginia, Illinois, Colorado, Tennessee, Virginia, New Mexico, Arizona, Utah

Review of Brief Draft: Connecticut, Virginia, New Mexico, Arizona, Utah, Georgia, Indiana, Colorado, Louisiana, Illinois, North Carolina, Delaware

It is hoped that these initial assessment responses can provide an impetus for participation from others involved with children's environmental health in school activities. Further, this assessment should provide a useful model for a possible future assessment focused on day care centers. In this respect, it is hoped that the assessment can be implemented as an ongoing activity, as we identify more partners and stakeholders.

5. Priority School Environmental Health Indicators

The Institute of Medicine has established a set of criteria for evaluating environmental public health surveillance systems (cited in CEHN, 2018). These are the following:

- Simple – measuring only one item;
- Measurable – comparable and quantifiable;
- Understandable – comprehensible to policy makers and the public;
- Defensible – supporting a relationship between environmental health factors and health status;

[3] In addition, the US Environmental Protection Agency has s recommended, non-enforceable action level for of 20 ppb for schools and child care facilities.

- Credible, relevant, and able to be acted on;
- Responsive to local needs; and
- Reflective of societal values with respect to environment and health.

While many environmental health risks have been identified, there are relatively few indicators of those risks that have been sufficiently developed or are potentially available for routine tracking purposes. Consequently, from a strategic perspective, it is important to start with those indicators that best meet the above criteria. Moreover, they also need to be specific enough to the school environment. Other potential indicators identified in this paper can be explored, with the idea that they can be further developed through pilot projects that could serve an *incubator* role.

Specifically, these indicators include radon and lead, which were also the primary focus in the CSTE assessment that is also a component of the workgroup project. Another relatively straightforward measure could include an inventory of safe school policies regarding mercury and PCBs.

- Lead dust testing
- Lead water testing
- Radon air testing
- Safe Schools Policies on PCBs and mercury[4]

6. Establishing Guidance Criteria

We need to seriously consider the precautionary approach to establishing acceptable environmental exposure levels. The serious legacy pollutants we are addressing today – lead, PCBs, asbestos, mercury and pesticides – are of concern not only because of their toxicity but also their ubiquity in the environment. The health and economic consequences of past actions are with us today as we realize the full costs of mobilizing these substances in our environment. Though it is beyond the scope of this paper to evaluate or establish metrics, the guiding public health position is on the precautionary principle and primary prevention.

Several environmental health at school recommendations call for the establishment of environmental standards to protect children's health (APHA, 2017b). While this approach has resulted in significant environmental improvements over the past few decades, the limitations of this approach have also become evident. There are a number of reasons for this.

[4] Specifically, the Agency for Toxic Substances and Disease Registry specifies that mercury policies should include the following: identifying sources of mercury; labeling sources of mercury clearly and consistently; disposing of mercury safely; responding to a mercury spill; purchasing mercury free products https://www.atsdr.cdc.gov/dontmesswithmercury/policy.html. Also, the US Environmental Protection Agency has guidance on limiting PCB exposure from old lighting systems, caulk, and through maintaining a proper ventilation system https://www.epa.gov/schools-healthy-buildings/renovations-and-polychlorinated-biphenyls-pcbs-healthy-school-environment

- Many of the common pollutants of interest are either carcinogens (e.g., radon, asbestos, PCBs) or lack a clear threshold above background levels that can be considered safe (e.g., lead, particulates, ozone).
- In other cases, such as carbon monoxide, elevated levels may not pose an immediate health threat, but could be indicative of situations that could present serious problems (such as faulty combustion sources).
- Acceptable ambient levels for most other pollutants are driven more by what we don't know than by what we know (e.g., up to 10,000 fold uncertainty factors and low dose extrapolations).
- There are many critical health endpoints for which the shape of the dose-response curve, the timing of exposures, and the characteristics of sensitive and vulnerable populations are poorly defined (e.g., neurodevelopmental, neurodegenerative, and sensitization).
- Not surprisingly, environmental and occupational health standards have become progressively tighter over the past several decades as more information has become available.

In light of these factors, the preferred approach should not be that of deriving acceptable levels from levels that are known to be harmful, but rather ensuring that environmental concentrations do not rise significantly above background levels. In some cases, such as with lead exposures, measures must even be taken to lower background concentrations.

7. Pilot projects

The pilot project ideas described in this brief can address a variety of objectives. First, they provide an opportunity for the CSTE Environmental Health in Schools Workgroup to engage partners at a more local level in developing key environmental health indicators. Second, they can provide a means of adding new workgroup members. Finally, they could serve as "laboratories" by which we develop emerging indicators that are necessary to fully characterize school environmental quality.

Two pilot collaborative project ideas are presented here. One pilot idea brings together several ongoing projects within the Pittsburgh area focused on improving the environmental health conditions of school children in the region. The other idea proposes to coordinate ongoing and emerging school environmental health activities regarding syndromic surveillance, poison control centers, and the Pediatric Environmental Health Specialty Unit in the Mid-Atlantic region.

These projects have complementary objectives. If both are implemented, a potentially very productive cross-talk could be established in which the project participants could share experiences and lessons learned. Conceivably, this dialogue could be created under the auspices of the Environmental Health in Schools workgroup. Further, this dialogue could inform of a planning strategy that would eventually culminate in a national environmental health in schools tracking network.

1. Pittsburgh Area Pilot Projects

Pittsburgh is an excellent area for exploring school environmental health based pilot projects. First, it is in an area where the environmental hazards associated with lead and radon are well documented. Second, the Pittsburgh area has a vibrant environmental health community, including one focused on schools. The school-focused environmental health community includes various school administrations, non-profits, and academic institutions. Finally, the Pittsburgh area is addressing particularly important priority problems around asthma, air quality, and socio-economic disparities. A pilot project in this region, therefore, could represent an intersection between the area's specific environmental health concerns and the broader concerns identified through a national dialogue.

Asthma.

Asthma is a condition especially indicative of environmental stresses. Unfortunately, we often lack information on asthma at sufficient resolution to understand the interplay of environment with the underlying physiological responses of individuals. Dr. Deborah Gentile and her colleagues are using a validated algorithm for estimating childhood asthma prevalence. By employing this algorithm, they estimated childhood asthma prevalences in certain Pittsburgh school districts to be as high as 25-30%. http://www.post-gazette.com/news/health/2017/05/03/World-Asthma-Day-2017-children-asthma/stories/201705030120

Further, significant proportions of children had symptoms consistent with an asthma diagnosis, but were not diagnosed by a physician. Through a pilot project activity focused on childhood asthma surveillance, these health practitioners intend to develop a model that can be used to obtain hyperlocal data throughout the country.

This validated survey is widely used by Breathmobile Programs across the US and has a high level of sensitivity and specificity for the detection of asthma.

Survey questions include:

1. Has your child ever been diagnosed with Asthma by a Physician? ☐ Yes ☐ No

2. **During the last 1 year**, has your child had ***repeated*** episodes of **asthma**? ☐ Yes ☐ No

3. Does your child have episodes of cough, chest tightness, trouble breathing, or wheezing when they **play or exercise**? (Select the **one** best answer)

Never	Rarely	Sometimes	Often	Most of the time
☐	☐	☐	☐	☐

4. In the **past 4 weeks**, how often has your child had episodes of cough, chest tightness, trouble breathing, or wheezing in the **morning or during the daytime**? (Select the **one** best answer)

Never	Less than two days a week	Two or more days a week but not every day	Everyday	More than once a day on most days
☐	☐	☐	☐	☐

An algorithm is then used to assess the risk of asthma and the level of disease control.

Specific Measures

Dr. Deborah Gentile's team is able to conduct the following in school and community based environments.

Lung function testing as assessed by spirometry. Reductions in forced expiratory volume in one second (FEV1) is the recognized gold standard in the diagnosis of asthma.

Airway inflammation measurement as assessed by exhaled nitric oxide determination. Elevations of nitric oxide in exhaled breath is consistent with active airway inflammation.

Determination of second hand tobacco smoke exposure as assessed by the measurement of cotinine, which is a nicotine metabolite, in saliva samples.

Measurement of height and weights and determination of body mass index (BMI). There is a strong link between being overweight/obese and asthma outcomes.

Additionally, she has access to local measurements that may influence asthma outcomes.

> She directs the only certified pollen and mold counting station located in the Pittsburgh region. Elevations of these allergens are recognized as asthma triggers.

She has an active collaboration with investigators at Carnegie Mellon University that track local pollution levels using a mobilized platform technology.

Low Cost Air Monitoring - Purple Air.

Purple Air is a real time particle counter being used in southwest Pennsylvania air study projects, including schools. Distributed monitoring devices like Purple Air could help school administrators and health personnel understand the local nature of particle air pollution threats and develop appropriate responses in times of elevated pollutant levels. They can also be used to identify sources of indoor particle pollution, potentially as a part of an indoor environmental quality management program like **Tools for Schools**.

Environmental Charter School

The Pittsburgh area is fortunate enough to have its own Environmental Charter School https://ecspgh.org/. This school could represent a "pilot within a pilot," incorporating core environmental surveillance activities around lead and radon with other tracking activities - including asthma, health/odor complaints – within a comprehensive environmental management system approach.

Outreach/Education Activities

There are also several collaborative outreach and education programs involving environmental health issues in schools that could serve as a mechanism for incorporating these environmental public health tracking efforts within an intervention strategy. For example, the A+ Schools initiative is a collaborative project of non-profits and schools focused on educating parents and families around reducing educational disparities. http://www.aplusschools.org/ Issues around mold, lead, and radon have been incorporated into its communication efforts and the potential exists for expanding it further.

Also, the Pittsburgh-based ASSET, Inc. (https://assetinc.org/) is a STEM focused educational resource for schools in the area. ASSET has developed educational modules around climate change and air quality. It is possible that this organization can also develop a module around school environmental quality.

2. Syndromic Surveillance Pilot

Originating from concerns regarding bioterrorism, the fundamental objective of syndromic surveillance (SyS) has been to identify illness clusters early, before diagnoses are confirmed and reported to public health agencies, and to mobilize a rapid response, thereby reducing morbidity and mortality (Henning,

2004). Since then, SyS queries have been used as means to understand aberrant morbidity patterns with a temporal, spatial, and situational granularity that traditional environmental epidemiological methods do not provide. Recently, for example, CDC's Environmental Public Health Tracking Program has explored SS as means to assess carbon monoxide poisonings and heat related illnesses.

Within the context of the Environmental Health in Schools workgroup, a subcommittee was formed to develop a prototype of a SyS triage notes query relative to school related Emergency Department visits using ESSENCE.[5] The results of this prototype query found that common subsyndromes included fever, GI illness, poisonings, and falls. The prominence of poisonings in the SS queries indicates the potential to compare the findings with Poison Control Center (PCC) reports. The PCCs, in turn, work closely with the Pediatric Environmental Health Specialty Units (PEHSUs) (PEHSU, 2017). In addition to their collaborations with Poisons Control Centers, the PEHSUs are federally supported by the CDC, along with other key state/local agency and non- governmental organization partners. While not restricted to school settings per se, the PEHSU tracking system has a number of key attributes important to school environmental health surveillance:

- Activity: Consultation type, Primary reason for encounter;
- Caller: location (state), Demographics, Referral Source, Resources Contacted Prior to PEHSU;
- Client: Age, Gender, Pregnancy Status, Week of Pregnancy, Demographics;
- Exposure: Agent/Health Concern, Setting, Media;
- Treatment: Discrete Recommendations;
- Flagging Unique Cases;
- Follow up.

Collectively, the data collected from the SyS queries conducted by a health agency, a PCC, and a PEHSU could comprise a focused pilot project. A collaboration consisting of representatives from these three entities, along with CSTE and CDC, could identify opportunities in which shared data analyses would further our understanding of environmental health risk factors in schools.

8. Initiating a Tracking Network

The purpose behind establishing a school environmental health surveillance strategy is to reduce both short term and longer term adverse health outcomes to children. In both cases, the overall objectives are to inform prevention based intervention strategies that can reduce environmental hazards in

[5] The ESSENCE search items were: "in school" or "at school" "in recess" or "at recess" "in daycare" or "at daycare" with either daycare or day care, as long as they don't explicitly state they are "not in/at daycare"

schools. . To meet these objectives, the first step is to develop and measure indicators of school environmental health, allowing for baseline understanding of the extent of the problem as well as trends in environmental hazards in school environments going forward.

Despite the proven effectiveness of preventive actions, there is no systematic prevention strategy implemented across all schools, leaving many facility occupants – comprised largely of vulnerable children and women of child-bearing age – with unexpected, unaddressed and unexamined risks to health, learning, and productivity (APHA, 2017a,b; NACCHO, 2013). A school environmental health tracking network should provide the foundation for moving forward a coordinated public health strategy in this area.

The basic environmental public health strategy model links together environmental hazards and exposures with adverse health outcomes, thereby creating the scientific basis for interventions that mitigate those adverse health outcomes (CEHN, 2018). A tracking network focuses on establishing a systematic way to measure hazards, exposures, and health outcomes. It serves as both a planning tool and an evaluation tool for the implementation of effective interventions.

The proposed model for a school environmental health tracking network follows that of CSTE's earlier recommendation for an aeroallergen monitoring network: (CSTE, 2016)

- Data Collection;
- Data Storage;
- Data Analysis;
- Data Dissemination.

In making this recommendation, it is important to recognize that in both cases state and local health departments may not be the sole or even the primary sources of information and expertise. On the other hand, protection of public health is the underlying goal irrespective of the environmental health challenge. As such, CSTE can serve an important **coordinating role** in establishing collaborative networks that catalyze public health actions.

Yet, while the basic framework is the same for both aeroallergens and school environmental health, the issues surrounding the latter are far more complex. At the most fundamental level, rather than measuring just pollen and mold spores using a limited number of sampling methodologies, a school environmental health surveillance system has many measures to track with widely different tracking tools. Also, unlike an aeroallergen network, a school environmental health tracking network will be established within a constellation of existing programs, regulations, and stakeholder groups. Therefore, rather than creating a network *de novo*, as is the case with aeroallergens, the school environmental network will build on existing efforts to create a more coordinated program and encourage adoption of existing tracking programs by other jurisdictions lacking environmental health tracking in schools..

Consequently, we are proposing an incremental approach to establishing this network, both in terms of indicators and the components of the tracking system to be emphasized. Its springboard is the priority indicators developed by the Workgroup's Environmental Monitoring Subcommittee, namely lead and radon, which are the primary focus areas of an assessment underway by CSTE. A priority indicator could also include tracking policies regarding products containing toxic substances such as PCBs and mercury. Additionally, while all components of the tracking system need to be developed, the proposed initial activities will focus on data collection and storage.

Primary Indicator Areas: Lead, radon, policies on toxins in products

Initial Tracking System Components: Data Collection, Data Storage

The critical first step in this effort is to begin to establish an organizational structure for the network. By gathering together known partners we can start to form an initial steering committee that can inform future activities. This Steering Committee could operate under the auspices of CSTE or another entity identified through the stakeholder engagement process.

- Convene stakeholders and partners who are active in lead and radon monitoring in schools, particularly those with jurisdictional responsibilities
    - Establish school environmental health steering committee
    - Identify host agency/organization for the Steering Committee

Immediate next steps include the following:

- Identify best practice sampling and analysis protocols
- Identify or develop basic specifications for lead and radon data repositories
- Identify current repositories (if any) for lead and radon monitoring results
- Evaluate suitability of current repositories for becoming the basis of a national tracking system

Over the longer term, this steering committee can be expanded in composition and functions to address the analysis and dissemination components as well as incorporating new indicators into the system. As mentioned above, the pilot projects could provide a means of developing new indicators for eventual incorporation into the network.

9. Conclusions and Recommended Next Steps

Decades of studies and assessments have documented the need for an environmental public health tracking network in schools. With this brief, we have begun to outline a strategy for establishing such a network. The initial step in this strategy was the development of an assessment for environmental health in schools. This assessment was sent out to state and local CSTE environmental health contacts throughout the country. It was developed by the Environmental Monitoring Subcommittee, with

additional questions added based on recommendations of earlier reports. The results of the initial responses are summarized above. Though the responses did not show any evidence of systematic environmental health monitoring, there are two important features of the responses to date that are worth emphasizing:

- There are key state examples regarding environmental health surveillance in schools that can be referenced in building an empirically-based tracking network (e.g., lead, indoor air quality, complaints);
- State health department and other specialists in environmental health have expressed their interest in this initiative and their willingness to further engage in this effort.

Further, in conceptualizing the framework for a national environmental health in schools initiative, we used the recent CSTE initiative on establishing an aeroallergen monitoring network as a model. There are a number of similarities between these two efforts. First, as with the environmental health in schools initiative, the aeroallergen initiative began with a CSTE sponsored assessment. In addition, priority was also placed on enhancing and developing partnerships among governmental, non-governmental, private, and academic entities. Also, as a way to further engage partners in the development of the aeroallergen monitoring network, we collaborated with partners on a variety of ongoing or pilot projects. Finally, as a way to ensure communication and coordination, we established annual "Pollen Summits" and a multi-agency Steering Committee to guide our network development activities. We see all these activities as part of the emerging program to establish an environmental health in schools tracking network.

There are several recommended next steps.

- First, we recognize that state and local health departments are not the only sources of information and activity regarding environmental health in schools. For example, education departments, individual school districts, and school nurses' associations are also likely to be important partners. They were not included in the initial assessment for logistical reasons, as our priority was on creating an assessment tool with core CSTE constituents. We recommend expanding the assessment to include these potential partners as well.
- Second, we did not include day care centers in either the assessment or the current strategic focus. While of critical importance, we determined that there were enough differences between schools and day care centers to warrant separate consideration of the latter as a next step.
- Third, it is critically important to involve researchers in the network to help ensure that the data gathered through the tracking system is sufficient to further our understanding of the relationships among school environments, health, and learning.
- Finally, we believe it is important to establish an ongoing dialogue under the auspices of CSTE through annual summits and the establishment of a multi-agency Steering Committee. This Steering Committee could be comprised of: 1) interested respondents to the environmental

health in schools assessment; 2) pilot project participants; and 3) previously identified partners and collaborators listed above.

References

Allen, JG, et al, 2016, Association of Cognitive Function Scores with Carbon Dioxide, Ventilation, and Volatile Organic Compound Exposures in Office Workers: A Controlled Exposure Study of Green and Conventional Office Environments, Environmental Health Perspectives, Vol. 124, pp. 805-812. https://ehp.niehs.nih.gov/wp-content/uploads/124/6/ehp.1510037.alt.pdf

APHA, 2017a, Policy 201710, Protecting Children's Environmental Health, https://www.apha.org/policies-and-advocacy/public-health-policy-statements/policy-database/2018/01/23/protecting-childrens-environmental-health

APHA, 2017b, Policy 201713, Establishing Environmental Public Health Systems for Children at Risk or with Environmental Exposures in Schools

CDC, 2016, Results from the School Health Policies and Practices Study, 93 pp.

CEHN (Children's Environmental Health Network), 2018, Children's Environmental Health Indicators: A Summary and Assessment, 22 pp. http://cehn.org/wp-content/uploads/2018/02/CEH-Indicators-report-FINAL.1.pdf

Center for Effective Government, 2016, Living in the Shadow of Danger: Poverty, Race, and Unequal Chemical Facility Hazards, 26 pp. https://www.foreffectivegov.org/sites/default/files/shadow-of-danger-highrespdf.pdf

CSTE, 2016, Establishing an Aeroallergen Network in the United States: A Framework for Action, Draft, November, 2016, 18 pp.

CSTE, 2017, CSTE Environmental Health in Schools Workgroup Overview, June 1, 2017

CSTE Position Statement 16-EH-02, Standard Measures to Identify and Track Racial Disparities in Childhood Asthma

EPA, 2012, President's Task Force on Environmental Health Risks and Safety Risks to Children: Coordinated Federal Action Plan to Reduce Racial and Ethnic Asthma Disparities, 19 pp.

GAO (General Accounting Office), 1995, School Facilities: Condition of America's Schools, 71 pp. https://www.gao.gov/assets/230/220864.pdf

Healthy Schools Network, Children's Environmental Health Network, Learning Disabilities Association, 2018, Eliminating Lead Risks in Schools and Child Care Facilities, 36 pp. http://healthyschools.org/eliminating_lead_in_schools_and_childcare.pdf

Healthy Schools Network, 2016a, Towards Healthy Schools: Reducing Risks to Children, Coalition for Healthier Schools,

Healthy Schools Network, 2016b, Environmental Health at School: New Solutions Put Children First – June 2016 Panel and Workshop

Healthy Schools Network, 2015, Environmental Health at School: Ignored Too Long, Panel and Facilitated Workshop, 55 pp. http://www.healthyschools.org/documents/Final_full_report.pdf

HSPH (Harvard School of Public Health), 2017, Foundations for Student Success: How School Buildings Influence Student Health, Thinking and Performance, 46 pp.

Henning, K.J., 2004, Overview of Syndromic Surveillance: What Is Syndromic Surveillance?, MMWR, Vol. 53, Suppl., pp 5-11. https://www.cdc.gov/mmwr/preview/mmwrhtml/su5301a3.htm

Jagger, M., et al, 2017, Too Cool for School?: Identifying School-Related Syndromic Surveillance Visits, presented at the CSTE Annual Conference, June 13, 2018.

NACCHO (National Association of City and County Health Officials), 2013, Statement of Policy: Children's Environmental Health, 4 pp. https://www.naccho.org/uploads/downloadable-resources/99-12-Childrens-Environmental-Health.pdf

PEHSU (Pediatric Environmental Health Specialty Unit), 2017, Program Overview, CSTE Webinar, June 1, 2017

Pew Environmental Health Commission, 2000, America's Environmental Health Gap: Why the Country Needs a Nationwide Health Tracking Network, 21 pp. http://healthyamericans.org/reports/files/healthgap.pdf

USDHHS (US Department of Health and Human Services, 2010, Reducing Environmental Cancer Risk: What We Do Now, President's Cancer Panel, 147 pp plus Appendices.