U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
CENTERS FOR DISEASE CONTROL AND PREVENTION
National Center for Environmental Health/
Agency for Toxic Substances and Disease Registry

Board of Scientific Counselors Meeting
January 17-18, 2017
Atlanta, Georgia

Record of the Proceedings

TABLE OF CONTENTS

Agenda Item	Page
Executive Summary	1
MINUTES OF THE JANUARY 17-18, 2017 BSC MEETING	5
January 17, 2017 Opening Session: Welcome, Introductions and Agenda Review for Conflict-of-Interest Topics	5
NCEH/ATSDR Office of the Director Updates	7
NCEH/ATSDR Response to Public Health Emergencies	15
Unconventional Oil/Gas Extraction and Hydraulic Fracturing	20
Public Comment Session	25
Panel Presentation: Lead Poisoning Prevention	27
• NCEH/ATSDR's Role in Lead Poisoning Prevention	27
• HUD's Role in Lead Poisoning Prevention	28
• EPA's Role in Lead Poisoning Prevention	31
• Laboratory Perspective on Lead Poisoning Prevention	33
• Report from the LPPS Reference Value Workgroup	35
January 18, 2017 Opening Session: Welcome-BSC Meeting Reconvenes	37
BSC's Formal Vote on the Blood Lead Reference Value	38
LPPS's Recommendations to the BSC	38
NCEH/ATSDR Program Responses to BSC Guidance and Action Items	41
Update on Zika	46
Federal Research Action Plan on Recycled Tire Crumb Rubber	49
Public Comment Session	52
Updates by the BSC *Ex-Officio* Members	55
Closing Session and Adjournment	57
Attachment 1: Participants' Directory	59
Attachment 2: Glossary of Acronyms	61

Executive Summary

The U.S. Department of Health and Human Services and the Centers for Disease Control and Prevention (CDC) National Center for Environmental Health/Agency for Toxic Substances and Disease Registry (NCEH/ATSDR) convened a meeting of the Board of Scientific Counselors (BSC) on January 17-18, 2017 at the CDC Chamblee Campus in Atlanta, Georgia.

MEETING OVERVIEW

The Designated Federal Official (DFO) conducted the meeting in accordance with all rules and regulations of the Federal Advisory Committee Act. The DFO verified that the voting members and *ex-officio* members constituted a quorum for the BSC to conduct its business on both days of the meeting. The DFO announced that BSC meetings are open to the public and all comments made during the proceedings are a matter of public record.

The DFO reminded the BSC voting members of their individual responsibility to identify potential conflicts of interest with any of the published agenda items and recuse themselves from participating in or voting on these matters. None of the BSC voting members publicly disclosed any conflicts of interest for the record. The nine new BSC members were welcomed to their first meeting. The DFO called for public comment at all times noted on the published agenda for the January 17-18, 2017 BSC meeting.

NCEH/ATSDR OFFICE OF THE DIRECTOR (OD) UPDATES

The NCEH/ATSDR Director structured the OD report as a comprehensive "NCEH/ATSDR 101" overview for the benefit of the new BSC members and covered the following topics.

- The NCEH/ATSDR mission and ongoing reorganization
- Overviews of NCEH and ATSDR, including their histories, current activities and research, and high-priority programmatic areas
- "Hot topics," including new funding to NCEH/ATSDR through the Water Resources Development Act of 2016 and efforts to strengthen longstanding interagency collaborations with key federal partners

PUBLIC HEALTH EMERGENCY (PHE) RESPONSE

The NCEH/ATSDR Office of Environmental Health Emergency Management (OEHEM) described its new process to transform and improve its response to PHEs. Phase I of NCEH/ ATSDR's emergency management transformation was focused at the OEHEM level, while Phase II was focused at the center level. OEHEM prioritized solutions and identified "quick wins" to strengthen several areas of its PHE response.

FRACKING

ATSDR described its site-specific activities to evaluate public health issues related to unconventional oil/gas extraction and hydraulic fracturing (i.e., "fracking"). ATSDR is targeting its research and activities in fracking communities to four categories: (1) self-reported health complaints; (2) quality of life/stress issues; (3) environmental release pathways and public health exposures; and (4) potential chemical exposures.

PUBLIC COMMENT

Members of the public read written statements into the official record on a revision to the blood lead reference value (BLRV) (day 1) and efforts to improve childhood lead screening rates with point-of-care (POC) testing (day 2).

LEAD POISONING PREVENTION (LPP)

A series of overviews were presented for the federal agencies and the BSC to provide their perspectives on LPP.

- NCEH/ATSDR described its efforts to continue to collaborate with federal partners to develop a national model to eliminate lead from children's environments.

- The U.S. Department of Housing and Urban Development (HUD) announced the publication of its amended Lead Safe Housing Rule on September 1, 2016. HUD made strong efforts to apply CDC's 2012 guidance whenever possible. HUD shifted from the use of a specific blood lead level (BLL) cutoff to a new performance-based standard for housing. The new standard is the same BLL at which CDC recommends an environmental investigation. HUD grantees will be instructed to use CDC's guidance to advance from conducting a risk assessment to implementing a full-scale environmental investigation of children's housing units. In accordance with CDC guidance, the detection of elevated BLLs (EBLLs) in a child's housing unit will trigger the enhanced evaluation of all HUD-assisted units at the same property.

- The U.S. Environmental Protection Agency (EPA) described its unified cross-agency approach to enhance its focus on lead:
  - Stronger National Primary Drinking Water Regulations for lead and copper
  - Partnerships with primacy agencies to ensure appropriate implementation of the Lead and Copper Rule
  - Analyses to determine the feasibility of and need to modify existing residential lead hazard standards
  - The capacity of the EPA Land Cleanup Program to reduce site-related public health risks from exposures to lead-contaminated soil and consider other sources of lead
  - The establishment of National Ambient Air Quality Standards for lead
  - An investigation to determine whether lead in aviation fuel is a potential health impact

- The NCEH Division of Laboratory Sciences described its laboratory performance to measure low blood lead concentrations and reviewed its evaluation of data collected from proficiency testing (PT) programs. The three primary methods to measure blood lead were included in the evaluation: inductively coupled plasma mass spectrometry, graphite furnace atomic absorption spectroscopy, and the portable LeadCare II instrument. In terms of the sensitivity of all three methods, DLS concluded that a BLL of 3.5 µg/dL was above the limit of detection (LOD). In terms of the precision of all three methods, DLS

concluded that sufficient data are not available at this time to evaluate their capacity to measure BLLs at 3.5 µg/dL.

- The Reference Value Workgroup of the BSC Lead Poisoning Prevention Subcommittee (LPPS) presented a report of its findings to support its consensus recommendation for CDC to lower the current BLRV from 5 to 3.5 µg/dL. However, the workgroup recognized the benefit in temporarily keeping the BLRV at 5 µg/dL while additional PT data are collected.

- The LPPS presented six recommendations that were developed during its meeting on September 19, 2016 for the BSC's review and approval. The NCEH/ATSDR Director described the actions that would be taken to address the six LPPS recommendations.

Formal Vote: The BSC unanimously approved a recommendation for NCEH/ATSDR to lower the BLRV from 5 to 3.5 µg/dL and develop appropriate language to communicate this change.

PREVIOUS BSC GUIDANCE

NCEH/ATSDR OD presented its response to the BSC's requests for new agenda items. For the benefit of the new members, individual NCEH/ATSDR programs presented more detailed updates on high-priority topics in their response to the BSC. The ATSDR response included an update on per-/polyfluoroalkyl substances (PFAS), while the NCEH response included updates on safe water and climate and health.

ZIKA RESPONSE

NCEH/ATSDR OD presented an update on its additional six months of Zika response experience, particularly its lessons learned in Puerto Rico. The update included a proposal for the BSC to rescind its previous formal recommendation to establish a new Fracking Workgroup and form a new Zika Workgroup to address NCEH/ATSDR's role in CDC's vector management and pesticide recommendations. A series of questions were presented for the BSC to consider in this effort. The BSC members with an interest and/or expertise in serving on the new Zika Workgroup were instructed to notify the BSC Chair and DFO.

RECYCLED TIRE CRUMB RUBBER (TCR)

ATSDR presented key outcomes from the multi-agency Federal Research Action Plan (FRAP) on recycled TCR that is used on playing fields and playgrounds. The four key objectives of the FRAP were to (1) conduct outreach to states and key stakeholders; (2) conduct a literature review to identify major knowledge gaps; (3-4) characterize chemical compounds in TCR samples, characterize exposures, and identify exposure pathways to these chemical compounds based on the activities of players on the fields; and (5) identify follow-up activities to provide additional insights on exposures. ATSDR released the FRAP report in February 2016.

***EX-OFFICIO* UPDATES**

- The National Institute of Environmental Health Sciences, National Toxicology Program reported on the release of the 14th Report on Carcinogens; ongoing literature-based health hazard assessments; current research on PFAS and lead; the Synthetic Turf/ Crumb Rubber Research Program; glyphosate studies; Zika-related research; and upcoming meetings and webinars.

- The National Institute for Occupational Safety and Health reported on the pesticide surveillance system in its Sentinel Event Notification System for Occupational Risk Program; the new NIOSH Disaster Science Responder Research Team; and an upcoming study to address occupational health impacts of wild land firefighters.

- EPA reported on its continued focus on the increasing severity and magnitude of wildfires throughout the country and its new focus on social science.

CURRENT BSC GUIDANCE

The BSC provided extensive input over the course of the meeting in response to updates and presentations by NCEH/ATSDR OD and the individual programs.

- Leverage more resources for the National Environmental Public Health Tracking Network to strengthen its functionality and enhance its value to professional and lay audiences.
- Continue to strengthen NCEH/ATSDR's relationships with internal CDC programs under the leadership of the new CDC Director.
- Implement exercises and simulations to determine the capacity of the CDC.gov website in advance of a large-scale event.
- Collect data from existing sources to help fill the current data gaps in fracking.
- Provide parents of children with detectable BLLs between 3.5 and 5 µg/dL with lead education and tools for their individual empowerment.
- Develop and distribute a strong communications plan to clearly articulate the implications of the lower BLRV.
- Reach out to federal partners and other resources as a next step in creating a pesticide research agenda at NCEH/ATSDR.
- Clearly communicate to stakeholders that the FRAP exposure research conducted to date is only the first step in a much broader, longer-term effort to address TCR.

The next BSC meeting will be held the week of September 11, 2017, but the members will be polled by email to determine the specific date.

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BOARD OF SCIENTIFIC COUNSELORS MEETING
January 17-18, 2017
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Minutes of the Meeting

The U.S. Department of Health and Human Services (HHS) and the Centers for Disease Control and Prevention (CDC) National Center for Environmental Health/Agency for Toxic Substances and Disease Registry (NCEH/ATSDR) convened a meeting of the Board of Scientific Counselors (BSC). The proceedings were held on January 17-18, 2017 in Building 106 of the CDC Chamblee Campus in Atlanta, Georgia.

The BSC is a Federal Advisory Committee that is chartered to provide advice and guidance to the Secretary of HHS, Director of CDC, and Director of NCEH/ATSDR regarding program goals, objectives, strategies and priorities in fulfillment of the agencies' mission to protect and promote persons' health. The BSC provides advice and guidance to assist NCEH/ATSDR in ensuring the scientific quality, timeliness, utility and dissemination of results. The BSC also provides guidance to help NCEH/ATSDR work more efficiently and effectively with its various constituents to fulfill its mission to protect America's health.

Information for the public to attend the BSC meeting in person or participate remotely via teleconference was published in the *Federal Register* in accordance with Federal Advisory Committee Act (FACA) regulations. All sessions of the meeting were open to the public (*Attachment 1: Participants' Directory*).

January 17, 2017 Opening Session: Welcome, Introductions and Agenda Review for Conflict-of-Interest Topics

William Cibulas, Jr., PhD, MS
Deputy Associate Director for Science, NCEH/ATSDR
BSC Designated Federal Official (DFO)

Dr. Cibulas opened the floor for introductions and confirmed that the 19 voting members and *ex-officio* members in attendance constituted a quorum for the BSC to conduct its business on January 17, 2017. He called the proceedings to order at 8:33 a.m. and welcomed the participants to day 1 of the BSC meeting.

Dr. Cibulas announced that BSC meetings are open to the public and all comments made during the proceedings are a matter of public record. He reminded the voting members of their responsibility to disclose any potential individual and/or institutional conflicts of interest for the public record and recuse themselves from voting or participating in these matters. None of the BSC voting members publicly disclosed conflicts of interest for any of the items on the January 17, 2017 published agenda.

Dr. Cibulas regrettably informed the participants that Ms. Sandra Malcom passed away in the late summer of 2016 after a long and courageous battle with cancer. She was the lead Committee Management Specialist for the BSC for over two decades and had primary responsibility for all logistical and administrative issues related to the meetings. The participants joined Dr. Cibulas in recognizing Ms. Shirley Little and Ms. Amanda Malasky, of NCEH/ATSDR OD, who now oversee and manage the BSC meetings.

Melissa Perry, ScD, MHS, BSC Chair
Chair, Department of Environmental and Occupational Health
George Washington University School of Public Health and Health Services

Dr. Perry also welcomed the participants to day 1 of the BSC meeting. Similar to her NCEH/ATSDR colleagues, she also was sad about the passing of Ms. Malcom. She emphasized that Ms. Malcom was a consummate public servant to NCEH/ATSDR and the BSC. In her role as the Committee Management Specialist, she always demonstrated a strong commitment to the BSC, tremendous grace and a passion for public health.

Dr. Perry asked the participants to join her in welcoming the nine new BSC members (one *in abstentia*) to their first meeting.

New BSC Member	Title/Affiliation
Kenneth M. Aldous, PhD	Director, Division of Environmental Health Sciences New York State Department of Health
Aaron ("Ari") Stephen Bernstein, MD, MPH	Associate Director, Center for Health and the Global Environment Harvard T.H. Chan School of Public Health
Darryl R. Brown, PhD	Assistant Professor, Department of Health Management and Policy Drexel University School of Public Health
Suzanne K. Condon, MS	Retired, Associate Commissioner Massachusetts Department of Public Health
Roberta L. Grant, PhD	Manager, Toxicology Section Texas Commission on Environmental Quality
Joyce M. Martin, JD, MA	Health Policy Consultant JM Environmental Health Consulting, Inc.
Ralph McCullers [absent]	Compliance and Enforcement Division Clark County Department of Air Quality

New BSC Member	Title/Affiliation
John D. Meeker, ScD, MS, CIH	Associate Professor & Associate Dean for Research University of Michigan, School of Public Health
Devon Payne-Sturges, DrPH	Assistant Professor, Maryland Institute for Applied Environmental Health University of Maryland, School of Public Health

Dr. Perry provided the new members with clarification on the BSC's advisory role. The meeting agendas are structured with ample time after each presentation for the BSC to provide guidance directly to NCEH/ATSDR leadership. NCEH/ATSDR has a long history of extensively engaging the BSC in its impressive portfolio of environmental public health (EPH) activities and thoroughly considering the BSC's supportive input, candid and critical feedback, and expertise.

Dr. Perry noted that the standing agenda item, "NCEH/ATSDR Program Responses to BSC Guidance and Action Items," particularly demonstrates the value the Office of the Director (OD) and individual programs continue to place on the BSC's input, insights and perspectives. She was pleased to report that NCEH/ATSDR has implemented new projects or modified existing initiatives in direct response to the BSC's advice.

NCEH/ATSDR Office of the Director Updates

Patrick Breysse, PhD, CIH
Director, NCEH/ATSDR
Centers for Disease Control and Prevention

Dr. Breysse reported that he structured his update as a comprehensive "NCEH/ATSDR 101" overview for the benefit of the new BSC members.

NCEH/ATSDR Mission

The mission of NCEH/ATSDR is to "protect people's health from environmental hazards that can be present in the air we breathe, the water we drink, and the world that sustains us by (1) investigating the relationship between environmental factors and health, (2) developing guidance, and (3) building partnerships to support healthy decision-making." NCEH/ATSDR fulfills its mission by allocating approximately 75% of its budget to state and local health departments through cooperative agreements (CoAgs). For example, NCEH/ATSDR provides funding, resources and other support to states to implement lead prevention programs in their individual communities.

NCEH/ATSDR Reorganization

OD submitted a proposal to modify NCEH/ATSDR's current organizational structure in response to a major budget cut that was expected to occur in fiscal year (FY) 2016. OD solicited extensive internal and external input from a diverse group of partners and stakeholders in this effort.

The FY2016 budget cut was not approved, but OD recognized that the proposed organizational structure could still play an important role in strengthening NCEH/ATSDR's programs and consolidating its activities in a more efficient and effective manner. Moreover, an independent

consultant recommended the same program consolidation in 2012. After the new NCEH/ ATSDR organizational structure is officially approved, OD will begin filling leadership and staff positions.

Dr. Breysse presented two organizational charts to illustrate NCEH/ATSDR's current and proposed organizational structures

Current Organizational Structure	Proposed Organizational Structure
NCEH	
Division of Emergency and Environmental Health Services (EEHS) Division of Environmental Hazards and Health Effects (EHHE)	New EEHS/EHHE consolidated division: "Division of Environmental Health Science and Practice"
Division of Laboratory Sciences (DLS)	No change
ATSDR	
Division of Community Health Investigations	No change
Division of Toxicology and Human Health Sciences	No change
OFFICE OF THE DIRECTOR	
Office of Financial, Administrative and Information Services	New name: "Office of Management and Analytics"
Office of the Associate Director for Policy	New name: "Office of the Associate Director for Policy, Partnerships and Programs"
Office of the Associate Director for Communication	No change
Office of Environmental Health Emergency Management (OEHEM)	No change
Office of the Associate Director for Science	No change
N/A	New senior leadership position in OD to provide ongoing guidance directly to the NCEH/ATSDR Director on strengthening and growing ATSDR

OVERVIEW OF ATSDR

The Love Canal dump site in Niagara Falls, New York was documented as one of the most appalling environmental tragedies in U.S. history and raised awareness of hazardous waste sites among the American public and legislature. In response to Love Canal, Congress passed the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (also known as "Superfund") that authorized the U.S. Environmental Protection Agency (EPA) to identify, investigate and clean up hazardous waste sites on the National Priorities List (NPL).

In addition to specifying EPA's authority, Superfund also mandated the establishment of ATSDR as a non-regulatory public health agency to safeguard communities from harmful chemicals. The legislation outlined six key functions for ATSDR to perform.

- Conduct public health assessments (PHAs) at hazardous waste sites
- Develop toxicological profiles on the guidance values/minimum risk levels of harmful substances to inform decision-making
- Conduct epidemiological health studies
- Maintain health registries and conduct medical surveillance
- Respond to emergency releases of hazardous substances
- Perform applied research to support PHAs

ATSDR established 10 regional offices throughout the country to create a national presence and promote extensive community engagement in its site-specific activities. Dr. Breysse noted two examples of ATSDR's high-profile focus areas that have gained national attention: (1) the collection of scientific data, ongoing studies and other community-based activities to address health impacts from exposure to contaminated drinking water at Camp Lejeune, North Carolina and (2) the collection of toxicological data to better understand the health effects from per-/ polyfluoroalkyl substances (PFAS) in U.S. drinking water systems.

The ATSDR Program to Promote Localized Efforts to Reduce Environmental Exposure (APPLETREE) is a three-year CoAg that allocates $11 million annually to 25 grantees (or an average of $440,000 per grantee each year). Under the APPLETREE CoAg, ATSDR provides states with technical expertise, assistance and resources to manage site-specific activities and respond to emergency releases of hazardous substances. ATSDR's support allows states to build their capacity to ensure that communities remain safe from harmful environmental exposures and related diseases.

ATSDR targets APPLETREE funding to NPL sites, petition sites, EPA-led sites due to the Superfund legislation and the Resource Conservation and Recovery Act of 1976, Brownfields sites, and sites with other types of releases. However, the APPLETREE CoAg is not national in scope and only covers approximately 50% of the country. As a result, ATSDR has been challenged by fulfilling its mandate, while addressing other critical EPH issues that are of interest to communities.

ATSDR recently expanded the focus of the APPLETREE CoAg to produce guidance for the "Choose Safe Places for Child Care" Program. For example, ATSDR's investigations showed that current preschool child care facilities are located at the same sites as a former mercury thermometer manufacturing plant and a glass manufacturing plant with heavy metal production. ATSDR is developing guidance to enhance state and local capacity to proactively address topical priorities nationwide through the prevention of exposures, such as the redevelopment of Brownfields sites.

ATSDR is continuing to serve as a leader in advancing environmental science, medicine and technology. Most notably, ATSDR has a long history of supporting Pediatric Environmental Health Specialty Units (PEHSUs) throughout the country to address the impact of environmental factors on the health of children and adults of reproductive age. ATSDR publishes ToxProfiles™ to provide the public with sound scientific data on contaminants found at hazardous waste sites.

ATSDR develops and releases EPH tools and other resources (e.g., data from Geographic Information Systems (GIS), mapping and spatial relationships) for wide use by CDC programs and external researchers throughout the country. ATSDR supports the environmental medicine community by publishing evidence-based data and clinical guidance to inform decision-making on multiple EPH issues. For example, ATSDR currently is developing clinical guidance to assist physicians in addressing community exposures to perfluorinated compounds (PFCs). ATSDR is continuing to conduct EPH studies and gather data to strengthen its EPH registries.

OVERVIEW OF NCEH

CDC established the Center for Environmental Health in 1980, but rebranded this operating unit as the "National Center for Environmental Health" in 1991. The mission of NCEH is to "protect people's health from environmental hazards by providing national leadership in prevention

programs, global health, testing and services." NCEH fulfills its mission by conducting five major activities.

- Support state, local and tribal health through training and technical assistance (TA)
- Provide communication and education
- Develop and disseminate standards, guidelines and recommendations
- Conduct public health surveillance
- Conduct applied EPH research (e.g., epidemiologic studies, laboratory and statistical analyses, behavioral interventions, and operations and systems research)

NCEH's broad EPH portfolio covers multiple issues, including food safety, vessel sanitation and cancer cluster investigations. As a result, NCEH solicited extensive input and expertise from internal CDC partners, the BSC and other external stakeholders to narrow its focus and identify topical priority areas that should be included in its Strategic Plan. NCEH's rationale for selecting the following five strategic priorities is outlined below.

1. **Asthma:** NCEH selected this issue as a strategic priority due to the national burden of asthma and the tremendous capacity of the CDC National Asthma Control Program. CDC allocates funding to states and national organizations to reduce asthma morbidity in children and adults across the country. CDC also closely collaborates with its federal partners to develop and promote quality measures for states to evaluate their asthma programs. The National Asthma Control Program has a long history of success that has resulted in external stakeholders strongly advocating for continued or increased funding of this initiative to policymakers.

2. **EPH Tracking:** NCEH selected this issue as a strategic priority due to the numerous benefits provided by the CDC National EPH Tracking Program. Surveillance is a core function that CDC performs to identify populations at risk, guide interventions, monitor implementation, improve policymaking and inform the public. The major users of tracking data include asthma, water and health, food safety, climate and health, preparedness and birth defects programs. CDC launched the Tracking Network in 2009, but the reach of the program has been expanded since that time to include national, state and local data on various diseases, conditions and environmental factors.

Category of Tracking Network Data	Examples
Health effects data	Asthma, birth defects, cancer, developmental disabilities, heart disease, reproductive and birth outcomes
Exposure data on the amount of a substance or chemical in an individual's blood	Childhood lead, pesticide exposures
Hazard data on chemicals or substances in the environment	Carbon monoxide poisoning, community drinking water, outdoor air pollution, toxic substance releases
Demographic data to better understand factors that cause an individual to have a particular health problem	Age, gender, race, behavior, lifestyle risk factors (e.g., smoking or overweight/obesity)

Category of Tracking Network Data	Examples
Other types of data	Climate change, community design, homes, hospitalizations/emergency department visits, population characteristics

The Tracking Program now serves as the best online source to show relationships between the environment and health. This resource also allows organizations to connect environmental and health information, increase their knowledge, and access data to help save lives and protect communities. CDC currently funds health departments in 25 states and New York City to develop local tracking networks and submit data to the National Tracking Program. Moreover, the Tracking Program is widely promoted by over 200 state and local practitioners; 34 CDC/Association of State and Territorial Health Officials fellowships; and multiple partners (e.g., CDC programs, federal agencies and national organizations). Of all measures on the National Portal, 73% (or 281) cover more states beyond the 26 Tracking Network grantees.

3. **Safe Water:** NCEH selected this issue as a strategic priority due to the existing capacity of the CDC Safe Water for Community Health (Safe WATCH) Program. CDC currently funds a five-year CoAg totaling $12.73 million to 19 state and local health departments. The grantees use their funds to reduce exposures from private water sources in their communities by identifying and addressing gaps in current programs and decreasing exposures to contaminants. State and local health officials rely on the expertise and resources of Safe WATCH to investigate the environmental causes of waterborne illness outbreaks; respond to toxic contamination and natural disasters that affect drinking water; assess exposures in unregulated drinking water sources; and translate prevention into practice through CDC guidance, tools and training. Safe WATCH also is used to fill gaps between EPA's water regulations and public health.

4. **Childhood Lead Poisoning Prevention (CLPP):** NCEH selected this issue as a strategic priority due to current data that estimate children reside in at least 4 million U.S. households with exposures to high lead levels. At this time, approximately 500,000 children in the United States 1-5 years of age have blood lead levels (BLLs) $\geq$5 µg/dL. CDC recently awarded a three-year CoAg totaling $11 million to health departments in 29 states, the District of Columbia and five cities to support CLPP efforts. Under the flagship CLPP Program, CDC collaborates with its federal partners to provide grantees with national expertise, guidance and recommendations. The grantees use their funds to reestablish blood lead surveillance efforts that serve as an essential component of primary prevention to reduce or eliminate lead sources before children are exposed.

5. **Innovative Laboratory Methods:** NCEH selected this issue as a strategic priority due to DLS's role as the gold standard, both domestically and globally, in laboratory science. DLS uses biomonitoring for the detection, diagnosis, prevention and treatment of harmful exposures, nutritional diseases and other environmental conditions. To support this effort, DLS implements CDC's National Biomonitoring Program and oversees a network of state biomonitoring programs. DLS improves the detection and treatment of important newborn, chronic, environmental and nutritional diseases by assuring the quality of diagnostic tests in laboratories. DLS provides an effective laboratory response to chemical and radiologic threats, including those involving botulinum, anthrax and ricin toxins. DLS produces state-

of-the-art laboratory science to reduce exposure to addictive and toxic substances in tobacco products.

In addition to focusing on its five strategic priorities, NCEH also conducts a number of other EPH programs.

NCEH Program	Primary Function
Air Pollution and Respiratory Health	Leads CDC's fight against environmental-related respiratory illnesses, including asthma, and studies indoor and outdoor air pollution.
Chemical Weapons Elimination	Protects public health and safety by reviewing, advising and making recommendations on the safe disposal and transportation of stockpile and non-stockpile chemical warfare agents. Provides technical guidance for issues involving highly hazardous chemicals. Emphasizes prevention with vigilance.
Climate and Health	Helps state and local health departments prepare for specific health impacts of climate change faced by their communities.
Environmental Health Services	Provides surveillance, practice-based research, evidence-based practice, training and TA to state, tribal, local and territorial EPH practitioners. Disseminates tools to prevent environmental exposures and protect health. Collaborates with state and local health departments to identify and address environmental causes of foodborne and waterborne illness outbreaks via traditional and innovative training and resources to support EPH practitioners at all levels.
Health Studies	Conducts rapid epidemiologic investigations in response to outbreaks that are believed to have environmental causes. Responds to natural and technological disasters. Applies findings to develop, implement and evaluate strategies for preventing or reducing harmful exposures.
Newborn Screening	Serves as the only laboratory in the world devoted to newborn screening. Serves as a vital public health program to test infants for congenital disorders that are not apparent at birth. Ensures the accuracy of newborn screening tests in every state and more than 78 countries. Serves as a valuable resource for parents and physicians in the United States and worldwide to trust the results of newborn screening tests. Develops analytical methods to measure substances in dried blood spots (DBSs). Produces certified DBS quality control and reference materials for newborn screening tests.
Nutritional Indicators	Conducts and publishes ongoing assessments of the nutrition status of the U.S. population by measuring blood and urine concentrations of biochemical indicators (e.g., nutrients or dietary indicators with potential health relevance).
Radiation Studies	Identifies potentially harmful environmental exposures to ionizing radiation and associated toxicants; conducts

NCEH Program	Primary Function
	energy-related health research; and implements a response to protect the public's health in the event of an emergency involving radiation or radioactive materials.
Vessel Sanitation Program	Assists the cruise ship industry to prevent and control the introduction, transmission and spread of gastrointestinal (GI) illnesses on cruise ships. Monitors, investigates and responds to GI illness outbreaks. Inspects cruise ships via periodic, unannounced operational sanitation inspections and scheduled construction inspections. Trains cruise ship employees on public health practices.

NCEH/ATSDR RESPONSE TO PUBLIC HEALTH EMERGENCIES

OEHEM coordinates NCEH/ATSDR's science-based emergency management activities related to the EPH consequences of natural and technological disasters. OEHEM's disaster risk reduction efforts aim to minimize adverse health impacts caused by natural hazards by reducing exposure to hazards, decreasing vulnerability and improving preparedness. OEHEM's recent activities and response efforts include chemical terrorism preparedness, disaster risk reduction, lead-contaminated water in Flint, Michigan, flooding in Louisiana, and the Zika response.

"HOT TOPICS"

The Water Resources Development Act of 2016 (WRDA) included appropriations language for NCEH/ATSDR to allocate new funding to three areas.

- NCEH/ATSDR will allocate WRDA funding to establish a new FACA-chartered Lead Advisory Committee that will be independent of the current Lead Poisoning Prevention Subcommittee (LPPS) of the BSC. The new FACA committee will have a broader scope than CDC's former Advisory Committee on Childhood Lead Poisoning Prevention (ACCLPP) that focused on children only. WRDA's prescriptive language on the composition of the new FACA committee requires federal agencies to represent 50% of the 15-member committee and describes specific expertise that should be recruited. NCEH/ATSDR initiated efforts to establish the new FACA committee and will retire the LPPS after the committee is operational. However, an existing BSC member with expertise in lead will be appointed to serve on the new Lead Advisory Committee as a liaison between the two groups. NCEH/ATSDR hopes to complete the entire FACA establishment process, including HHS's official approval of all 15 members, by the end of January 2017. Based on this timeline, NCEH/ATSDR expects to convene the first meeting of the new FACA committee in September 2017.

- NCEH/ATSDR will allocate WRDA funding to provide resources to a minimum of 10 new states under the CDC Lead Program CoAg. NCEH/ATSDR is disappointed that the WRDA resources cannot be used to restore full funding to the existing Lead Program grantees. NCEH/ATSDR also is uncertain about future support for the Lead Program because the funding source is still the Prevention and Public Health Fund (PPHF) of the Affordable Care Act. As a result, OD leadership is attempting to transfer the new lead funding to NCEH/ATSDR's normal budget authority to ensure the stability and sustainability of the program over time.

- NCEH/ATSDR will allocate WRDA funding to establish a new registry in Flint with data on adults and children who were exposed to lead during the water crisis. However,

NCEH/ATSDR will award CoAgs to various academic institutions and community-based organizations throughout the state of Michigan to maintain and oversee the registry. NCEH/ATSDR recognizes that the Flint registry should be a community-owned product based on input provided by multiple federal partners with expertise, experience and lessons learned in this area. The registry has not yet been designed, but NCEH/ATSDR expects that basic information will be collected and maintained: blood lead test results and other healthcare data for each participant; persons who use lead-related health services in Flint provided by Medicaid; outreach to persons who do not use the lead-related health services; and early developmental testing results of children in the Flint community.

NCEH/ATSDR is continuing to prepare for the transition to the new Administration and changes in internal CDC leadership. Most notably, Dr. Thomas Frieden, Director of CDC, recently announced his resignation. NCEH/ATSDR leadership prepared a booklet to articulate its priorities to the Trump transition team, particularly the critical need for a concerted national effort to eliminate lead from children's environments. Moreover, the uncertainty of the FY2017 budget process is a threat to several NCEH/ATSDR programs. For example, the Climate and Health Program potentially could be eliminated. A tremendous $10 million cut has been proposed for the National EPH Tracking Program. A smaller cut also has been proposed for the discretionary budget for all other EPH issues.

The "Strengthening Protections for Children and Communities from Disease Clusters Act" (or "Trevor's Law") was introduced to Congress in 2011. HHS has taken no action on this legislation to date because Congress did not appropriate funding to support expensive disease cluster investigations. If resources are allocated in the future, however, HHS likely will instruct CDC to become more aggressive in investigating cancer and other disease clusters.

NCEH/ATSDR initiated efforts to strengthen its longstanding interagency collaborations with key federal partners. For example, NCEH/ATSDR and EPA are convening weekly teleconferences to identify potential synergies, such as the Flint water crisis and synthetic turf/recycled tire crumb rubber. NCEH/ATSDR conducted one-day site visits to the National Institute of Environmental Health Sciences (NIEHS) and the U.S. Department of Housing and Urban Development (HUD). NIEHS and HUD also made site visits to NCEH/ATSDR and confirmed their commitment to maintain communications. NCEH/ATSDR and the National Institute of Occupational Safety and Health (NIOSH) are continuing to discuss overlapping intra-agency issues that could offer key opportunities to both centers in the future.

BSC DISCUSSION: NCEH/ATSDR OD UPDATES

The BSC discussed the following topics during the question/answer session with Dr. Breysse and other NCEH/ATSDR staff.

- The need to leverage more resources for the Tracking Network to strengthen its functionality; enhance its value to community members, environmental health (EH) professionals and state/local policymakers; and increase the number of participating states.
- NCEH's efforts to demonstrate the significant impact of the Tracking Network (e.g., exposure reduction and primary prevention) to make a strong case for increased funding.
- NCEH's criteria and overall process to prioritize certain conditions for the Tracking Network, such as the decision to exclude diabetes, and its ability to translate tracking data into public health programs for CDC.

- NCEH's ongoing efforts to develop a module to collect and disseminate Tracking Network data in real time.
- NCEH's ongoing efforts to expand the Tracking Network to capture and maintain more infectious disease data, such as Lyme disease.
- The potential impact of the ongoing debate related to the blood lead reference value (BLRV) on the establishment of the new lead exposure registry in Flint.
- Ongoing EPH activities by NCEH/ATSDR and its federal partners to address PFCs in Pennsylvania, particularly in the Warminster community: APPLETREE funding to address contaminated water, TA for a cancer cluster investigation, water monitoring, and efforts to leverage resources from the U.S. Department of Defense (DoD) to support biomonitoring.

Dr. Perry made several clarifying remarks in response to questions by new BSC members on the restrictions of Special Government Employees. BSC members, as private citizens, are permitted to communicate with policymakers. For example, individual BSC members used a template in 2016 to write letters to their Congressional representatives regarding the proposed cuts to the NCEH/ATSDR budget. Due to the continued threats to key NCEH/ATSDR programs, individual BSC members could take similar efforts in a proactive and aggressive manner.

Dr. Perry conveyed that the Environment Section of the American Public Health Association (APHA) and the NCEH/ATSDR Policy Office also serve as useful sources for the BSC members to obtain up-to-date information on potential changes to the EPH budget. Moreover, she published a commentary in the *Annals of Epidemiology* in 2016 on the BSC's role and funding of federal EPH initiatives. She confirmed that she would distribute her commentary to the BSC members.

Ms. Witherspoon pointed out that she and other BSC members who serve on the National Environmental Health Partnership Council also could provide regular updates on ongoing or upcoming advocacy efforts in Washington, DC to support NCEH/ATSDR's EPH activities.

BSC GUIDANCE

Dr. Perry was pleased that NCEH/ATSDR initiated outreach efforts to enhance its collaborations with external federal partners. However, she emphasized the need for NCEH/ATSDR to continue to strengthen its relationships with internal CDC programs. She advised Dr. Breysse to meet with the new CDC Director immediately after the official appointment. She noted that under Dr. Frieden's leadership, NCEH/ATSDR gained a great deal of momentum and support for program collaboration and integration between EPH activities and other CDC initiatives. She was interested in ensuring that the change in leadership would not dilute NCEH/ATSDR's presence in other CDC programs.

NCEH/ATSDR Response to Public Health Emergencies

CAPT Renée Funk, DVM, MPH&TM, MBA, DACVPM
Associate Director for Emergency Management
NCEH/ATSDR Office of Environmental Health Emergency Management

Dr. Funk reported that NCEH/ATSDR launched a process to transform and improve its response to public health emergencies (PHEs). Phase I of NCEH/ATSDR's emergency management

transformation was focused at the office level. The Office of Environmental Health Emergencies was renamed to OEHEM with a new vision statement to "keep people and communities safe from environmental threats." OEHEM's new mission statement is to "coordinate and management NCEH and ATSDR resources and expertise to protect the public's health from environmental threats."

OEHEM conducted interviews with NCEH/ATSDR staff at all levels and obtained extensive input on its functions that are unique from other agencies with a role in emergency response. Based on this feedback, OEHEM identified five core functions to guide its activities: strategic alignment; situational awareness, fusion and outreach; incident management and coordination; plans, training and exercises; and disaster risk and hazard reduction. OEHEM created a new organizational chart to identify leadership for each of its five core functions as well as technical leadership for broader hazards that are under NCEH/ATSDR's purview: chemical incidents, radiological/nuclear events and natural disasters.

Phase II of NCEH/ATSDR's emergency management transformation was focused at the center level. OEHEM conducted interviews with NCEH/ATSDR staff at all levels and obtained extensive input on areas for improvement. Based on this feedback, OEHEM identified three key themes, formed an advisory group to guide the transformation, and proposed a comprehensive list of potential solutions for each theme. OEHEM then prioritized three solutions for each theme and identified three "quick wins" that should be rapidly launched. OEHEM formed workgroups that will be responsible for creating and implementing each of the three priority solutions.

In the first set of key themes, OEHEM was advised to establish clear roles and responsibilities. OEHEM's authority over emergency preparedness and response (EPR) activities should be clearly defined and clarified. A "subject-matter expert" (SME) should be clearly defined and an NCEH/ATSDR-wide roster should be developed. "Ownership" should be clearly defined when NCEH and ATSDR conduct a collaborative response.

In the second set of key themes, OEHEM was advised to enhance communications. The chain of command should be defined by clarifying communication requirements for specific key scenarios. Communications should be strengthened between ATSDR headquarters and its 10 regional offices across the country. Situational awareness should be improved by clarifying internal communications of steady state activities across NCEH and ATSDR.

In the third set of key themes, OEHEM was advised to define and streamline processes. A new guidebook should be developed with standard operating procedures (SOPs), templates and common responses. Best practices should be leveraged from the CDC Emergency Operations Center (EOC) and the technical review process should be streamlined. The end-to-end EPR process should be clearly defined to promote uniform understanding of the entire response cycle.

OEHEM identified quick wins in three categories that were rapidly implemented to address the areas of improvement. "The Director's critical information requirements" (DCIR) is focusing on identifying high-priority topics, standardizing staff reporting of incoming requests for EPR assistance, and streamlining the notification process for OD leadership. OEHEM agreed that the following high-priority topics would be included in the DCIR process.

- Emergency events and outbreaks (e.g., high-profile incidents with a large-scale public health impact that require an integrated response)
- ATSDR's Assessment of Chemical Exposures

- Epidemiologic assistance (i.e., Epi-Aids)
- Safety of personnel
- Deployment of personnel to domestic sites, global locations or the CDC EOC
- PFAS and perfluorooctanoic acid (PFOA)
- Radiological/nuclear incidents
- Water system failures and disruptions

The "incident management cadre" is focusing on identifying and training senior staff to fill senior-level position in incident management during emergency responses. The "deployment roster" is focusing on pre-identifying potential staff, obtaining rapid approval and preparing staff for deployments to responses.

Based on approximately 10 notices that OEHEM has received to date, the new DCIR process appears to be effective. OEHEM will complete its implementation of the other priority solutions over the next six months, but four activities already have been completed: (1) defining an SME; (2) clarifying communication requirements; (3) developing an SME roster and a redundant list of key personnel; and (4) implementing EPR best practices and streamlining the technical review process.

OEHEM is taking an all-hazards approach to fulfill its mission of providing an emergency response to events that do not involve infectious diseases, such as chemical, biological, nuclear/radiological and trauma/natural disasters. Recent data have shown an increase in the economic and human impact of disasters over the past 12 years. At a global level, these disasters have resulted in $1.3 trillion in damages, 2.7 million affected individuals and 1.1 million deaths.

Both infectious disease and non-infectious disease incidents have an EH component, but environmental emergencies have several unique aspects. Most notably, the wide range of health and safety concerns in environmental emergencies requires different expertise, diverse skill sets and resources. Moreover, coordination with multiple partners is necessary, including health and non-health partners. Specific challenges are associated with non-infectious disease outbreaks.

OEHEM's ongoing EPR activities are highlighted as follows. In terms of chemical terrorism preparedness, Syria has a highly active chemical warfare program and maintains a stockpile of chemical weapons that potentially could be deployed to the United States. OEHEM collaborated with internal NCEH/ATSDR and CDC partners and also engaged EPA in several activities to strengthen its chemical terrorism preparedness capacity.

- Updated information on the CDC.gov website
- Conducted National Poison Data System surveillance
- Enhanced laboratory detection and confirmation capacity
- Served as a liaison to DoD response capacity
- Developed a Rapid Registry Program
- Created and disseminated decontamination guidance
- Initiated environmental cleanup efforts
- Targeted outreach to the Federal Bureau of Investigation
- Offered the "Agents of Opportunity" course to provide education on chemical and radiological incidents
- Increased emphasis on EH in the new cycle of Public Health Emergency Preparedness (PHEP) grants to state and local health departments

- Initiated planning on a CDC-wide chemical exercise

In terms of radiation/nuclear incident preparedness, OHEM leveraged CDC's existing capacity (e.g., staff, training, coordination and exercises) to effectively respond to these types of incidents. CDC also provided funding, guidance and tools to state, local, territorial and tribal health departments to increase their understanding of responsibilities in radiological/nuclear emergencies. The CDC.gov website was updated with information for diverse audiences: (1) just-in-time tools, training and other materials to assist health departments in planning for and evaluating a radiation emergency; (2) information for individuals to protect themselves during a radiation emergency; and (3) resources for professionals to make informed decisions during a radiation emergency.

CDC also developed toolkits with training products for public health professionals, emergency services clinicians and other practitioners involved in radiation EPR. These toolkits are available on the CDC.gov website and also have been disseminated to more than 28,000 professionals in the United States and other countries. "Radiation Basics Made Simple" is the first in a series of training modules and includes eight different segments. The key components include a video-based lecture, interactive knowledge checkpoints and continuing education credits.

The World Health Organization (WHO) assessed the ability of the U.S. government to respond to different EPR scenarios. Based on the WHO evaluation, radiation preparedness had the lowest score. CDC is now taking actions to respond to WHO's four key recommendations.

- Establish a mechanism for systematic information exchange between radiological-competent authorities and the HHS surveillance unit.
- Create novel, high-throughput systems that are capable of performing bio-dosimetry and bioassay in both mass casualty and large-scale radionuclide dispersion situations
- Implement recommendations in the National Council on Radiation Protection and Measurements report, *Where Are the Radiation Professionals?*
- Integrate triage systems and population monitoring guidance with the existing national public health and clinical systems to provide national capacity for continued assessment, care and treatment.

NCEH/ATSDR has played a critical role in CDC's recent emergency response. In the response to the Flint water crisis, NCEH/ASDR provided guidance and developed a plan for monitoring children with elevated BLLs (EBLLs); identified and linked community members to case management; coordinated health messaging with partners; assessed chemical exposure to the community; and identified the long-term needs of the community.

In the response to Zika, NCEH/ATSDR developed and disseminated guidance materials to inform EH and vector control program planning and improvement. This effort allowed EH and vector control professionals to access available training to enhance their competencies. An integrated vector management approach is essential to controlling Zika virus mosquito vectors. the response to Hurricane Matthew in October 2016, NCEH/ATSDR took a leadership role in the domestic component. However, this effort was closely coordinated with CDC's international component of the response.

Dr. Funk concluded her presentation by requesting the BSC's guidance on whether OEHEM is taking an appropriate direction at this time and if OEHEM should consider additional topics or concerns.

BSC DISCUSSION: NCEH/ATSDR RESPONSE TO PHES

The BSC discussed the following topics during the question/answer session with Dr. Funk.

- OEHEM's existing surveillance methods for EH emergencies.
- The distinction between "lessons observed" and "lessons learned," such as OEHEM's efforts to inventory its existing skill sets to ensure staff readiness prior to an EH emergency.
- OEHEM's role in offering training, exercises and internships to prepare public health students as effective practitioners in EH emergencies.
- OEHEM's close partnership with the National Council on Radiation Protection and Measurements.
- Dr. Friden's request for OEHEM to draft a transition proposal on radiation preparedness to provide to the new CDC Director.

BSC GUIDANCE

- The BSC was pleased that state EH programs potentially could benefit from EPR support provided by NCEH/ATSDR through the PHEP CoAg.
- OEHEM is to be commended on the development and implementation of its new DCIR process to proactively identify high-priority topics before an emergency occurs. However, this process should be revised to include a robust debriefing component to identify the factors that cause a high-priority topic to become an actual emergency.
- OEHEM's should make strong efforts to leverage and partner with CDC's longstanding and rigorous infrastructure to investigate infectious disease outbreaks to inform its response to EH emergencies. For example, CDC developed a framework with multiple municipalities to predict and address heat-related emergencies.
- OEHEM should conduct exercises and simulations to determine the capacity of the CDC.gov website. Knowledge of the ability of the website to withstand a tremendous amount of traffic will be necessary prior to a large-scale event if, for example, 6 million visitors attempted to obtain information during a nuclear incident.

Drs. Funk and Breysse made several comments in follow-up to the BSC's discussion.

- The presentation did not cover the active after-action component that OEHEM included in the DCIR process because this particular activity currently is undergoing the CDC clearance process. OEHEM will provide with BSC with details on the after-action component after the CDC clearance process is completed.
- NCEH/ATSDR has no statutory authority to become involved in an emergency response at the state or local level. NCEH/ATSDR can only provide assistance in response to a specific request. For example, NCEH/ATSDR launched a response to the Flint water crisis approximately nine months after the event occurred because no state or local officials in Michigan requested assistance before that time. The "invitation-only" requirement is a significant challenge because NCEH/ATSDR cannot exceed the scope of its federal authority, but the public perception is that NCEH/ATSDR is ignoring the affected community.

- Based on the BSC's discussion, NCEH/ATSDR will explore strategies to offer academic programs on public health disaster response earlier in the careers of public health students.

Unconventional Oil/Gas Extraction and Hydraulic Fracturing

Tina Forrester, PhD, MS
Acting Director, Division of Community Health Investigations
Agency for Toxic Substances and Disease Registry

Dr. Forrester described ATSDR's site-specific activities to evaluate public health issues related to unconventional oil/gas extraction and hydraulic fracturing (i.e., "fracking"). Current data predict that natural gas production from shale deposits in the United States is expected to increase from 14% in 2009 to approximately 45% in 2035. The production of natural gas from shale deposits occurs in the majority of the country. ATSDR primarily has been involved in Marcellus shale on the East Coast, Barnett shale in Texas, and Wind River Formation in Wyoming.

Fracking is a method for extracting natural gas from the ground, particularly shale deposits. Large quantities of water (e.g., up to 5 million gallons per well) are combined with sand and chemicals and then injected at a high pressure into underground formations to expand pores and fissures. This process facilities the natural gas flow. The water is used to mix chemicals and sand at the well site and inject the wells. The water is then recovered as flow-back or produced water and stored as impoundments on the site. Wastewater is eventually transported for treatment and disposal. ATSDR has identified at least nine potential environmental release pathways from fracking.

- Air releases of volatile organic compounds (VOCs) from containment ponds
- Air releases from drilling operations, blowout, compressors, diesel engines and accidents,
- Liquid releases from contain or flow-black ponds
- Releases from drilling operations near the surface and on the drilling pad
- Liquid or gas releases from casing failures
- Liquid or gas releases from fracking based on materials pushed by fissures and pressure
- Transportation incidents
- Dewatering and purifying of natural gas product
- Public water supply degradation

A 2008 study reported that water and sand comprise 99.51% of fracking fluid, but a tremendous number of other chemicals are added. Fracking operations were initiated in 2009 and were viewed as an inexpensive source for oil and gas production. Oversight or control of the fracking process was extremely limited at that time. None of the compounds were assessed. Moreover, only five states have passed laws that require fracking companies to disclose the constituents of each compound.

Dr. Forrester presented aerial photographs of the landscape in a rural area in Washington County, Pennsylvania to illustrate the impact of fracking on a community. The pristine, peaceful and quiet environment now has a larger human population and increased noise, lighting, seismic activity, traffic and accidents.

ATSDR identified several potential public health concerns related to natural gas drilling activities: private and public drinking water contamination; local and regional air quality effects; explosive hazards and earthquakes; radiological concerns; and increased pressure on the health system and emergency response infrastructure.

ATSDR gathered extensive feedback from residents of fracking communities in Texas, Pennsylvania and Wyoming in four major categories. Category 1 is self-reported health complaints. These symptoms include breathing issues, irritation and asthma; unusual rashes, headaches and severe nosebleeds; GI upset/diarrhea; burning eyes and throat, metallic taste in mouth and sore throat; elevated arsenic urine levels; and livestock with health issues. The Pennsylvania Department of Health administered a survey to collect self-reported health concerns from 2011-2015. The top five symptoms reported by 185 community respondents were respiratory issues/sore throat, anxiety and stress, rashes, headaches and nosebleeds.

Category 2 is quality of life/stress issues. These community concerns include high volumes of truck traffic, impacts on existing infrastructures, noise and light pollution, odors, influx of temporary workers, increased crime, and higher rental property prices.

Category 3 is environmental release pathways and public health exposures. ATSDR's investigations of potential exposures have focused on media-specific impacts (e.g., air and water quality); the life cycle of operations (e.g., active production involving the release of high levels of contamination, post-production and site closure); and oil and gas production products. ATSDR completed water quality investigations at several sites in Indiana, Pennsylvania and Wyoming. ATSDR also contributed technical expertise to EPA on its national study, *Hydraulic Fracturing for Oil and Gas: Impacts from the Hydraulic Fracturing Water Cycle on Drinking Water Resources in the United States.*

ATSDR's ongoing water quality investigations include a water quality petition submitted after an acute event at JKLM Energy's gas well in Coudersport, Pennsylvania and more than 30 petitions submitted by the Damascus Citizens for Sustainability (DCS) from 2013 to the present. Of the DCS petitions submitted to ATSDR, approximately 50% include environmental sampling data. The general findings of ATSDR's water quality investigations are summarized below.

Alternative water supplies are needed for many private wells owners. Many contaminants are detected at levels of health concern, including salts, metals, oil and grease, radiation and some fracking-specific compounds. The potential for explosive hazards exists due to the buildup of methane content in the water. Existing pre-drill data are insufficient. Operations, particularly active production and the closure of wells, impact water quality. More groundwater monitoring data are needed.

ATSDR took several public health actions to address water quality issues at fracking sites. Alternative water supplies were provided. Assistance was provided in obtaining approval to install municipal lines to affected wells. Actions were initiated to close inactive wells that impact water quality. Community residents were provided with guidance on reducing potential explosive hazards in their homes. Community residents were educated on contaminant-specific exposure issues.

ATSDR acknowledges the limitations of its water quality investigations. Most notably, existing data sources to support these investigations are insufficient: pre-drill well data and monitoring

well data, life cycle of operations data, data on the suite of contaminants monitored, and data on alternate water supplies.

ATSDR's air quality investigations found several sources of contamination, including storage ponds and pits, compressors, storage tanks, drilling machinery, flaring, diesel trucks, generators and products. The air quality findings from external investigations are summarized as follows. NIOSH found that exposures to particulate matter (PM) posed a hazard to workers at fracking sites. Samples of respirable crystalline silica were collected from the breathing zones of onsite workers and specific equipment that is used in the fracking process. NIOSH also detected eight VOCs at concentrations that exceeded ATSDR's minimal risk levels and/or EPA's cancer risk levels. Benzene and formaldehyde were identified near specific equipment on sites, including compressor and pig launching stations.

Other external investigations collected residential air exposure samples from 0.04 to 3.2 miles from an active well pad. Polycyclic aromatic hydrocarbon (PAH) mixtures that were detected in areas with heavy fracking activities might have a higher than acceptable cancer risk. The investigation showed that this risk increased as the exposure moved closer to the active site. Health effects from air emissions from the fracking process were found to likely occur in residents living nearest to the well pads. Numerous chemicals in the air were found around hydraulic fracturing sites. Methane, ethane, propane and other alkanes accounted for some of the highest concentrations.

ATSDR completed air quality investigations at several sites in Colorado, Pennsylvania and Wyoming. ATSDR's ongoing air quality investigations include long-term air monitoring and the evaluation of air data for various operations requested by the Pennsylvania Department of Environmental Protection; DCS's submission of over 30 community petitions; and an air modeling evaluation of pipeline pigging operations. The general findings of ATSDR's air quality investigations are summarized below.

Sore throats, nasal irritation and breathing issues were reported by community residents. $PM_{2.5}$ exposures were found to be harmful to sensitive populations on average and were greater than regional National Ambient Air Quality Standards (NAAQS). Of 64 contaminants detected in the air near a compressor station, many had no or limited toxicity data. Average contaminant levels were not found to be a health hazard, but peak concentrations of carbonyls, aldehydes, sulfur compounds and PM might pose a risk to sensitive populations. Fence line data are needed to evaluate offsite exposures. Improper closure of wells can lead to imminent danger.

ATSDR took several public health actions to address air quality issues at fracking sites. Recommendations were made to reduce peak exposures to particulates, carbonyls, aldehydes and sulfur compounds. Efforts are underway to develop integrated risk analyses for multi-contaminant air exposures. Actions were initiated to close schools to protect students from exposure to dangerous air quality. Additional and more targeted air monitoring strategies were launched for air quality sites. Assistance was provided to EPA to enforce cases. Community residents were educated on contaminant-specific exposure issues. A hotline was established for residents to discuss their concerns related to fracking.

ATSDR acknowledges the limitations of its air quality investigations. Multiple air emission sources on these sites have individual characteristics. A stronger focus is needed to address outside sources of emissions, such as heavy traffic. The availability of temporal datasets over multiple

seasons and weather conditions is limited. Because fracking sites are private properties, access for sampling typically is limited. Additional toxicity data on contaminants are needed.

Category 4 is potential chemical exposures. ATSDR currently is conducting product evaluations of fracking sands at two sites. In the silica investigation in Wedron, Illinois, community residents have complained of exposure to natural and resin-treated crystalline silica. Sand mining, processing and offsite transportation were identified as contamination sources. Monitoring of $PM_{2.5}$ and $PM_{4.0}$ was conducted in October-December 2016. The analysis of these data is underway.

In the silica investigation in Valley, Washington, community residents have complained of the presence of crystalline silica the ceiling of a school and offsite residential exposures. Monitoring of $PM_{2.5}$, $PM_{4.0}$, PM_{10} and SO_2 was conducted, but more data are needed to assess risks for environmental agencies to take action. Additional monitoring is underway at this site. ATSDR also is exploring strategies to protect community residents from potential explosive hazards related to methane. ATSDR's site investigations identified methane in the water at potentially explosive levels.

The shutdown of 37 gas-linked wastewater wells in Oklahoma was initiated in December 2016 as a result of earthquakes that were measured at 5-6 on the Richter magnitude scale. The earthquakes were linked to the underground disposal of wastewater from natural gas production. The 81% increase in the disposal of wastewater over the past six years coincided with the increase in earthquakes. Dr. Forrester presented a photograph of one of the buildings in Oklahoma that was affected by the December 2016 earthquakes.

ATSDR will take several important steps to advance its evaluation of public health issues related to unconventional oil/gas extraction and fracking. Additional research will be conducted to identify exposures. More rigorous characterization data will be collected, particularly to address current gaps in pre-drill data, the life cycle of fracking operations, site closure, different site operations and products. Improved surveillance data will be gathered on fracking operations, such as health effects of community residents who live near these sites. Future investigations will be specifically targeted to address these health effects. Better toxicity data will be collected to guide analyses of detected compounds. Collaborations will be strengthened with NIOSH, NIEHS and industry to mitigate exposures. Most notably, ATSDR serves as the public health arm for HHS on the President's Task Force on Unconventional Oil and Gas to develop a fracking research plan.

Dr. Breysse made several remarks for the BSC to consider in its discussion. ATSDR is a small agency with an annual budget of $97 million. Despite its level funding over the past 20 years, the scope of activities that ATSDR completes is impressive. For example, Dr. Forrester's presentation demonstrates ATSDR's outstanding public health response to unconventional oil/ gas extraction and fracking.

Dr. Breysse noted that NCEH/ATSDR's priorities and programmatic budgets have changed since the BSC formally recommended the establishment of a new Fracking Workgroup. Most notably, NCEH/ATSDR's contribution of its EH expertise to CDC's Zika response is continuing to increase. Moreover, the WRDA legislation allocated funding for NCEH/ATSDR to establish a new FACA-chartered Lead Advisory Committee.

To improve the management of changes in its priorities and resources, Dr. Breysse emphasized that NCEH/ATSDR would be better served if the BSC rescinded its recommendation for a

Fracking Workgroup and formally approved the establishment of a new Zika Workgroup. If the BSC agreed with this request, he specified that the magnitude and scope of the new workgroup would extend beyond Zika and also would include a focus on pesticide application and exposure, integrated vector management and vector-borne diseases. He also clarified that the BSC's establishment of a new Zika Workgroup would not diminish ATSDR's ongoing public health response to fracking.

BSC DISCUSSION: NCEH/ATSDR'S PUBLIC HEALTH RESPONSE TO FRACKING

The BSC discussed the following topics during the question/answer session with Dr. Forrester.

- ATSDR's efforts to monitor noise pollution in fracking communities.
- ATSDR's approach to access fracking sites on private properties, such as invoking its regulatory authority under Superfund, obtaining permission from industry, or leveraging EPA's enforcement powers.
- Additional methods to dispose of wastewater from fracking operations.
- ATSDR's focus on measuring and monitoring ultrafine particle levels in addition to $PM_{2.5}$.

BSC GUIDANCE

- Dr. Breysse's request for the BSC to target its expertise to a new Zika Workgroup rather than a Fracking Workgroup is well understood. From a public health perspective, however, this decision should be based on the number of individuals who are affected by fracking activities in their communities versus those who are impacted by Zika.
- Dr. Breysse's request should be carefully considered due to the importance of pesticide exposure, particularly to children. Multiple jurisdictions in the United States have not reported any Zika cases to date. However, the formation of a new BSC workgroup to focus on pesticide application and exposure would be valuable to communities that have reported a population impact from other vector-borne diseases, such as the West Nile virus and Eastern equine encephalitis.
- Caution should be taken before the BSC shifts its focus from a Fracking Workgroup to a Zika Workgroup. Most notably, EH activities typically focus on urban communities, but fracking primarily affects rural populations. Rural areas of the country traditionally have been underserved in the context of limited research.
- ATSDR's high-quality data and other findings from its investigations in fracking communities are extremely important to states. For example, Maryland has been successful in presenting ATSDR's data to the state legislature to halt plans or proposals to expand fracking to other parts of the state. In its future site-specific fracking activities, ATSDR should review and apply lessons learned, experiences and best practices by Texas in terms of closely collaborating with local media outlets, parent groups and professional associations. Ms. Witherspoon offered to provide points of contact and guidance to assist ATSDR in this regard.
- ATSDR should place more emphasis on state data as a source to fill its existing fracking data gaps. Because Texas houses some of the largest oil and gas reserves in the country, the Texas Commission on Environmental Quality (TCEQ) has built and currently maintains a phenomenal air monitoring database related to fracking. Dr. Grant offered to provide Dr. Forrester with links to TCEQ's published studies that are in the scientific literature.
- ATSDR should make strong efforts to avoid repeating historical mistakes in the public health response to lead. For example, productive partnerships should be established, particularly with industrial hygiene experts, to minimize adversarial government/industry

relationships. ATSDR also should regularly share its data with industry to strengthen these collaborations.

- ATSDR should ensure that its fracking data and findings from the small number of sites are widely disseminated. This information could help ATSDR's state and local public health partners to prepare for and prevent adverse health effects from fracking operations that might be implemented in their local communities in the future.
- ATSDR should increase its focus on occupational exposures from fracking by leveraging its existing partnership with NIOSH and engaging the Occupational Safety and Health Administration (OSHA). For example, NIOSH's air quality investigations found significant hazards to workers at fracking sites due to PM exposures, equipment used in fracking operations, and concentrations of VOCs that were higher than federal thresholds. Moreover, ATSDR's stronger focus on occupational exposures could inform its design of EH exposure studies.
- ATSDR should reach out to NIEHS to review its rich database on PAH mixtures.
- ATSDR and NIOSH should address brain development as an additional health concern in their silica investigations. Animal studies with the rat model have demonstrated the ability of silica to move to the brain. Moreover, the importance of brain development is increasing in air pollution research.

Public Comment Session

Perry Gottesfeld, MPH
Executive Director
Occupational Knowledge International

Mr. Gottesfeld made the following comments for the BSC's consideration. He and Dr. Cory-Slechta, a current BSC member, co-chaired an ACCLPP workgroup that was charged with developing CLPP guidelines. CDC formally adopted ACCLPP's guidelines in 2012. CDC's current consideration to update the BLRV could have a positive impact on addressing disparities related to lead exposure. Most notably, the socioeconomic aspects of lead poisoning have been well documented in case clusters that recently were reported over the past year by communities in California, Indiana and Michigan.

HUD's recent announcement to expand environmental testing and inspections of homes with children at or above the BLRV demonstrates the need for even stronger efforts to lower the BLRV. These actions will ensure the testing of homes of children with the highest lead exposures. Section 8 housing, the largest portion of HUD housing impacted by this rule, historically has required visual paint inspections only. However, a mechanism now exists to enforce property inspections before children are severely poisoned by lead.

Mr. Gottesfeld read a written statement into the official record that was submitted to the BSC in advance of the meeting for review. He noted that Dr. Bruce Lanphear (Professor of Children's Environmental Health, British Columbia Children's Hospital & Professor/Faculty of Health Sciences, Simon Fraser University) co-authored the statement. The statement addresses a revision to the BLRV and is set forth below with no changes to the content.

It has been brought to the attention of the Board of Scientific Counselors and widely reported in the media that the new blood lead reference value for children based on the most recent NHANES data should now be lowered to 3.5 µg/dL. The purpose of the CDC's reference value is not to initiate medical treatment, but to identify children, communities, and environments exposed to lead hazards.

Unlike most medical reference values, the blood lead action level serves a dual purpose in identifying individual children who are unduly exposed as well as communities with elevated exposures to lead. The reference level is used in the clinical setting to notify parents if a child's individual result is elevated compared with a population average. It only indicates that physicians should re-test a child at more frequent intervals, re-test a child with a venous puncture if the initial test was performed from capillary blood with the LeadCare portable testing device, and recommend investigating sources of lead in a child's environment.

It also serves to identify communities and public health authorities that some condition may be contributing to lead exposures that are above average. It is important to note that the reference value, according to current CDC Guidelines, does not trigger a medical response.

Although legitimate concerns have been raised about the reproducibility of laboratories and clinical testing equipment for blood lead levels at 3.5 µg/dL, these potential errors will have minimal impact on the interpretation of individual or aggregate community results. Moreover, efforts are already underway to enhance reproducibility of blood lead testing. In practice, it will make little difference to a parent if their child is above the 97.5th, 90th or even 60th percentile of the NHANES blood lead distribution. Concerns around the reporting of false-positive results, do not change the fact that even with some laboratory error, children with reported levels >3.5 µg/dL from a confirmed venous puncture are experiencing exposures that are elevated in relation to the U.S. population median (0.86 µg/dL).

These potential errors do not in any way prevent communities from using aggregate blood lead testing data to investigate and identify possible sources of lead exposure. Sources of lead contamination from the water in Flint, Michigan, and soil in Los Angeles, California and East Chicago, Indiana would not have been identified, nor would they have triggered a response, without the CDC's decision to adopt the reference value of 5.0 µg/dL in 2012.

When the CDC adopted the current guidance the goal was to shift to a primary prevention model to "reduce or eliminate dangerous lead sources in children's environments BEFORE they are exposed." (Centers for Disease Control and Prevention, "What Do Parents Need to Know to Protect Their Children?" https://www.cdc.gov/nceh/lead/acclpp/blood_lead_levels.htm).

It was for this reason that CDC adopted a program to update the reference value every four years to facilitate notifying parents and communities of potential harm. At the same time it was recognized that actions triggered by the reference value at an individual or community level "will be primarily dependent upon the availability of effective remediation approaches and financial means to accomplish them and, to some degree, related analytical considerations." (Centers for Disease Control and Prevention, 2012. Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention).

We urge the BSC to immediately take action to advise CDC to utilize the most recent national data to help identify individuals and communities at risk. Waiting for improved analytical capacity to more accurately measure blood lead levels will only further delay the adoption of a primary prevention model to identify and eliminate the sources of lead in our environment.

Panel Presentation: Lead Poisoning Prevention

Dr. Perry announced that the remainder of the BSC meeting on day 1 would focus on LPP. The session would include a series of overviews for the federal agencies and the BSC to provide their perspectives.

NCEH/ATSDR's Role in Lead Poisoning Prevention

Patrick Breysse, PhD, CIH
Director, NCEH/ATSDR
Centers for Disease Control and Prevention

Dr. Breysse described several aspects of NCEH/ATSDR's role in LPP to guide the BSC's discussion.

- Dr. Mary Jean Brown, former Chief of the CDC Lead Program, recently retired. Dr. Sharunda Buchanan will continue to serve in an acting capacity until CDC completes the search process and permanently fills this position.
- NCEH/ATSDR is continuing to collaborate with HUD and other federal partners to develop a national model to eliminate lead from children's environments.
- The Flint water crisis demonstrated that water should not be ignored as a source of lead exposure in communities. This event also emphasized the need for an additional investment of resources to strengthen the U.S. water infrastructure. NCEH/ATSDR is interested in support from the BSC and other stakeholders to ensure that an aggressive lead surveillance component is included in any new water infrastructure legislation.
- The BSC should give consideration to changing the terminology from "reference value" to "action level" for lead. The current language is not well understood.

Sharunda Buchanan, PhD, MS
Director, NCEH Division of Emergency and Environmental Health Services
Centers for Disease Control and Prevention

Dr. Buchanan reported that the impact of CLP has been a longstanding priority for CDC. Most notably, nearly 24 million homes in the United States still have deteriorated lead-based paint (LBP). At this time, 535,000 children 1-5 years of age have BLLs at or above the current BLRV. Exposure to lead can cause serious harm to a child's health, including damage to the brain and nervous system, slowed growth and development, learning and behavior problems, and hearing

and speech impediments. Because health impacts have been detected at the current BLRV of 5 µg/dL, CDC has a strong interest in mitigating these effects.

CDC originally was appropriated funding in the 1980s to establish a comprehensive CLPP Program with several components, including screening, surveillance, case management and follow-up. The CLPP Program was fully funded with an annual budget of $35 million from the 1980s to 2010. The drastic budget cut to $2 million in 2012 had severe consequences for state CLPP programs. The appropriation of new PPHF resources to CDC to conduct lead surveillance following the Flint water crisis allowed EPA, HUD and other federal partners to use these data.

CDC recently awarded a three-year CoAg totaling $11 million to health departments in 29 states, the District of Columbia and five cities to support CLPP activities. However, CDC will use its new WRDA funding to support lead surveillance programs in at least 10 additional states and large cities with a high burden of lead. All grantees are encouraged to use their CoAg awards ($250,000-$300,000 on average) to increase lead screening and testing rates among children in their communities, conduct more community-based interventions with a primary prevention focus, and strengthen local partnerships (e.g., housing authorities and educational departments).

BSC GUIDANCE: NCEH/ATSDR'S ROLE IN LPP

- The terminology should be changed from "reference value," but "action level" should not serve as the substitute. EPA has used "action level" for quite some time, but this language is still confusing and difficult to interpret.
- "Action level" should replace "reference value" to provide clear guidance to the pediatric community. With this terminology, for example, pediatricians would be able to inform parents that no safe level of lead exposure exists, but specific "actions" should be taken at a certain BLL. Moreover, the use of specific language is important to both the lay public and professional community.
- Input should be obtained directly from pediatricians rather than making assumptions on their level of knowledge and understanding regarding the current state of the CLPP field. However, lead is a complex environmental justice issue. The ability of pediatricians to effectively communicate lead to a broad segment of the American public with limited health literacy might be an unreasonable expectation. Instead of focusing on revising the current terminology, emphasis should be placed on the more important issues of preventing lead poisoning in children's environments and removing a major source of lead from 24 million homes in the country.

HUD's Role in Lead Poisoning Prevention

Warren Friedman, PhD, CIH, FAIHA
Senior Advisor to the Director
Office of Lead Hazard Control and Healthy Homes
U.S. Department of Housing and Urban Development

Dr. Friedman described HUD's Lead Hazard Control Program and highlighted the implications for a change in the CDC BLRV. The President's Task Force on Environmental Health Risks and Safety Risks to Children is currently updating the 2000 report, *Eliminating Childhood Lead: A Federal Strategy Targeting Lead Paint Hazards*. The Task Force expects to release the updated report over the next year.

HUD is a health promotion agency with a mission to promote decent, safe and sanitary housing, particularly for low-income families. HUD has developed multiple regulations (e.g., Uniform Physical Condition Standards and Housing Quality Standards) to ensure that homes are healthy and safe. The Lead-Based Paint Poisoning and Prevention Act prohibits the use of LBP and the presence of LBP chips in new or rehabilitated structures that are supported or owned by the federal government. When this legislation was passed, however, the BLL standard was 60 µg/dL for children ≤7 years of age. The legislation was amended and called for HUD to eliminate lead hazards from pre-1950 housing.

HUD established the Office of Lead-Based Paint Abatement and Poisoning Prevention in 1991 to consolidate its lead activities. Congress appropriated $10 million to HUD in 1999 to expand its focus on lead to include healthy homes. With its FY2017 budget, HUD will release a Notice of Funding Availability under the Healthy Homes Technical Studies Programs that will be open to non-federal applicants.

The Residential Lead-Based Paint Hazard Reduction Act of 1992 (Title X) is HUD's major lead legislation. Title X promotes infrastructure development; the inclusion of lead and other housing hazards in federal policies and activities; and the provision of education to the public and various sectors on reducing LBP hazards in federally-owned/assisted housing. Title X also addresses "target" housing (or pre-1978 housing). This language is aligned with the U.S. Consumer Product Safety Commission's (CPSC) ban on the use of lead at high levels in 1978.

HUD's awards of approximately $110 million in Lead Hazard Control grants each year (or a total of $1.58 billion for 860 grants) to state and local governments have made more than 190,000 housing units lead-safe across the country. States and localities that collect data to identify and target funding to neighborhoods with clusters of EBLLs receive additional points on their grant applications. Tribal governments are eligible for funding as well, but have not applied for HUD's lead grants. In addition to ensuring lead-safe homes, HUD grants also are used to conduct outreach to communities, property owners and families as well as to subsidize training and certification of workers.

The Lead Safe Housing Rule (LSHR) was issued in 1999 to specifically focus on primary prevention. For example, pre-1978 housing units are evaluated for the presence of lead through a lead risk assessment or visual inspection. Properties with identified lead hazards are remediated prior to occupancy and periodically reevaluated to verify ongoing maintenance. Lead-safe work practices must be used for all remediations to protect the occupants and workers.

HUD has administered several nationally representative surveys, reviewed the published literature, and collected data from other sources to determine the effectiveness of its regulations on lead and LBP hazards in housing. The prevalence of LBP hazards is statistically lower in HUD-assisted housing than in unassisted properties. Children who reside in HUD-assisted housing have significantly lower BLLs on average than children who are comparable in terms of demographics, housing status and other factors. The population of children with BLLs ≥3 µg/dL who reside in HUD-assisted housing is 50% smaller than the comparable population of children who reside in unassisted properties.

HUD collects data from CDC and local health departments to identify families that reside in housing units with known cases of EBLLs. These data play an important role in helping HUD to take enforcement actions against property owners who do not comply with the Lead Disclosure

Rule. The LSHR does not include a specific mandate related to EBLLs, but HUD agreed to address this issue as a public health protection measure. HUD used CDC's BLL guidance in 1999 to establish an environmental intervention BLL of ≥20 µg/dL or ≥15 µg/dL over a period of at least three consecutive months.

HUD began considering an amendment to the LSHR after CDC adopted the BLRV of ≥5 µg/dL in 2012. However, HUD first needed to determine the extent to which the BLRV was being implemented and identify any related problems. HUD learned that states and localities have not universally accepted and used the BLRV to date. The wide range of cutoffs across the country includes BLRVs of ≥5, ≥10 and ≥15 µg/dL. States and localities that are not using the CDC BLRV of ≥5 µg/dL reported laboratory/analytical and prioritization/implementation issues as the major problems.

HUD's position was that these problems could be resolved. As a result, HUD published a draft of the amended LSHR in the *Federal Register* for public comment on September 1, 2016. HUD thoroughly reviewed all of the public comments that were submitted; made strong efforts to apply CDC's 2012 guidance whenever possible; and published the amended LSHR on January 13, 2017. Changes in two major categories are particularly relevant to CDC.

First, HUD shifted from the use of a specific BLL cutoff to a new performance-based standard for housing. The new standard is the same BLL at which CDC recommends an environmental investigation. HUD took this approach to avoid initiating an entirely new rulemaking process if CDC changes its BLRV in the future.

Second, HUD grantees will be instructed to use CDC's guidance to advance from conducting a risk assessment to implementing a full-scale environmental investigation of children's housing units. However, HUD will expect its grantees to complete the enhanced, more complex evaluation to control and eliminate LBP hazards in the same timeline. The detection of EBLLs in a child's housing unit will trigger the enhanced evaluation of all HUD-assisted units at the same property. Due to strong arguments raised during the public comment period, housing units with families in the Housing Choice Voucher Program also will receive a full risk assessment rather than the visual inspection.

HUD was unable to apply CDC's guidance in some areas of the amended LSHR. For example, full-scale environmental investigations will be limited to HUD-assisted units with children <6 years of age. The control of lead hazards in water will be recommended and encouraged as a routine part of all environmental investigations, but HUD has no statutory authority to require remediation in this area.

Overall, HUD acknowledges that "actions" taken by state and local housing officials in response to EBLLs under the amended LSHR will vary. However, actions taken by the public or private sector should be based on reliable evidence and rigorous data.

Dr. Breysse commended Dr. Friedman for his leadership at HUD in launching the arduous rulemaking process to publish the amended LSHR. He also thanked HUD for its outstanding efforts to match the language in the amended LSHR with CDC's guidance whenever possible.

EPA's Role in Lead Poisoning Prevention

Wayne Cascio, MD, FACC, FAHA
Director, Environmental Public Health Division
U.S. Environmental Protection Agency

Dr. Cascio presented EPA's perspectives on LPP. EPA recognizes that high levels of lead exposure are a public health priority. As a result, EPA has made a strong commitment to maintain its partnerships with CDC and other federal agencies to collectively reduce lead exposure in communities, particularly those with a high burden.

EPA is aware of the challenges in addressing lead because most of these exposures are a result of legacy activities. CLP is a multimedia problem that is even more complex to address. However, federal, state, local and tribal programs have a long history of implementing effective cooperative efforts to focus on this issue. To continue to achieve meaningful reductions in lead exposure, a long-term concerted effort is needed that includes all current and historic sources of lead: LBP in older homes, lead in aviation fuel, lead-contaminated soil and house dust, and lead in drinking water pipes and fixtures.

The overarching public health goal across all agencies is to eliminate lead exposures. National sampling of BLLs helps to identify high-burden communities and track children at the highest risk for adverse health effects. However, children's vulnerabilities to lead exposure from any pathway will vary based on their particular stage of development.

The current CDC BLRV is based on the 97.5 percentile of the national sample to identify children with EBLLs. EPA shares CDC's goal to eliminate CLP and reduce exposures to lead for the entire U.S. population. As a result, EPA will continue to partner with CDC to achieve this goal and advance public health protection.

EPA's tools to reduce lead exposures are under different statutory authorities than those of other federal agencies. EPA implements diverse approaches to establish numerical lead-based standards. Lead-related policies of different EPA programs and the technical analyses that are conducted to inform these policies might differ as well.

EPA reviews health effects data to establish a maximum contaminant level goal (MCLG) for lead in drinking water under the National Primary Drinking Water Regulations. However, the MCLG covers public health issues only. LODs and the effectiveness of treatment technologies are not considered in the MCLG process. Because no safe level of lead exists in drinking water, EPA established the health-based MCLG for lead at 0 in its 1991 Lead and Copper Rule (LCR). However, the LCR currently is under review at EPA for a possible update.

In addition to its oversight of lead in drinking water, EPA also is mandated to address dust lead hazards. In 2001, EPA established dust lead standards at 40 µg/ft^2 for residential floors; 250 µg/ft^2 for residential windowsills; 400 ppm for exterior soil in residential play areas; and 1,200 ppm in the remainder of residential yards, schools and daycare facilities. Because EPA uses these standards to define hazardous conditions for LBP, this language was incorporated into its Lead-Based Paint Activities Rule as part of work practice standards for inspections, risk assessments

and abatements. The EPA requirement ensures that abatements are safely conducted and lead dust is not produced at the worksite at levels greater than the dust lead standards.

EPA addresses lead-contaminated soil by reviewing bioavailability and background data and implementing site-specific approaches. For example, EPA is mandated to establish NAAQS for criteria pollutants. The NAAQS for lead was established at 15 $\mu g/m^3$ in 2008, but EPA significantly reduced this standard by ten-fold to 0.1 $\mu g/m^3$.

EPA applies current scientific evidence to inform its regulatory decision-making. Most notably, recent data demonstrate that children's health effects occur at lower BLLs. Moreover, efforts to continue to reduce lead exposures, particularly in highly exposed communities, are still a public health priority. However, EPA's policies are not directly based on CDC's existing BLRV. As a result, EPA has implemented a unified cross-agency approach to enhance its focus on lead in several areas.

- EPA will strengthen the National Primary Drinking Water Regulations for lead and copper to protect all Americans from lead exposures in drinking water. EPA's publication of a white paper with LCR revisions in October 2016 provided examples of regulatory provisions that are being evaluated at this time to improve public health protection.

- EPA is continuing to partner with primacy agencies to ensure proper implementation of the LCR. To support this effort, EPA has provided a wealth of guidance on optimal corrosion control treatment, source water changes, sampling and monitoring. EPA has increased the number of primacy program reviews and training conducted across the country.

- EPA has conducted multiple analyses to determine the feasibility of and need to modify its existing residential lead hazard standards. The current lead hazard standards for interior dust and exterior soil currently are under review at EPA.

- The EPA Land Cleanup Program contributes to CLPP by reducing site-related public health risks from exposures to lead-contaminated soil and considering other sources of lead. For example, EPA conducts additional site-specific assessments of potential health risks when lead in soil is detected at higher levels than the established screening level, particularly for children. Evaluations of site-specific conditions to address other lead sources, in coordination with public health officials, continue to provide a foundation for EPA's comprehensive approach to focus on lead-contaminated sites. Data collected to date have indicated a significant decrease in community-wide BLLs, on average, at sites where EPA has monitored children's BLLs pre-/post-soil cleanup.

- EPA's regularly reviews data to establish NAAQS for lead and completed its most recent review in September 2016. EPA found that the current NAAQS for lead is appropriate.

- EPA is aware that lead is a persistent contaminant in aviation fuel. As a result, EPA will exercise its statutory authority under the Clean Air Act to investigate whether lead in aviation fuel is a potential health impact and regulate this fuel source if necessary.

LPPS GUIDANCE: EPA'S ROLE IN LPP

- EPA is on record with its commitment during an ACCLPP meeting in 2012 to change the cleanup guidance. Based on Dr. Cascio's presentation, however, EPA has not released revised cleanup guidance over the past five years. For example, the risk assessment guidance for Superfund is still based on a screening level of 400 ppm for exterior soil in residential play areas. The residential dust lead standard for floors is still 40 µg/ft^2.

In response to the LPPS comment, Dr. Cascio clarified that EPA is thoroughly reviewing its cleanup guidance at this time and hopes to release revised guidance over the next year.

Laboratory Perspective on Lead Poisoning Prevention

James Pirkle, MD, PhD
Director, NCEH Division of Laboratory Sciences
Centers for Disease Control and Prevention

Dr. Pirkle described DLS's laboratory performance to measure low blood lead concentrations and reviewed its evaluation of data collected from proficiency testing (PT) programs. Laboratory capacity to reliably measure BLLs must be thoroughly considered before the BLRV is lowered. Laboratories commonly use three primary methods to measure blood lead.

Inductively coupled plasma mass spectrometry (ICP-MS) is the best, but most expensive method. Graphite furnace atomic absorption spectroscopy (GFAAS) is still effective in measuring blood lead, but laboratories have decreased their use of this method. LeadCare II (i.e., a point-of-care (POC) portable blood lead instrument) is inexpensive and offers other advantages, but some of its performance specifications are not as rigorous as those of ICP-MS and GFAAS.

The LPPS asked DLS to examine the implications of the level of quantitation and precision of the three primary laboratory methods to determine the positive and negative predictive value of blood lead tests obtained in the setting of a revised BLRV of 3.5 µg/dL. DLS responded to LPPS's request by extensively reviewing data from the 1987 Taylor study, *Quality Assurance of Chemical Measurements*. DLS found that imprecision or errors began to increase non-linearly near the LOD.

In addition to reviewing the published literature, DLS also drafted two key research questions to inform its response regarding the sensitivity and precision of ICP-MS, GFAAS and LeadCare II to measure blood lead.

- For each of the three primary methods, is 3.5 µg/dL above the limit of detection (LOD)? DLS responded "yes" to the sensitivity question, but noted that a laboratory with reasonable capacity would need to conduct all three methods.
- For each of the three primary methods, is the precision of measurement at 3.5 µg/dL adequate for public health/clinical use? DLS concluded that sufficient data are not available at this time to evaluate the precision of the three methods to measure BLLs at 3.5 µg/dL. However, DLS found that PT data on BLLs at approximately 5 µg/dL could provide some estimates.

Based on its findings for question 2, DLS reviewed data from three major blood lead PT programs: Wisconsin State Laboratory of Hygiene (WSLH) Blood Lead Regulatory PT Program; New York State Department of Health (NYSDOH) Wadsworth's Trace Elements in Blood PT Program; and the CDC Lead and Multi-Element Program (LAMP). These programs perform blood lead PT by submitting five unknown samples three times per year as required by the Clinical Laboratory Improvement Amendments (CLIA). The CLIA PT regulations apply to ICP-MS, GFAAS, and all LeadCare instruments with the exception of LeadCare II.

The number of participating laboratories in the three PT programs with the capacity to conduct the three primary methods to measure blood lead is set forth below.

Method	WSLH Laboratories	NYDOH Laboratories	CDC LAMP Laboratories
ICP-MS	20	20-30	20-30
GFAAS	40-50	30-40	30-40
LeadCare II	300-350	<10	<10

DLS found that the number of participating laboratories represents a sufficient sample to collect PT data. Because the LeadCare II instrument has the poorest precision of all three methods, DLS was pleased that the use of this method by an extremely large number of laboratories in the WSLH PT Program would ensure a solid evaluation. DLS selected data from the PT programs that targeted BLL pools in the range of 4-6 µg/dL; calculated the difference of each result from the pool mean; and excluded outliers based on 4-sigma criteria.

Dr. Pirkle presented a slide to illustrate the difference in measurements with the LeadCare II instrument from the pool mean for BLL pools near 5 µg/dL. DLS's best estimates of the precision of blood lead measurements at 5 µg/dL are set forth below.

Method	95% Confidence Interval (µg/dL)	Number of Results
LeadCare II	±1.8	1,469
GFAAS	±1.5	908
ICP-MS	±0.97	769

DLS is aware of concerns that have been raised in the field regarding the capacity to implement CDC's guidance on the BLRV. As a result, DLS performed a simulation of sequential blood lead measurements with the LeadCare II instrument for an individual with a constant, true BLL of 5 µg/dL. The individual's BLL was actually 5 µg/dL, but LeadCare II produced results ranging from 2.8-6.6 µg/dL over the course of 40 different measurements that were conducted in the simulation. As a result, the confidence interval of ±1.8 for the LeadCare II instrument must be carefully considered. For example, a pediatrician could provide inaccurate clinical guidance or information to parents if the child's BLL showed a significant increase from 2.8 to 6.6 µg/dL. However, the change might actually be due to variations in LeadCare II measurements rather than increased exposure to lead.

Overall, DLS's precision estimates are based on BLL pools near 5 µg/dL, but data on BLL pools near 3.5 µg/dL are needed from PT providers. DLS has initiated the process of collecting PT data with the LeadCare II instrument on BLLs 3.5 µg/dL from the WSLH PT Program. However, the precision of measurements at 3.5 µg/dL will not be better than the current estimates at 5 µg/dL. Blood tube manufacturers should consider offering blood tubes less than the 0.5 µg/dL blood lead equivalent due to contamination in a large number of tubes. CDC's standard for blood lead tubes

is 0.1 µg/dL. Efforts to improve the precision of methods to measure blood lead continue to be important.

Report from the LPPS Reference Value Workgroup

Matthew Strickland, PhD, MPH
Associate Professor, School of Community Health Sciences
University of Nevada, Reno
LPPS Chair and BSC Member

Dr. Strickland reported that the LPPS formed the Reference Value Workgroup to review the most recent National Health and Nutrition Examination Survey (NHANES) data and determine whether CDC's current BLRV of 5 µg/dL should be lowered. The report of the workgroup's consensus recommendations was distributed to the BSC for review in advance of the meeting, but Dr. Strickland highlighted several key points.

- The workgroup reviewed ACCLPP's 2012 report with the following recommendations to CDC. "CDC should abandon the term "level of concern" with respect to childhood BLL. Instead, CDC should use a childhood BLL reference value based on the 97.5th percentile of the population BLL in children ages 1-5. The reference value should be updated by CDC every four years based on the most recent population based blood lead surveys among children."

- The workgroup found that CDC concurred in principle with ACCLPP's recommendations regarding the establishment of a BLRV. CDC affirmed its intention to:
  - Use the BLRV in recommendations that involve follow-up evaluation of children after BLL testing.
  - Use the BLRV as defined to identify high-risk childhood populations and geographic areas most in need of primary prevention.
  - Provide this information, including specific high-risk areas, to a wide variety of federal, state, and local government agencies and non-governmental organizations interested in LPP.

- The workgroup described actions that can be taken for children with BLLs $\geq$5 µg/dL. However, the workgroup extensively discussed challenges in lowering the BLRV to 3.5 µg/dL, particularly laboratory issues to measure BLLs with a high degree of precision and sensitivity. The workgroup engaged expertise from DLS to inform its discussions on this topic.

- The workgroup recognized the benefit in temporarily keeping the BLRV at 5 µg/dL while additional PT data are collected. However, the workgroup proposed a reasonable course of action at this time. The 97.5th percentile of the population BLL is 3.5 µg/dL based on the most recent NHANES data. CDC's current BLRV of 5 µg/dL is not consistent with the most recent NHANES data. The BLRV should be revised to $\geq$3.5 µg/dL. For BLLs $\geq$3.5 µg/dL, the workgroup cited the 2012 ACCLPP report on child-specific response actions to initiate; emphasized the need to report the actual value of all BLLs to appropriate

authorities for public health surveillance; and recommended the delivery of educational messaging from CDC.

Dr. Breysse made several remarks for the BSC to consider in its discussion. The BSC's formal recommendation on whether to lower the current BLRV from 5 to 3.5 µg/dL is critical to NCEH/ ATSDR. Most notably, NCEH/ATSDR is continuing to receive multiple requests from the media to issue a statement in this regard. If the BSC votes to approve a lower BLRV, he was interested in disseminating guidance to state and local LPP programs as quickly as possible.

BSC GUIDANCE: LPPS REFERENCE VALUE WORKGROUP REPORT

- The workgroup is not recommending any of ACCLPP's six child-specific response actions at this time for children with BLLs between 3.5 and 5 µg/dL: parental lead education, follow-up blood lead monitoring, complete history and physical examination, laboratory assessment of iron status, environmental investigation and lead hazard reduction, or neurodevelopmental monitoring. However, parents of children with detectable BLLs in this range should be provided with lead education and tools for their individual empowerment.

- The workgroup should revise and divide the report into sections to be clearer. An affirmative statement should be included at the outset with the recommendation to lower the BLRV to 3.5 µg/dL. The individual sections could include:
  - Text on analytical methods and the precision of BLL measurements.
  - A "child-specific response actions" section to better explain the role of the BLRV in public health practice and also to clearly distinguish between actions to take at a BLL of 3.5 versus 5 µg/dL.
  - A "reporting" section on public health surveillance of childhood BLLs.

- The workgroup proposed a sound approach to collect additional PT data to support a BLRV of 3.5 µg/dL. However, the workgroup should be mindful of the fact that PT and field operations of instruments to measure blood lead generate an entirely different set of data.

- A large segment of the medical community, including pediatricians, family practitioners and nurse practitioners, likely will voice strong opposition to a media report that states, for example, "CDC now recommends 3.5 µg/dL as the new, safe lead level." No preparations have been made and no resources have been allocated to manage the larger population of children who will be identified with BLLs $\geq$3.5 µg/dL.

Dr. Breysse highlighted key points from the workgroup's report to confirm his understanding of the document. The report includes a consensus recommendation to lower the BLRV to 3.5 µg/dL. However, all sequelae from the lower BLRV would not necessarily be triggered at this point. The report further recommends using resources as efficiently as possible while more data are gathered on the analytical precision of BLL measurements at the lower BLRV.

Dr. Breysse commended the members of the former ACCLPP on their brilliance in recommending a shift to a BLRV in 2012. This change allows agencies to regulate a contaminant with no known safe level and no health-based threshold. The BLRV approach also will promote a continued reduction in the distribution of the BLL population and the elimination of childhood BLLs at some point in the future.

Dr. Pirkle clarified that data from the next four-year cycle of NHANES potentially could support a higher BLRV, such as 3.8 µg/dL. This possibility actually occurred with measurements of serum cotinine levels and demonstrates the weakness of the approach of linking a BLRV to a population distribution of BLLs. The public perceives BLLs to be "safe" under CDC's recommended threshold and "dangerous" above the threshold. As a result, the reliability of BLL measurements and the effectiveness of actions taken should drive CDC's messaging. For example, "No safe level of lead exists. CDC is attempting to identify cost-effective strategies to reduce lead exposures." The credibility of the BSC and CDC might be damaged by recommending a policy that only applies to a decrease in BLLs and reversing the policy if BLLs increase.

Dr. Henry Falk is an Adjunct Professor of Environmental Health at the Emory Center for Injury Control. His previous career at CDC included several leadership positions, such as the former NCEH/ATSDR Director and the ACCLPP DFO. Based on his experience, he advised the BSC to thoughtfully consider the critical issue of messaging because CDC's BLRV will impact a broad range of audiences, particularly parents and pediatricians.

Dr. Perry exercised the chair's prerogative and closed the discussion. She conveyed that the second part of Dr. Strickland's presentation, LPPS's recommendations to the BSC, would be tabled until day 2. The BSC's formal vote on the workgroup's recommendation to lower CDC's BLRV to 3.5 µg/dL also would be tabled until the following day.

Dr. Breysse asked the BSC to consider several issues overnight. The BSC extensively discussed the workgroup's six-page report, but this document would not be the subject of the BSC's formal vote on the following day. Instead, NCEH/ATSDR is interested in whether the BSC approves or opposes a lower BLRV of 3.5 µg/dL. NCEH/ATSDR will publish its final decision in the *Morbidity and Mortality Weekly Report* (*MMWR*), along with a description of the potential implications of a lower BLRV and a detailed communications plan.

Dr. Cibulas clarified that the workgroup's full report would be submitted to NCEH/ATSDR and thoroughly considered during its decision-making process and formulation of next steps on the BLRV.

With no further discussion or business brought before the BSC, Dr. Perry recessed the meeting at 4:41 p.m. on January 17, 2017.

January 18, 2017 Opening Session: Welcome-BSC Meeting Reconvenes

William Cibulas, Jr., PhD, MS
Deputy Associate Director for Science, NCE/ATSDR
BSC Designated Federal Official (DFO)

Dr. Cibulas conducted a roll call and confirmed that the 19 voting members and *ex-officio* members in attendance constituted a quorum for the BSC to conduct its business on January 18, 2017. He reconvened the proceedings at 8:37 a.m. and welcomed the participants to day 2 of the BSC meeting.

Dr. Cibulas announced that BSC meetings are open to the public and all comments made during the proceedings are a matter of public record. He reminded the voting members of their responsibility to disclose any potential individual and/or institutional conflicts of interest for the public record and recuse themselves from voting or participating in these matters. None of the BSC voting members publicly disclosed conflicts of interest for any of the items on the January 18, 2017 published agenda.

BSC's Formal Vote on the Blood Lead Reference Value

Melissa Perry, ScD, MHS, BSC Chair
Chair, Department of Environmental and Occupational Health
George Washington University School of Public Health and Health Services

Dr. Perry also welcomed the participants to day 2 of the BSC meeting. Based on the thoughtful and robust discussion in response to the LPPS Reference Value Workgroup report on the previous day, her perspective was that the BSC expressed a strong and prevailing sense of support and agreement with the recommendation to lower CDC's BLRV to 3.5 µg/dL.

Chair's call for a vote	Dr. Cory-Slechta properly placed a motion on the floor for the BSC to recommend to NCEH/ATSDR to lower the BLRV from 5 to 3.5 µg/dL and develop appropriate language to communicate this change. Dr. Strickland seconded the motion.
Outcome of the vote	**The motion was unanimously passed by 15 BSC voting members.[1]**

LPPS's Recommendations to the BSC

Matthew Strickland, PhD, MPH
Associate Professor, School of Community Health Sciences
University of Nevada, Reno
LPPS Chair and BSC Member

Dr. Strickland reported that the LPPS was established to provide scientific expertise to the BSC to assist NCEH/ATSDR's efforts to track, reduce and prevent lead poisoning nationwide. The LPPS responds to requests from the BSC and NCEH/ATSDR to provide advice and guidance regarding new scientific knowledge and technological developments.

The LPPS is charged with making recommendations to the BSC. The BSC must vote to approve LPPS's recommendations before the submission of this guidance to NCEH/ATSDR leadership. The LPPS is now presenting six recommendations that were developed during its meeting on September 19, 2016 for the BSC's review and approval. Minutes of the LPPS meetings are available on the CDC.gov website.

[1]Dr. Dietrich emailed the BSC Chair after the meeting with a request to change his vote from "approve" to "abstain."

RECOMMENDATION 1

The Lead Poisoning Prevention Subcommittee recommends that CDC call on the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Housing and Urban Development (HUD) to revise their standards and guidelines concerning the actionable content of lead in paint, soil, dust and water to be consistent with the goal of maintaining the impacted population's blood lead level equal to or less than CDC's reference value.

Rationale for Recommendation 1: The HUD guidance on residential lead-based paint as a coating is 5,000 ppm. CPSC established the maximum allowable level of lead in paint as 600 ppm in 1977. The EPA threshold for lead in water is 15 µg/L. The EPA/HUD threshold for lead in floors is 40 µg/ft^2. The EPA Superfund screening value for lead in soil is 400 ppm. These guidelines are no longer sufficiently protective in light of CDC's current BLRV.

RECOMMENDATION 2

The Lead Poisoning Prevention Subcommittee recommends that CDC work with partner agencies and stakeholders to develop a Strategic Plan to implement primary prevention to include reduction of lead hazards in the home (including, but not limited to, lead-based paint, dust, soil, water and take-home exposures) and education to healthcare providers (including, but not limited to, obstetricians and pediatricians).

Rationale for Recommendation 2: This primary prevention recommendation emphasizes the need to reduce BLLs in the population by preventing EBLLs before their occurrence. Primary prevention has obvious benefits. The 2016 Nussbaumer-Streit, *et al.* study included a Cochrane systematic review and found no evidence that household education or dust control (e.g., secondary prevention measures) were effective in reducing BLLs.

RECOMMENDATION 3

The Lead Poisoning Prevention Subcommittee, which is presently a subcommittee to the NCEH/ATSDR BSC, would have the potential for greater impact and visibility if reconstituted at a higher level within HHS. Such a committee would more easily engage representatives across key federal agencies and stakeholders.

Rationale for Recommendation 3: The previous ACCLPP provided guidance to the HHS Secretary and the CDC Director. Coordination among multiple agencies is required to prevent lead poisoning and further reduce BLLs. Dr. Strickland noted that based on Dr. Breysse's OD report on the previous day, NCEH/ATSDR currently is addressing this issue.

RECOMMENDATION 4

Current OSHA standards for lead in general industry and construction provide inadequate protection for the health of workers. The Lead Poisoning Prevention Subcommittee (LPPS) recommends that CDC support the scientific rationale for revision of OSHA lead standards at the federal level. The LPPS recommends that CDC specifically provide comments to OSHA in support of its Advanced Notice of Proposed Rulemaking on occupational lead standards that will be issued in November 2016.

Rationale for Recommendation 4: The LPPS cited the following language: "The lead standards for general industry and construction are based on lead toxicity information that is over 35 years old. OSHA lead standards allow for the return of the employee to former job status at a BLL <40 µg/dL. The U.S. Department of Health and Human Services, Council of State and Territorial

Epidemiologists (CSTE), and California's Medical Management recommend that BLLs among all adults be reduced to <10 µg/dL."

RECOMMENDATION 5

The Lead Poisoning Prevention Subcommittee recommends that CDC develop a standardized template for clinical interpretation of blood lead results for use by clinical laboratories nationwide on their test reports. This interpretative guidance would identify the Reference Value and delineate risk-based intervals that represent escalating priorities for public health and medical intervention. In developing this template, CDC should examine recent guidelines, such as those developed by the Pediatric Environmental Health Specialty Unit program.

Rationale for Recommendation 5: The BLRV is a useful public health indicator and provides an approach to track childhood BLLs. The BLRV is not a medical definition of "lead poisoning," but the value can be used as a benchmark for medical professionals to discuss sources of lead. No level of lead in blood is known to be without deleterious effects. The LPPS reviewed the recommendations on medical management of childhood lead exposure and poisoning developed by the PEHSUs and the American Academy of Pediatrics (AAP). The LPPS did not explicitly recommend this guidance, but the possibility of standardizing and distributing the document to clinical laboratories across the country was discussed. Dr. Jennifer Lowrey, an LPPS member, offered to assist NCEH/ATSDR in implementing this recommendation.

RECOMMENDATION 6

The Lead Poisoning Prevention Subcommittee recommends that CDC communicate to HHS Secretary Sylvia Burwell the need for the Centers for Medicaid & Medicare Services to implement recommendations to tighten guidelines for blood lead proficiency testing criteria to ±2 µg/dL, ±10% under the Clinical Laboratory Improvement Amendments of 1988. In its communications with the HHS Secretary, CDC should note that it has been six years since the former Advisory Committee on Childhood Lead Poisoning Prevention made this recommendation to former HHS Secretary Kathleen Sebelius.

Rationale for Recommendation 6: The LPPS cited the following language from ACCLPP's 2010 letter to the HHS Secretary: "Current CLIA '88 criteria [±4 µg/dL, ±10%] ensure only that laboratories operate within a total error of 8 µg/dL in the 5-10 µg/dL range. That is, a BPb level of 7 µg/dL might be reported as 3 µg/dL by one laboratory and 11 µg/dL by another, and both would be considered acceptable performance under current CLIA '88 criteria."

Drs. Strickland and Breysse thanked the LPPS members for their outstanding efforts in reviewing the literature to develop the recommendations to the BSC.

BSC GUIDANCE: LPPS RECOMMENDATIONS TO THE BSC

- Recommendation 4: NCEH/ATSDR should leverage the expertise of NIOSH in federal efforts that are made to conduct a comprehensive review of and revise the OSHA lead standards.
- Recommendation 5: NCEH/ATSDR should closely collaborate with the PEHSUs and AAP to communicate the potential for a lower BLRV and disseminate updated PEHSU guidance to clinicians.

Dr. Breysse provided NCEH/ATSDR's responses to LPPS's six recommendations to the BSC.

1. NCEH/ATSDR will solicit guidance from the new FACA-chartered Lead Advisory Committee on its ongoing efforts to partner with EPA and HUD in revising their lead standards and guidelines.
2. NCEH/ATSDR has initiated a rigorous strategic evaluation process of its Lead Program.
3. NCEH/ATSDR's efforts to establish a new FACA-chartered Lead Advisory Committee are underway.
4. NCEH/ATSDR will defer to NIOSH to provide comments on OSHA's occupational lead standards.
5. NCEH/ATSDR will closely collaborate with the PEHSUs and AAP to conduct outreach on the lower BLRV. Dr. Lowrey will be engaged in this effort.
6. NCEH/ATSDR will communicate with the new HHS Secretary after the official appointment is announced.

NCEH/ATSDR Program Responses to BSC Guidance and Action Items

William Cibulas, Jr., PhD, MS
Deputy Associate Director for Science, NCEH/ATSDR
BSC Designated Federal Official (DFO)

Dr. Cibulas explained that this agenda item typically is structured with responses by NCEH/ ATSDR OD and individual programs to the BSC's recommendations, guidance, action items and requests for additional information. For the benefit of the new members, however, the program responses would include more detailed updates on high-priority topics.

Dr. Cibulas presented OD's responses to the BSC's requests for new agenda items.

BSC Request	NCEH/ATSDR OD Response
Present an update on the NCEH/ATSDR reorganization and strategic planning process.	Dr. Breysse covered these topics in his OD report to the BSC on the previous day.
Present an overview of LPPS's report and recommendations.	Dr. Strickland presented this overview on days 1 and 2 of the current meeting.
Present an update on NCEH's role in wildfire responses.	EHHE is extensively engaged with a wide variety of federal, local and academic partners and provides subject-matter expertise on the health effects of wildfires, including prescribed burns. Activities related to wildfires cut across EHHE and reflect collaboration throughout NCEH. EHHE's activities integrate applied epidemiology and exposure assessment into all aspects of the disaster management cycle. EHHE addresses information gaps, translates science into practice, and develops Clear Communication materials.
Present a status report on the new Fracking Workgroup.	Dr. Breysse asked the BSC to consider rescinding this recommendation and establishing a new Zika

BSC Request	NCEH/ATSDR OD Response
	Workgroup. An update would be presented to inform the BSC's decision-making on the proposal.

Dr. Cibulas introduced the speakers from the NCEH/ATSDR programs and opened the floor for their updates.

UPDATE ON PFAS

Lynn Wilder, PhD, CIH
ATSDR Division of Toxicology and Human Health Sciences

Dr. Wilder reported that PFAS are persistent; ubiquitous in the environment, wildlife and human populations; and are known to bioaccumulate in individuals. PFAS have long half-lives in humans of approximately 4-9 years. EPA's inclusion of PFAS in its list of "contaminants of emerging concern" requires extensive monitoring of municipal water supplies. In January 2009, EPA issued provisional health advisory values for perfluorooctane sulfonate (PFOS) at 200 ppt and PFOA at 400 ppt. In May 2016, EPA issued Drinking Water Lifetime Health Advisories (LTHAs) of 70 ppt for PFOS and PFOA separately or combined. Preliminary data indicate that 65 of 4,900 water supplies tested exceeded LTHA levels.

The sources of PFAS exposure include diet; consumer and industrial products (e.g., pesticides, aqueous firefighting foam (AFFF), food contact products and stain-resistant coatings); and environment (e.g., contaminated water, air and dust). The major sources of environmental contamination from PFAS in the United States include waste from manufacturing facilities, AFFF, and PFAS-containing sludge from wastewater treatment plants as a soil amendment.

Additional research is needed to determine the health effects from PFAS. Limited animal data show that PFAS are associated with increased liver weight; spleen, thymus and developmental effects; and cancer of the liver, testis and pancreas. Limited human data show that PFAS are associated with potential changes in growth, learning and behavior, decreased fertility, increased cholesterol, immune effects, and cancer of the kidney, bladder, testis and prostate.

Dr. Wilder presented two slides to illustrate the number and locations of municipal water systems that were tested and found to have PFOS/PFOA levels $\geq$70 ppt as well as the sites with ATSDR involvement. NCEH/ATSDR provides TA and other support to federal and state partners. These resources include a webpage on the CDC.gov website, community messaging, literature summaries/technical information, exposure assessments, laboratory expertise/biomonitoring, education to physicians, a PFAS ToxProfile™, and a biomonitoring framework and toolkit.

ATSDR oversees extensive coordination within and outside of CDC with federal, state and academic partners.

- National Toxicology Program (NTP) (PFAS toxicity)
- U.S. Food and Drug Administration (FDA) (PFAS levels in bottled water)
- NIOSH (worker exposures to PFAS)
- DoD (PFAS site assessments)
- EPA (water, children's health and Superfund sites)
- State laboratories (biomonitoring of PFAS)
- State health officials (ASTHO and CSTE)

- PEHSUs and AAP

ATSDR will convene a meeting for multiple federal partners to discuss their ongoing activities and current approaches to address PFAS. This effort will help to ensure that uniform messaging on PFAS is delivered to the public.

Dr. Wilder presented ATSDR's responses to the guidance the BSC provided on its PFAS activities during the June 2016 meeting.

BSC Guidance	ATSDR Response
Proactive outreach and partners	ATSDR has engaged ASTHO, APHA and CSTE in its PFAS activities. ATSDR also will create an algorithm to prioritize communities with recent, current or past contamination from PFAS.
Messaging	ATSDR will implement a statistically-based approach to develop and disseminate a biomonitoring framework and toolkit to state health departments.
Health studies	ATSDR is identifying key issues when selecting "medically actionable" health endpoints from priority data gaps.
Preparation for future issues	ATSDR will target its efforts to small municipal water systems and small-chain PFAS.

UPDATE ON SAFE WATER

Sharunda Buchanan, PhD, MS
Director, NCEH Division of Emergency and Environmental Health Services
Centers for Disease Control and Prevention

Dr. Buchanan reported that NCEH's role is to provide health departments with TA and guidance to identify and address routine water system failures and respond to drinking water emergencies and outbreaks. NCEH also develops and disseminates tools and guidelines to help communities protect their water resources. Moreover, NCEH provides support for creating and launching interventions that prevent water-related hazards or exposures.

NCEH targets its water activities to various types of systems that are not covered by the EPA Safe Drinking Water Act (SDWA), including private wells and small unregulated drinking water systems, water distribution systems, building premise plumbing systems and cooling towers, and recreational water venues. NCEH currently is focusing on several topics and program areas, including private drinking water systems through the Safe WATCH CoAg, *Legionella*, recreational water injuries through the Model Aquatic Health Code (MAHC), emergency response, and other emerging issues.

Dr. Buchanan presented NCEH's responses to the guidance the BSC provided on its safe water activities during the June 2016 meeting.

BSC Guidance	NCEH Response
Water-related areas not addressed by EPA	This recommendation is fully implemented. NCEH is applying its unique skills in addressing other water-related areas not covered by the SDWA. NCEH is collaborating with partners to address ongoing EH issues with

BSC Guidance	NCEH Response
	Legionella growth in poorly maintained building water systems. NCEH is targeting the Safe WATCH CoAg to unregulated drinking water systems. NCEH is serving as the co-lead of the MAHC effort. NCEH is identifying and reducing exposure to and disease from non-infectious waterborne contaminants (e.g., such as groundwater modeling to target interventions).
Private well testing results	This recommendation is partially implemented. NCEH has shared strategies and tools developed by funded partners to communicate risks to specific target populations. NCEH has developed a fact sheet that identifies state-based sources of private well data and describes meta-data. NCEH has informed its state and local Safe WATCH grantees of the expectation to address the 10 Essential Environmental Public Health Services in the context of their safe drinking water programs and increased sampling of private wells and other unregulated sources. NCEH is attempting to harmonize data collection efforts to gather comparable data across grantees that have similar contaminants of concern to better understand the potential extent and health impacts of specific exposures.
Efforts to grow the Safe Water Program	This recommendation is partially implemented. NCEH is making efforts to leverage additional resources. NCEH is addressing ongoing EH issues with *Legionella* growth in poorly maintained building water systems. NCEH is expanding its partnership with the National Tribal Water Center to develop a strategic plan for addressing tribal community issues and concerns related to water. NCEH is developing measures, at the request of the Indian Health Service (IHS), to demonstrate the effectiveness of the water and sanitation infrastructure in American Indian/ Alaska Native populations. NCEH is creating teaching materials and techniques with IHS to promote improved management of tribal safe water programs.
Efforts to document success	This recommendation is partially achieved. NCEH documented key outcomes from previously funded state partners and the accomplishments of CDC staff that address safe water. NCEH will include an evaluation component in its new comprehensive water strategy. NCEH developed an impressive set of tools for its funded state, local, tribal and territorial health departments, including a drinking water advisory toolkit.
Efforts to leverage partnerships with the U.S. Geological Survey (USGS)	This recommendation is partially implemented. NCEH is aware that its Safe WATCH grantees are interested in learning more about the USGS National Water Quality Assessment Program and the use of arsenic and nitrate maps. NCEH is facilitating discussions and collaborating with USGS and the University of Utah to provide TA to grantees on the use of existing water quality datasets and the development of hazard maps.

UPDATE ON CLIMATE AND HEALTH

George Luber, PhD
Chief, NCEH Climate and Health Program
Centers for Disease Control and Prevention

Dr. Luber reported that the NCEH Climate and Health Program was established in 2009 with a mission to focus on domestic adaptation to climate change impacts. The program closely collaborates with state and local health departments to incorporate climate science into their assessments and address climate-sensitive health threats: extreme weather and heat-related illness; cardiovascular, respiratory and mental health outcomes; vector-borne, water-borne and foodborne diseases; and injuries.

The activities of the NCEH Climate and Health Program focus on four major categories. The Climate-Ready States and Cities Initiative funds 18 state and local health departments to implement CDC's "Building Resilience Against Climate Effects" (BRACE) framework. The BRACE framework is an empirical, evidence-based approach for grantees to develop climate and health adaptation plans based on experiences in their individual jurisdictions. The 18 previous grantees were approved for a new five-year funding cycle to implement their adaptation plans at the local level in collaboration with vulnerable communities and high-priority sites.

The Climate-Ready Tribes and Territories Initiative funds three tribes (at awards of $89,000) and three territories (at awards of $50,000). NCEH launched this new initiative in direct response to the BSC's guidance. The BSC noted that the BRACE framework is best suited for large, high-capacity and highly skilled health departments. The BSC emphasized the need for NCEH to develop alternative approaches for smaller health departments with lower capacity. As a result, NCEH is extensively engaging the new tribal and territorial grantees in the development and implementation of a "BRACE-like" framework. ASTHO and the National Indian Health Board are partnering with NCEH on this effort.

Strategic planning and communication activities are designed to improve messaging on the magnitude and scope of complex climate and health problems. The Government Accountability Office's recent audit of climate and health activities recommended stronger communications in this area at all levels of government. NCEH contracted an external consultant to assist in developing a strategic plan and materials to enhance communications with decision-makers, grantees and communities. NCEH also contracted Johns Hopkins University to convene an expert panel with representation by federal, state and local public health agencies, tribal organizations and academia to provide guidance on the future direction of climate and health beyond the BRACE implementation phase.

Technical guidance documents are developed and disseminated to state and local health departments to improve their capacity in implementing climate and health methodologies and techniques and assessing climate-related risks. The technical guidance documents include *Projecting Climate-Related Disease Burden*; *Methods for Projecting Heat-Related Respiratory Health*; CDC/APHA fact sheets; and *Climate Change and Extreme Heat: What You Can Do to Prepare*.

Dr. Luber presented the Climate and Health Program's responses to the guidance the BSC provided during the June 2016 meeting.

BSC Guidance	Climate and Health Program Response
CDC's climate change activities should have a much stronger focus on social impacts.	The program distributed a guidance document on conducting GIS-based vulnerability assessments that consider the key concepts of environmental justice, the disproportionate impacts on certain vulnerable populations, and social/cultural determinants of health. These factors have been particularly prioritized in the Climate-Ready Tribes and Territories Initiative.
CDC should make efforts to integrate its public health surveillance data systems with databases that are not currently available to better address unknowns related to climate change.	The program is identifying relevant, non-public health datasets that can be adapted for and used in a public health framework. The program closely collaborates with the National EPH Tracking Program and the National Oceanic and Atmospheric Administration to collect, tailor and disseminate these datasets to internal CDC partners and the broader public health community.
CDC should broadly disseminate the BRACE technical guidance documents to non-funded state and local health departments.	The program posts all of its technical guidance documents on the CDC.gov website. All health departments with an interest in climate and health, including non-grantees, are invited to join the program's Communities of Practice. Multiple workgroups have been established under this initiative to specifically focus on 11 different topics, including methods, vulnerability assessments and vector-/water-borne diseases.
CDC should ensure that quantitative impact and outcome data from activities and evaluation projects conducted by grantees are collected and shared with non-funded, lower-capacity states with similar morbidity and mortality rates related to climate change.	The program hired a full-time and a part-time evaluator to thoroughly review all data submitted by the climate and health grantees. The program will widely disseminate reports by the end of FY2017 with a comprehensive summary of the grantee data and qualitative analyses of key outcomes from grantee focus groups (e.g., effective approaches, ineffective strategies, and barriers to implementing the BRACE framework).

Update on Zika

RADM Scott Deitchman, MD, MPH
Chief Medical Officer
NCEH/ATSDR Office of the Director

Dr. Deitchman announced that his update would include a proposal for the BSC to establish a new workgroup to address NCEH/ATSDR's role in CDC's vector management and pesticide recommendations. NCEH/ATSDR carefully considered, but took no action on the BSC's previous guidance that focused on mosquito repellants for pregnant women. Most notably, NCEH/ATSDR found that its additional six months of Zika response experience, particularly its lessons learned in Puerto Rico, warrant the BSC's advice on larger, more complex issues.

Zika is a single-stranded RNA virus that is in the same group of flaviviruses as dengue, yellow fever, Japanese encephalitis and West Nile viruses. Zika primarily is transmitted through *Aedes aegypti* and *Aedes albopictus* mosquitoes. However, the *Aedes aegypti* mosquito has been the major vector in outbreaks in the continental United States and Puerto Rico.

Aedes aegypti mosquitoes live in close proximity to people; prefer to bite people, frequently indoors; might feed on multiple people in a single blood meal; lay eggs in obscure locations near small amounts of water; maintain cryptic breeding sites; and are difficult to control due to erratic egg laying behavior. Daytime is their peak feeding time. Moreover, outdoor control might not kill these mosquitoes indoors.

Dr. Deitchman presented a series of maps. The first set of maps showed the approximate geographic distribution of *Aedes aegypti* and *Aedes albopictus* mosquitoes globally and in the United States. The second set of maps illustrated the severe Zika outbreak in Puerto Rico in 2016 based on the total case count by census tract and the incidence of cases per 100,000 people. The third set of maps showed the results of CDC's sensitivity testing. The mosquitoes were found to be highly resistant to the Alpha-cypermethrin pesticide and susceptible to the Naled organophosphate (OP).

Based on CDC's sensitivity test results and the urgency to control Zika transmission in Puerto Rico, aerial spraying with Naled was determined to be the best approach. Naled is an OP pesticide that inhibits acetylcholinesterase. Naled has been an EPA-registered pesticide since 1959 and was approved for use with the following labeling: "When applied according to label instructions, Naled can be used for public health mosquito control programs without posing risks to people." Naled has an extensive history of use for mosquito control and crop pest control. The pesticide is applied through ultra-low volume (ULV) spray for mosquito control.

Naled was delivered to Puerto Rico to be used in the Zika campaign, but Dr. Deitchman presented a series of photographs to illustrate several grassroots demonstrations. Local activists launched massive community protests to voice their adamant opposition to the use of Naled. Based on these events, the governor of Puerto Rico did not authorize aerial spraying with Naled and returned the product.

The public concerns in Puerto Rico focused on environmental effects. Naled is highly toxic to honeybees and other beneficial insects. Naled has acute and long-term aquatic toxicity to fish and invertebrates. Dichlorvos is a breakdown product of Naled that potentially is carcinogenic to humans. Naled is not registered for use in Canada or the European Union because these countries found that the product has an unacceptable environmental risk and insufficient data to make informed environmental decisions.

A growing body of evidence in the literature shows that Naled and other OPs are associated with neurodevelopmental effects after fetal exposure. EPA currently is conducting a comprehensive literature review because Naled is due for a re-registration evaluation in 2017. Dr. Deitchman presented a photograph of a community flyer that was distributed in Miami with the following message: "Zika's cure is worse than the disease!"

Integrated vector management (IVM) involves a holistic and coordinated approach to pest control. A stronger focus on IVM is needed as part of a long-term pest control campaign. IVM includes seven key components.

- Surveillance to document the mosquito population
- Public education on strategies to avoid mosquito exposures and control mosquitoes in the home

- Source reduction to eliminate mosquito breeding sites, reduce conducive conditions, and eliminate containers holding water
- Repellents
- Larvicides to kill larvae before their development into mature adult mosquitoes
- Biological control agents
- Adulticides to inform decision-making on when and when not to spray

Dr. Deitchman explained that the new BSC Zika Workgroup would be required to comply with FACA rules and regulations. BSC members would need to serve as the chair and at least one member, but external experts could be engaged as well. He presented a series of questions for the BSC to consider in NCEH/ATSDR's proposal to establish a new Zika Workgroup.

- What should be NCEH/ATSDR's role during and in preparation for future vector-borne disease emergencies? How can NCEH/ATSDR complement other CDC vector control programs to:
  - Promote the full range of vector management strategies?
  - Identify strategies, during PHEs requiring vector control measures, that are most consistent with public health principles and best suited for the current situation?
  - Effectively communicate vector management messaging to the public?

- Should NCEH/ATSDR lead the development of a guideline for IVM programs in local health departments?

- How can human health risk/benefit analyses be communicated to the public and elected officials?

- During PHEs requiring vector control, how can CDC address human health and ecological toxicity concerns of pesticides under consideration? How can CDC coordinate these efforts with EPA?

Dr. Perry made several comments on NCEH/ATSDR's proposal, but she clarified that her role as the chair should not influence the BSC's decision-making. She was extremely energized and excited about the proposal because NCEH/ATSDR has outstanding toxicological expertise, access to CDC's vector-borne disease programs, and an excellent reputation as the world's leading resource in biomonitoring. NCEH/ATSDR's leadership capacity and resources are well suited to take action on Zika-related issues. Moreover, CDC's vector-borne disease control experts issued a statement in 2016 on the need to reconsider the use of DDT in response to the Zika outbreaks. Dr. Perry's position was that the BSC membership reflects exceptional pesticide expertise to advise NCEH/ATSDR on these issues.

BSC GUIDANCE: NEW ZIKA WORKGROUP

- NCEH/ATSDR should reach out to its federal partners and other resources as a next step in creating a pesticide research agenda.
  - The National Institutes of Health (NIH) aims to enroll up to 10,000 pregnant women in its "Zika in Infants and Pregnancy (ZIP) Study" and has established a workgroup to address pesticide issues.
  - NTP is conducting toxicity testing on several pesticides, including pyriproxyfen.

    - The EPA Office of Research and Development has extensive capabilities to address toxicological issues with high throughput approaches and analyze fetal development with animal toxicological data.
    - The Developmental Neurotoxicology Society is comprised of animal and human researchers who have collected valuable data on pesticides.
- The decision not to authorize aerial spraying with Naled in Puerto Rico is surprising. Naled has been an EPA-registered pesticide since 1959, but the epidemiologic research and human health effects studies on this product are extremely limited. The current literature primarily includes descriptive analyses of the use of ULV aerial spraying in small populations.
- NCEH/ATSDR and its federal partners should increase research on the current Zika population to better control vector-borne diseases in the absence of chemical controls.

Based on the discussion, Dr. Perry's perspective was that the BSC expressed a general sense of support to establish a new Zika Workgroup. She advised the BSC members with an interest and/or expertise in serving on the workgroup to notify her (mperry@gwu.edu) and Dr. Cibulas (wic1@cdc.gov).

Federal Research Action Plan on Recycled Tire Crumb Rubber

Angela Ragin-Wilson, PhD
Chief, Environmental Epidemiology Branch
ATSDR Division of Toxicology and Human Health Sciences

Dr. Ragin-Wilson presented an overview of the Federal Research Action Plan (FRAP) on recycled tire crumb rubber (TCR) that is used on playing fields and playgrounds. The FRAP is a multi-agency effort that ATSDR is conducting in collaboration with EPA and CPSC. ATSDR's role in the FRAP focuses on playgrounds.

Since synthetic turf playing fields were introduced in the 1960s, the number of these fields has grown to more than 13,000 in the United States. Based on current estimates, 1,200-1,300 fields are installed each year at municipal and county parks, schools, universities, professional sports stadiums, and military bases. The benefits of synthetic turf fields over grass fields include low maintenance, water conservation, and the potential to decrease the risk of injuries to athletes.

Synthetic turf fields are installed with bottom gravel and a stone layer for drainage as well as multi-layered backing material. The infill material is composed of rubber granules that often are produced from recycled tires (i.e., TCR). Manufacturing processes generate different types of TCR, including tires from trucks and cars. Chemical compositions also widely vary between different processes and source materials and within rubber granules from the same origin.

ESPN's 2015 broadcast that questioned the safety of synthetic turf fields and exposure to TCR among children who play on these fields garnered national attention from community groups, parents and activists. In response to these concerns, ATSDR, EPA and CPSC released the FRAP in February 2016. The purpose of the FRAP is to study key questions concerning the potential for human exposure resulting from the use of TCR in synthetic turf playing fields and playgrounds. ATSDR has conducted numerous activities to achieve the key objectives of the FRAP.

Objective 1 of the FRAP was to conduct outreach to states and key stakeholders. ATSDR held monthly conference calls with federal, state and local partners to obtain input on state-specific activities. ATSDR also provided regular updates on the FRAP activities and hosted webinars for government partners and the general public. The webinars were well attended with more than 150 participants. ATSDR used an email listserv to distribute study updates to approximately 800 stakeholders. ATSDR participated in tours of tire crumb manufacturing facilities to learn about the tire recycling process to inform the FRAP research.

Objective 2 of the FRAP was to conduct a literature review to identify major knowledge gaps. ATSDR identified (1) 88 relevant references that were grouped into 20 general informational categories and 100 subcategories; (2) more than 350 discrete metals and chemical compounds; and (3) metals and semi-VOCs (SVOCs) as constituents of concern. ATSDR also identified several data gaps, including limited research on human exposure assessments, limited characterizations of dermal and ingestion exposure pathways, limited biomonitoring studies, small sample sizes, and no epidemiological studies.

The literature review showed that existing studies do not demonstrate elevated health risks from playing on synthetic turf fields with TCR infill material. Moreover, current studies have various limitations and do not comprehensively address concerns regarding potential health risks. However, several of the identified data gaps, particularly characterizations of TCR and exposures, are addressed in the FRAP research activities.

Objectives 3 and 4 of the FRAP were to characterize chemical compounds in TCR samples, characterize exposures, and identify exposure pathways to these chemical compounds based on the activities of players on the fields. ATSDR developed a research protocol in collaboration with EPA. The scientific and administrative review and approval processes included internal reviews in all of the partner agencies, an external peer review, and approvals from an Institutional Review Board (IRB) and the Office of Management and Budget (OMB). The “Tire Crumb Characterization Study” and the “Exposure Characterization Study” were the two major products from the research protocol.

Recruitment and sampling goals were established for the Tire Crumb Characterization Study: (1) recruit manufacturing facilities and synthetic turf fields and (2) collect native samples from these facilities and TCR samples from the field. ATSDR recruited and collected native samples from nine manufacturing facilities. These sampling efforts were completed in November 2016. ATSDR also recruited synthetic turf fields from the Midwestern, Northeastern, Southern and Western regions of the country, including 21 community, 19 military, 15 indoor and 25 outdoor fields.

For the community fields, ATSDR implemented a convenience sampling approach. A list was compiled of approximately 350 synthetic turf fields across the United States. The owners of these fields were contacted by telephone. ATSDR did not place restrictions on the age or type of field, but colored and painted fields were excluded from the recruitment process. Due to time and resource constraints, only two fields were recruited per facility. ATSDR administered a questionnaire to collect information on the installation, use and maintenance of the fields.

For the military fields, ATSDR held conference calls with Army MEDCOM to discuss the FRAP and the research protocol. ATSDR also collaborated with Army MEDCOM to identify eligible fields at military installations in the country. The Army trained its personnel to collect samples

from the military fields, but ATSDR maintained oversight of quality assurance/quality control (QA/QC) procedures.

The laboratory component of the Tire Crumb Characterization Study includes several ongoing analyses by EPA and NIOSH: a direct constituent analysis of metals and SVOCs; a dynamic chamber emission analysis of SVOCs and VOCs; a particle characterization analysis, a microbial sample analysis; and a bioaccessibility analysis of metals and SVOCs.

The objective of the bioaccessibility analysis is to conduct *in vitro* bioaccessibility testing of metals and SVOCs in TCR samples with artificial bio-fluids, such as saliva, gastric fluid and sweat. This analysis also is designed to estimate oral and dermal bioavailability based on bioaccessibility testing data. ATSDR's role in the bioaccessibility analysis is to manage and coordinate the project as well as to ensure adherence to the approach, methods and QA/QC procedures outlined in the SOPs and statement of work. NIOSH's role in the bioaccessibility analysis is to extract artificial bio-fluids, perform analytical measurements on the bio-fluid extractions, and oversee the method development and optimization process.

ATSDR and its federal partners completed several major milestones in a short timeline from February-December 2016.

- Released the FRAP
- Completed and submitted the research protocol and QA plan for multi-agency review
- Finalized and submitted the research protocol for external peer review
- Received approval from the CDC IRB
- Received approval from OMB to initiate activities in the field
- Completed sampling of the synthetic turf fields
- Released a status report with a description of ATSDR's FRAP activities

Objective 5 of the FRAP was to identify follow-up activities to provide additional insights on exposures. ATSDR currently is analyzing the TCR samples that have been collected from synthetic turf fields and recycling facilities. NIOSH is conducting the bioaccessibility analysis at this time. An information collection request package for the Exposure Characterization Study is being prepared for submission to OMB. The federal partners expect to release a final FRAP report in 2017.

BSC GUIDANCE: FEDERAL RESEARCH ACTION PLAN ON RECYCLED TCR

- ATSDR should ensure that the FRAP research findings and other results are shared with the PEHSUs. The PEHSUs are on record with their longstanding interest in TCR.
- The current FRAP research protocol does not fill existing data gaps, such as data collection on health risks and epidemiological studies. ATSDR should clearly communicate to stakeholders that the FRAP exposure research conducted to date is only the first step in a much broader, longer-term effort to address TCR.
- ATSDR and its federal partners should compile the FRAP data collected to date to deliver evidence-based messaging directly to anxious parents. Parents primarily are concerned about potential cancer risks to their children who play on synthetic turf fields. Efforts to address TCR on these fields have been underway at the state level for a much longer period of time than at the federal level. As a result, ATSDR should review the fact sheets of "frequently asked questions" that have been developed and are available on the

websites of multiple state and local health departments, including Connecticut, Massachusetts, New Jersey and New York.

- ATSDR's future FRAP research should clearly distinguish between the significant differences of indoor versus outdoor synthetic turf fields, particularly in the context of the impact of climate change on infill material.
- The existing FRAP research protocol only focuses on current exposures to TCR, but ATSDR and its federal partners should design a study in the future to capture human health effects from longitudinal exposures. For example, a large segment of the young adult population that played on synthetic turf fields likely had long-term, ongoing and cumulative exposures to TCR from 5-6 years of age to 18-22 years of age.
- ATSDR administered a questionnaire to collect information on the installation, use and maintenance of community fields. However, data also should be gathered on the degradation of these fields.
- NIOSH is playing a major role in the bioaccessibility analysis for the Tire Crumb Characterization Study. NIOSH also should design and launch an occupational study on the health effects of workers who produce TCR at the manufacturing facilities.

Public Comment Session

Catherine Lufkin
Director of Marketing
Magellan Diagnostics, Inc.

Ms. Lufkin thanked the BSC for providing an opportunity for Magellan Diagnostics to present a public comment on improving childhood lead screening rates with POC testing. She read a written statement into the official record that was submitted to the BSC in advance of the meeting for review. The statement is set forth below with no changes to the content.

> Following yesterday's discussion which evaluated results from LeadCare II, used in CLIA-waived settings by untrained users, and results from highly complex laboratory methods such as GFAAS and ICP-MS, we seek to highlight the unique value that a point of care screening test brings to the public health battle against lead toxicity.
>
> As this committee knows, the risk of lead exposure is nationwide: children in roughly four million households are likely exposed to high levels of lead, out of 24 million homes estimated to have deteriorating lead-based paint and household dust contaminated with lead.[1] Rapid lead testing at the point of care is a key strategy to provide broad-based access to screening in order to identify occult exposure and minimize the permanent neurological damage and adverse, life-long consequences of lead exposure, including IQ deficits, attention-related behavior issues, and lower academic achievement.[2]
>
> Lead toxicity is preventable through primary prevention to remove lead hazards in the environment, and secondary prevention through screening, followed by appropriate medical care and follow-up by providers, parents and public health authorities.
>
> Timely testing is key to mitigating the impact on children who are already exposed and identifying any other children in the home who are also at risk.

> A study in Maryland estimated that eliminating high lead exposure (blood lead level ≥5 µg/dL) for 100 percent of a group of one- and two-year old children would save the state $143 to $556 million, including $7 million to $26 million in tax revenue. This estimate included special education, lifetime earnings and criminal justice system spending, but did not include increased risks for potential long-term direct health care costs for conditions including attention deficit hyperactivity disorder (ADHD), adult hypertension, stroke, and osteoporosis, though these were assumed to be high. This analysis led the state to emphasize universal screening of young children and to take steps to encourage the use of point-of-care testing.[3]

Because lead is ubiquitous in the environment, children of any income level can be exposed, but low-income children are at highest risk of lead toxicity and its long-term harmful effects. Accordingly, federal Medicaid regulations require that children enrolled in the program be tested at 12 and 24 months of age, and testing is expected to be routine as part of preventative care delivered at these well-visits.[4]

However, testing rates fall far short of this requirement. Variation and inconsistencies in data collection among states make exact comparisons challenging, but recent reports suggest that in some states less than half of children in Medicaid are tested.[5] The National Committee on Quality Assurance (NCQA) estimated that in 2014, an average of 66.8 percent of children in Medicaid managed care plans had one or more blood lead tests by their second birthdays, suggesting that there is substantial room for improvement across the country.[6]

> "Sometimes doctors have difficulty reaching parents to tell them that a lead test came back high, says Courtney Lias, director of the Division of Chemistry and Toxicology Devices at the Food and Drug Administration." That access is a real benefit [of this test]," says Lias. "It allows more people to be tested for lead."[7]

When laboratory referrals are made, state-level experience suggests that testing often does not happen. By removing the logistical barriers, fear of a venipuncture, and lost time to families for a separate trip to a lab, rapid testing at the point of care encourages more prevalent and timely testing. It also enables providers to begin follow-up care immediately to limit the harm to children's health; engage families with health education about the impact of lead exposure; and take steps to trigger public health intervention to identify the source of lead.

> "I took my son for his 1 year appointment and he was tested. He didn't even realize he was getting pricked – it was so fast and easy. And now I have peace of mind!" Melissa Malone, Florida Parent

> "We've had LeadCare II for over 2 years. We no longer have to rely on patients actually going to the lab and we have the results within a matter of minutes." Dr. Edward Lewis, MD, Lewis Pediatrics, Rochester NY

> "Quick results. We live in a high-risk area so it is nice having access to results fast. We are able to treat accordingly." Leticia L. Garcia, Harlingen Pediatrics, TX

Wisconsin's experience demonstrates the substantial impact that point-of-care testing can have on the health of low-income children.[8] In 2010, the Wisconsin Department of Health and Family Services worked with Medicaid health plans and WIC clinics to make three-minute blood lead testing available in providers' offices. In the first full year of testing, the number of children screened in the Milwaukee area increased from an average of 47 children in the three years prior to the study, to 4,704 in 2011. During the same period, 118 children with blood lead levels above 10 µg/dL (the reference level at the time) were identified, compared to just 11 children total identified in the three years before the program. This was a dramatic demonstration of the impact of screening – identifying children who would not otherwise have been tested and enabling early intervention to prevent more serious harm from lead poisoning. This effort won the Children's Health Award in 2012 for quality healthcare from the Medicaid Health Plans of America.

If a finger-prick test shows an elevated lead level, a second venous test is performed to confirm the screening results. A point-of-care lead test is even more critical in these situations to begin the education process with the family immediately and to prevent the child's case from falling through the cracks.

> The value of delivering an immediate result was demonstrated in Kent County, Michigan, in a 2004 study by the health department comparing their WIC "no show" rate (patients who did not return for a follow-up appointment following an elevated lead result) between laboratory testing and point-of-care testing. The study revealed that no-shows decreased by 76% after the implementation of point-of-care testing (from 206 with laboratory testing to just 50 with point of care).[9]

Lead Care II was developed as a point-of-care device to increase access to testing, decrease time to treat and identify those most at risk for lead exposure. The cost per test is approximately $7.50, offering a cost-effective tool to improve lead testing rates, as the experience in Wisconsin and other states confirms.

At a time of increased public awareness of the risks of lead exposure, the LeadCare II point of care test can increase screening rates and help ensure appropriate medical follow-up for vulnerable children exposed to lead, preventing substantial harm to children and their future potential.

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[1]Centers for Disease Control and Prevention, "Childhood Lead Poisoning," fact sheet updated April 2013. https://www.cdc.gov/nceh/lead/factsheets/Lead_fact_sheet.pdf

[2]Raymond J., Wheeler W., Brown M.J., "Lead Screening and Prevalence of Blood Lead Levels in Children Aged 1–2 Years — Child Blood Lead Surveillance System, United States, 2002–2010 and National Health and Nutrition Examination Survey, United States, 1999–2010," Centers for Disease Control and Prevention Morbidity and Mortality Weekly Report (MMWR), September 12, 2014: 63(02); 36-42. http://www.cdc.gov/mmwr/preview/mmwrhtml/su6302a6.htm

[3]Maryland Department of Health and Mental Hygiene, "Maryland Targeting Plan for Areas at Risk for Childhood Lead Poisoning," October 2015. http://phpa.dhmh.maryland.gov/IDEHASharedDocuments/MD%202015%20Lead%20Targeting%20Plan.pdf

[4]As of 2012, the Centers for Medicare and Medicaid Services (CMS) aligned its policies with CDC guidelines, which encourage targeted screening in states that can demonstrate that universal screening is not the most effective method of identifying exposure to lead. States can request to include Medicaid-eligible children in a more targeted lead screening plan rather than following the requirement to universally screen all Medicaid-enrolled children at 12 and 24 months (see https://www.medicaid.gov/federal-policy-guidance/downloads/cib-06-22-12.pdf). However, use of this option appears to be very limited so far, and it has faced criticism from advocates including the National Health Law Program (see http://www.healthlaw.org/issues/child-and-adolescent- health/epsdt/reponse-to-the-new-proposed-

policies-for-screening-children-enrolled-in-medicaid-for-elevated- blood-lead-levels#.V7YJp_krLcs) and more recently some members of Congress in light of increased public attention to the risk of lead poisoning nationwide (e.g., https://democrats-energycommerce.house.gov/sites/democrats.energycommerce.house.gov/files/documents/CMS.Slavitt.%20EPSDT%20Lead%20Screening%20Policy%20Letter.2016.06.21.pdf).

[5]Joshua Schneyer and M.B. Pell, "Unsafe at Any Level: Millions of American children missing early lead tests, Reuters finds," Reuters, June 9, 2016.

[6]National Committee for Quality Assurance, *The State of Health Care Quality 2015*, "Lead Screening Rate in Children."
http://www.ncqa.org/report-cards/health-plans/state-of-health-care-quality/2015-table-of- contents/lead-screening

[7]Carolyn Beans, Has My Child Been Exposed To Lead? When And How To Test," NPR, August 4, 2016.

[8]City of Milwaukee Health Department Women, Infant and Children (WIC) Lead Testing Program. Becky Litwaitis, RD, CD, CLC, Nancy Castro, RD, CD, CLC. Presented at: National WIC Conference, Little Rock, Arkansas; 2013.

[9]Data provided by Kent County Michigan Department of Health, 2004. On file at Magellan Diagnostics.

Dr. Dietrich inquired about the date when Magellan expects to release the LeadCare III instrument to measure BLLs as low as 2 µg/dL. Because NCEH/ATSDR affirmed its commitment to recommend a lower BLRV, he emphasized the need for an even higher sensitivity rate. Dr. Friedman requested an update on the level of quantification results for the LeadCare II and III instruments.

Ms. Lufkin explained that after Magellan completes its ongoing internal studies to lower the LOD, the FDA approval process will be initiated for the LeadCare III instrument. Magellan's research and development program is focusing on continuously improving the capability of its existing technologies and enhancing its ability to analyze and assess other technologies. She confirmed that the LOD of the LeadCare instrument is a top priority for Magellan.

Updates by the BSC *Ex-Officio* Members

Ruth Lunn, DrPH, MS
Director, Office of the Report on Carcinogens
National Institute of Environmental Health Sciences

Dr. Lunn reported that NIEHS released the 14th Report on Carcinogens (RoC) in November 2016. Of 248 listings in the RoC, seven were newly reviewed. Trichloroethylene and five viruses were categorized as "known to be a human carcinogen." Cobalt and compounds that release cobalt *in vivo* were categorized as "reasonably anticipated to be a human carcinogen."

NIEHS is conducting several literature-based health hazard assessments. RoC assessments include light at night, shift work and circadian disruption; haloacetic acids found in drinking water; *Helicobacter pylori*; and antimony trioxide. Office of Health Assessment and Translation (OHAT) assessments include fluoride and neurodevelopment; adverse health effects and occupational exposure to cancer chemotherapy agents; and air pollution and children's health.

NIEHS is focusing on PFAS and lead. OHAT conducted a systematic review of immunotoxicity related to PFOA and PFOS during a peer reviewed meeting in July 2016. The review panel concluded that PFOA and PFOS are presumed to be an immune hazard to humans. This finding was based on studies that showed suppression of antibody response in humans and experimental animals. The final document of the systematic review is available on the NIH.gov website. NIEHS is collaborating with multiple federal partners on lead through the President's Task Force. NTP

is considering evaluating evidence for intervention strategies to reduce health effects for children with EBLLs.

NIEHS is implementing a Synthetic Turf/Crumb Rubber Research Program. NIEHS responded to a request to complement an extensive field sampling and personal biomonitoring effort. NIEHS is coordinating activities with CDC, EPA and CPSC in four key areas: (1) chemically and physically characterize crumb rubber; (2) determine the bioaccessibility and bioavailability of chemical components of crumb rubber in simulated biological fluids and from samples from animals following exposure; (3) assess the feasibility of several routes of exposure for *in vivo* and *in vitro* toxicological testing; and (4) conduct short-term controlled exposure assessments for exposure systems that are deemed feasible.

NIEHS is conducting glyphosate research. This herbicide is widely used, but recent health evaluations differ in their outcomes. Genotoxicity studies, mechanistic research and literature mining activities of the parent compound and formulations are underway. NIEHS's goal within the next 6-9 months is to provide additional data that are specific to the potential toxicity of the parent compound versus formulations to inform ongoing worldwide evaluations.

NIEHS and NIH are conducting epidemiology studies to inform its Zika-related research. These studies are focusing on the safety of public health use of pesticides, particularly the use of pyriproxifen for mosquito control. A rabbit teratology study showed that pyriproxifen would not meet current testing guidelines. Existing guideline studies do not evaluate whether the insecticide affects resistance of the host to viral infections. NTP plans to conduct a set of studies to evaluate prenatal development and resistance to viral influenza infection in rats. Based on the results of the ZIP cohort study or systematic literature reviews, NTP also might evaluate other vector control agents or environmental exposures

NIEHS will host several meetings and webinars in 2017 for the U.S. Interagency Coordinating Committee on the Validation of Alternative Methods.

Douglas Trout, MD
Associate Director for Science
Division of Surveillance, Hazard Evaluations and Field Studies
National Institute for Occupational Safety and Health

Dr. Trout reported that NIOSH maintains a pesticide surveillance system in its Sentinel Event Notification System for Occupational Risk Program. An *MMWR* article currently is under review related to aerial spraying of pesticides in Florida from 2001-2016.

The NIOSH Disaster Science Responder Research Team is a new framework that will enable rapid initiation and effective implementation of occupational safety and health research during an emergency response or disaster without inferring with the actual event. The team was established with four strategic goals: (1) identify critical topic areas for responder research; (2) address major challenges associated with conducting research during disasters; (3) identify data collection capabilities and information resources to be utilized for research purposes; and (4) ensure that research findings and lessons learned are translated into practice. NIOSH will closely collaborate with NCEH on this new initiative in the future.

NIOSH is continuing to focus on the occupational health impacts of wild land firefighters. NIOSH has proposed to initiate a large four- to five-year study, beginning in 2018, to address this issue.

Wayne Cascio, MD
Director, Environmental Public Health Division
U.S. Environmental Protection Agency

Dr. Cascio reported that EPA is continuing to focus on the increasing severity and magnitude of wildfires throughout the country. EPA closely collaborated with several local, state and federal partners, including NCEH, the ATSDR PEHSUs and NIOSH, to release a revised draft of *Wildfire Smoke: A Guide for Public Health Officials* in May 2016. The guide will be finalized, based on feedback from states, and released in 2017.

EPA recently hosted its "Wildfire Family Summit" internal workshop for staff to discuss future wildfire research with an emphasis on public health issues. This initiative might provide additional collaborative opportunities between EPA and NCEH/ATSDR.

EPA is increasing its focus on and strengthening its capacity in the important topic of social science. EPA will particularly recruit skill sets and expertise in this area when filling positions in the future.

Dr. Breysse advised NIOSH to include the health history of firefighters (e.g., testicular and kidney cancer) who have used AFFF in its upcoming study. He noted that this research would greatly benefit the existing literature on PFCs. He confirmed that NCEH would contribute its biomonitoring expertise to the NIOSH study to support analyses of the body burden among firefighters.

The BSC also expressed encouragement and strong support for the federal emphasis on the health effects of wildfires by NIOSH and EPA. In addition to the focus on occupational health effects, Dr. Bernstein also suggested the implementation of studies on post-traumatic stress disorder and anxiety disorders in children exposed to wildfires. New research in this area could lead to the development of a comprehensive wildfire response plan that includes appropriate mental health professionals to prevent sequelae from these exposures.

Closing Session and Adjournment

Due to time constraints, Dr. Perry asked the BSC members to email her (mperry@gwu.edu) and Dr. Cibulas (wic1@cdc.gov) to propose topics to place on the next meeting agenda. She planned to follow-up with the BSC members, as private citizens, to write letters and/or participate in ongoing letter writing campaigns to Congressional representatives to call attention to the urgent need to sustain or increase the NCEH/ATSDR EPH budget.

Dr. Breysse thanked the BSC for continuing to contribute its expertise and support to provide NCEH/ATSDR with excellent guidance. Dr. Cibulas thanked Ms. Little, Ms. Malasky and other OD staff for their continued commitment to planning and organizing extremely productive BSC meetings.

The next BSC meeting would be held the week of September 11, 2017. The members would be polled by email to determine the specific date.

With no further discussion or business brought before the BSC, Dr. Perry adjourned the meeting at 11:31 a.m. on January 18, 2017.

I hereby certify that to the best of my knowledge, the foregoing Minutes of the proceedings are accurate and complete.

_____
Date

_____
Melissa Perry, ScD, MHS
Chair, NCEH/ATSDR Board of Scientific Counselors

Attachment 1: Participants' Directory

BSC Members Present
Dr. Melissa Perry, Chair
Dr. Kenneth Aldous
Dr. Aaron ("Ari") Bernstein
Dr. Darryl Brown
Ms. Suzanne Condon
Dr. Deborah Cory-Slechta
Dr. Kim Dietrich
Dr. Roberta Grant
Dr. Sharron LaFollette
Joyce Martin, Esq.
Dr. John Meeker
Dr. Devon Payne-Sturges
Dr. Matthew Strickland
Dr. Phillip Williams
Ms. Nsedu Witherspoon

BSC Member Absent
Mr. Ralph McCullers

BSC *Ex-Officio* Members Present
Dr. Wayne Cascio
U.S. Environmental Protection Agency

Dr. Ruth Lunn
National Institute of Environmental Health Sciences, National Toxicology Program

Dr. Bonnie Richter
U.S. Department of Energy

Dr. Douglas Trout
National Institute for Occupational Safety and Health

LPPS Member in Attendance
Dr. Michael Kosnett

Designated Federal Official
Dr. William Cibulas, Jr.
Deputy Associate Director for Science, NCEH/ATSDR

NCEH/ATSDR Director
Dr. Patrick Breysse

Invited Guests
Dr. Henry Falk
Emory Center for Injury Control

Dr. Warren Friedman
U.S. Department of Housing and Urban Development

CDC/NCEH/ATSDR Representatives
Dr. Ileana Arias
Ms. Kitty Armstrong
Dr. Lina Balluz
Mr. Rob Blake
Ms. Caroline Brunton
Dr. Sharunda Buchanan
Dr. Kathy Caldwell
Dr. Yulia Carroll
Mr. Alex Charleston
Dr. Stella O. Chuke
Ms. Stephanie Davis
Ms. Kristine Day
Dr. Rey de Castro
Dr. John Decker
Dr. Scott Deitchman
Mr. Edward Dieser
Dr. Shirley Ding
Ms. Teresa Durden
Mr. Peter Edwards

Dr. Alisha Etheredge
Dr. Renée Funk
Ms. Cherie Gray
Ms. Olivia Harris
Dr. James Holler
Ms. Diane Jackson
Mr. Jeff Jarrett
Ms. Laurie Johnson
Dr. Robert Jones
Dr. Caitlin Kennedy
Dr. Zheng Li
Ms. Shirley Little
Dr. George Luber
Ms. Amanda Malasky
Dr. Josephine Malilay
Mr. Delano Massey
LCDR Eva McLanahan
Ms. Jackie Mason
Dr. Susan Moore
Dr. Mary Mortensen
Dr. Amy Mowbray
Dr. Moiz Mumtaz
Mr. James Nowicki
Mr. Wellington Onyenwe
Dr. James Pirkle
Dr. Judith Qualters
Dr. Angela Ragin-Wilson
Dr. Helen Rogers
Ms. Lovisa Romanoff
CAPT John Sarisky
Mr. Steve Skowronski
Dr. James Stephens
Dr. Heather Strosnider
Dr. Padmaja Vempaty
Ms. Claudia Vousden
Dr. Kristen Wallon
Ms. Angie Werner
Ms. Pamela Wigington
Dr. Lynn Wilder
Dr. Sharon Williams-Fleetwood
Dr. Fuyuen Yip

Members of the Public

Mr. Perry Gottesfeld
Occupational Knowledge International

Ms. Catherine Lufkin
Magellan Diagnostics, Inc.

Attachment 2: Glossary of Acronyms

Acronym	Definition
AAP	American Academy of Pediatrics
ACCLPP	Advisory Committee on Childhood Lead Poisoning Prevention
AFFF	Aqueous Firefighting Foam
APHA	American Public Health Association
APPLETREE	ATSDR Program to Promote Localized Efforts to Reduce Environmental Exposure
ASTHO	Association of State and Territorial Health Officials
BLLs	Blood Lead Levels
BLRV	Blood Lead Reference Value
BRACE	Building Resilience Against Climate Effects
BSC	Board of Scientific Counselors
CDC	Centers for Disease Control and Prevention
CLIA	Clinical Laboratory Improvement Amendments
CLP; CLPP	Childhood Lead Poisoning; Childhood Lead Poisoning Prevention
CoAg	Cooperative Agreement
CPSC	Consumer Product Safety Commission
CSTE	Council of State and Territorial Epidemiologists
DBSs	Dried Blood Spots
DCIR	Director's Critical Information Requirements
DCS	Damascus Citizens for Sustainability
DFO	Designated Federal Official
DLS	Division of Laboratory Sciences
DoD	U.S. Department of Defense
EBLLs	Elevated Blood Lead Levels
EEHS	Emergency and Environmental Health Services
EH; EPH	Environmental Health; Environmental Public Health
EHHE	Environmental Hazards and Health Effects
EOC	Emergency Operations Center
EPA	U.S. Environmental Protection Agency
EPR	Emergency Preparedness and Response

Acronym	Definition
FACA	Federal Advisory Committee Act
FDA	U.S. Food and Drug Administration
FRAP	Federal Research Action Plan
FY	Fiscal Year
GFAAS	Graphite Furnace Atomic Absorption Spectroscopy
GI	Gastrointestinal
GIS	Geographic Information System
HHS	U.S. Department of Health and Human Services
HUD	U.S. Department of Housing and Urban Development
ICP-MS	Inductively Coupled Plasma Mass Spectrometry
IHS	Indian Health Service
IRB	Institutional Review Board
IVM	Integrated Vector Management
LAMP	Lead and Multi-Element Program
LBP	Lead-Based Paint
LCR	Lead and Copper Rule
LOD	Limit of Detection
LPPS	Lead Poisoning Prevention Subcommittee
LSHR	Lead Safe Housing Rule
LTHAs	Lifetime Health Advisories
MAHC	Model Aquatic Health Code
MCLG	Maximum Contaminant Level Goal
MMWR	*Morbidity and Mortality Weekly Report*
NAAQS	National Ambient Air Quality Standards
NCEH/ATSDR	National Center for Environmental Health/ Agency for Toxic Substances and Disease Registry
NHANES	National Health and Nutrition Examination Survey
NIEHS	National Institute of Environmental Health Sciences
NIH	National Institutes of Health
NIOSH	National Institute for Occupational Safety and Health
NPL	National Priorities List
NTP	National Toxicology Program
NYSDOH	New York State Department of Health
OD	Office of the Director
OEHEM	Office of Environmental Health Emergency Management
OHAT	Office of Health Assessment and Translation
OMB	Office of Management and Budget
OP	Organophosphate
OSHA	Occupational Safety and Health Administration
PAH	Polycyclic Aromatic Hydrocarbon
PEHSUs	Pediatric Environmental Health Specialty Units

Acronym	Definition
PFAS	Per-/Polyfluoroalkyl Substances
PFCs	Perfluorinated Compounds
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane Sulfonate
PHAs	Public Health Assessments
PHEP	Public Health Emergency Preparedness
PHEs	Public Health Emergencies
PM	Particulate Matter
POC	Point-of-Care
PPHF	Prevention and Public Health Fund
PT	Proficiency Testing
QA/QC	Quality Assurance/Quality Control
RoC	Report on Carcinogens
Safe WATCH	Safe Water for Community Health
SDWA	Safe Water Drinking Act
SME	Subject-Matter Expert
SOPs	Standard Operating Procedures
SVOCs	Semi-Volatile Organic Compounds
TA	Technical Assistance
TCEQ	Texas Commission on Environmental Quality
TCR	Tire Crumb Rubber
ULV	Ultra-Low Volume
USGS	U.S. Geological Survey
VOCs	Volatile Organic Compounds
WHO	World Health Organization
WRDA	Water Resources Development Act of 2016
WSLH	Wisconsin State Laboratory of Hygiene
ZIP	Zika in Infants and Pregnancy