Pollen Summit 2016

February 17-18 in Atlanta, GA

Meeting Summary

Summit Overview

The Council of State and Territorial Epidemiologists (CSTE), in collaboration with the Centers for Disease Control and Prevention (CDC), hosted its second Pollen Summit on February 17-18, 2016 in Atlanta, Georgia. The purpose of the summit was to build on the work initiated at the 2015 Pollen Summit and continued by CSTE's Asthma & Allergy Workgroup over the past nine months.

See Appendix A for more information about CSTE

Financial support for the 2016 Pollen Summit was provided by CSTE in collaboration with the Centers for Disease Control and Prevention (CDC). Views expressed by the summit participants or in this summary of the summit discussions do not necessarily represent the positions of CSTE or CDC.

The goals of the 2016 Pollen Summit were to:

- Share the latest research and activities regarding the many faces of pollen, including its interconnectedness among entities with diverse pollen monitoring needs
- Finalize a CSTE position statement in support of a national pollen monitoring network
- Develop an implementation plan for a national pollen monitoring network
- Provide networking opportunities in a relaxed environment

Meeting agenda: the 2016 Summit included seven detailed presentations from experts in the field as well as small group discussions to refine an implementation plan and prioritize activities for the coming year.

See Appendix B for the full meeting agenda

Discussion Summaries

Review of 2015 Activities

A. Priorities from the 2015 Pollen Summit

- Grow the CSTE Asthma & Allergy Workgroup
- Explore internal communications options
- Explore funding options
- Outreach to potential new partners and stakeholders

- Inventory what's already in place
- Advance the CSTE position statement
- Keep working on an implementation plan that responds to key questions:
    - What data could/should be collected?
    - Where could/should data be collected?
    - Who could/should collect data?
    - How could/should the data be collected?
    - How could/should the data be stored?
    - How could/should the data be used?
    - How much will a network cost to set up and maintain; how could it be funded?
    - Who are natural stakeholders and decision-makers – proponents and opponents?
    - What should be communicated about this effort, and to whom?

B. CSTE Asthma & Allergy Workgroup

- **Co-Chairs**
    - Wendy Brunner, Minnesota Department of Health
    - Arie Manangan, CDC Climate and Health Program

- **History and purpose:**
    - The Asthma and Allergy workgroup first began in 2005 as the State Environmental Health Indicators Collaborative (SEHIC) Asthma workgroup with the purpose of developing and pilot-testing chronic respiratory disease-related indicators of population health that are known to be related to environmental conditions. These include asthma hospitalizations, asthma emergency department visits, and chronic lower respiratory disease mortality.
    - More recently, the workgroup has been interested in aeroallergens, such as pollen and mold, and its relationship to respiratory conditions, such as asthma, in the United States. The workgroup developed a set of indicators to track pollen season timing, pollen concentration and pollen type (e.g. oak, birch, maple pollen).

- **Meeting schedule and contact information:**
    - The Asthma and Allergy Workgroup currently meets on the first Tuesday of every month at 3pm ET for hourly conference calls.
    - For more information or to be added to the listserv, please contact Jessica Wurster at jwurster@cste.org.

See Appendix C for a summary of CSTE work products and articles of interest

C. Pollen Monitoring Assessment Project (Lead: Norm Anderson)

- **Background**
    - In January, 2016, the Council of State and Territorial Epidemiologists (CSTE) Asthma and Allergy Workgroup developed and distributed an online assessment among its members to gauge CSTE's current state of knowledge regarding pollen monitoring activities.

- This assessment was sent to the state epidemiologists, the CSTE environmental health subcommittees as well as the principal investigators of the CDC Environmental Public Health Tracking, Climate and Health, and Asthma Control Programs.
- The assessment included questions regarding
  - the timing and operations of the monitoring stations;
  - the inclusion of mold analysis;
  - whether they were certified by the National Allergen Bureau;
  - whether they planned to continue monitoring;
  - how they disseminate their results; and
  - their willingness to share data with a CSTE sanctioned data repository
- While listings of certified pollen monitoring stations are available through the National Allergen Bureau, the CSTE Asthma and Allergy workgroup was interested in identifying pollen monitoring activity even if the station was not certified.
- The workgroup viewed this assessment as the initial step of an ongoing assessment of needs and assets necessary for engaging the public health community on this issue.

- **Summary of results**
  - Overall, CSTE received responses from members in 20 states, as well as Puerto Rico and Canada. Of these responses, 15 documented knowledge of pollen monitoring and 5 reported no knowledge of pollen monitoring.
  - In all, respondents identified 38 monitoring stations over 17 states and Puerto Rico. Detailed information was provided for 21 of these 38 stations. Most of the stations listed are NAB certified.
  - It is encouraging that monitoring stations have been identified in all regions of the U.S.
  - While many of the stations have data going back several years, it was unclear from the assessment responses whether or not the stations would be willing to share the data.
  - Most of the stations indicated that they planned to continue pollen monitoring in the future. Those stations that were uncertain of future activity were mostly non NAB certified stations (e.g., Maine, North Carolina) due to possible cutbacks in funding support.
  - The assessment identified a variety of ways in which pollen stations communicate their results.
  - Some/many public health agencies may not know what pollen counting is being done in their state – this is why outreach to other pollen counters is so important.
  - Follow-up efforts will focus on obtaining information from the 17 sites identified but without any detailed information. Hopefully, subsequent assessments will identify even more stations, especially as the workgroup better identifies the providers of the aeroallergen monitoring data.

- **Recommendations from Pollen Summit participants**
  - The assessment responses should be overlaid onto CDC-funded states (asthma tracking and BRACE/climate grantees) for analysis and further outreach
  - Follow-on calls may help increase/improve the response

See Appendix D for a draft report from the Pollen Monitoring Assessment Project

The Many Faces of Pollen – Briefings from the Field

- **Andrea Nurse, University of Maine Climate Change Institute**
    - TOPIC: National Atmospheric Deposition Program (NADP) Filter Project: *A New Technique for Monitoring Airborne Pollen in Rainwater*
    - LINK TO PRESENTATION: http://c.ymcdn.com/sites/www.cste.org/resource/resmgr/PDFs/Nurse.pdf
    - DISCUSSION
        - Outstanding questions:
            - Scope of next study
            - Funding
            - Utilizing graduate students
            - Pollen fragments with exposure to water – not all pollen has the same "sturdiness" – do we need to allow for this?
            - Can we use EPA particulate matter (PM) filters in the same way? If so, are they in helpful locations?
        - Utilization: this type of research will provide bloom times, not quantification

- **Frances Coates, Aerobiology Canada**
    - TOPIC: *Introduction to Aerobiology Research and the Canadian Network System*
    - LINK TO PRESENTATION: http://c.ymcdn.com/sites/www.cste.org/resource/resmgr/PDFs/Coates.pdf

- **Lewis Ziska, USDA Agricultural Research Service**
    - TOPIC: *Climate change, carbon dioxide and aerobiology*
    - LINK TO PRESENTATION: http://c.ymcdn.com/sites/www.cste.org/resource/resmgr/PDFs/Ziska.pdf

- **Shubhayu Saha, CDC Climate and Health Program**
    - TOPIC: *Climate change, pollen and health*
    - LINK TO PRESENTATION: http://c.ymcdn.com/sites/www.cste.org/resource/resmgr/PDFs/Saha.pdf

- **Theresa Crimmins, National Phenology Network**
    - TOPIC: *USA-NPN and Nature's Notebook: Indeed, many faces!*
    - LINK TO PRESENTATION: http://c.ymcdn.com/sites/www.cste.org/resource/resmgr/PDFs/Crimmins_slides-Pollen_Summi.pdf

- **Landon Bunderson and Nathan Allan, Pollen Sense**
    - TOPIC: *Pollen Sense: Automated Real-Time Particulate Quantification*

Position Statement Finalization (Lead: Meredith Jagger)

A. References

- Arie, Frances, Charlie and Wendy will help with references for "aeroallergen"
- Charlie and Frances will help with references for the health outcomes of mold exposure
- Frances will help with references for how weather (temperature, precipitation, wind, etc) impacts mold

B. Education and talking points for CSTE members

- We could provide background education via webinar prior to the Annual Conference
- Len and Arie will help articulate how pollen.com is not a valid data tool – it is based on sample empirical data rather that is not statistically validated

C. Agencies for response, by section

- Inventory: CSTE, AAAAI
- Network: CDC, EPA
- Repository: CDC, NOAA
- Utilization/Data-Sharing: CDC, EPA, NOAA, CSTE
- Alert System: CDC, EPA, NOAA
- Outreach: CDC, CSTE, AAAAI, National Phenology

D. General points

- We are making the assumption that an alert system would reduce morbidity but we don't necessarily know that yet – we need more evidence and research strategies
- A pollen monitoring network could be a diagnostic aid for health providers

See Appendix E for the final Position Statement

Designing the framework of a pollen monitoring network: collect, store, share

A. Collecting

- **Big picture: what do we want to build?** (*participant survey results in italics*)
  - Add existing vs. Create new
    - (*Survey=45%/55%, n=17)*
  - Diffused (national/international) vs. Focused (e.g. regional/pilot project)
    - (*Survey=45%/55%, n=18)*
  - Build on today's system vs. Build system looking to future technology and functionality
    - *(Survey=30%/70%, n=21)*

- **Purpose**
  - Consumer needs
  - Research needs

- **Size and location**
    - What is the minimum and ideal size of a network?
    - Where do we need to add sites/capacity in order to fill out the network?

- **Ideal network needs to include:**
    - Public availability
    - Speciation
    - Spatial variability (should consider both population and area)
    - Pollen grain composition (changing temperatures and CO2 levels)

- **Models**
    - National Air Bureau model
        - Is this model scalable and does it provide functionality?
        - It's expensive and not particularly forward-looking
        - It may be the best data but can we use/value other data as well?
        - What would be the added value of new NAB sites?
        - Cost: $20,000 plus .25 FTE
    - Data Hub (Aerobiology Canada model)
        - Cost: 1 FTE for every 10 collectors
        - Close to real-time data
    - Pollen Sense
        - Collects and images pollen and other particulates
        - Real-time data
        - Cost: Equipment and maintenance; otherwise fully automated
    - Citizen Scientists – how can we knit in this cohort? Google?

- **Quality of data:** Can we overlay quality control onto data that would allow us to federate without merging?

- **Data sources**
    - Existing sources
        - National Air Bureau (NAB) sites (approximately 85 sites)
        - Len Bielory's National Pollen Database (adds approximately 70 sites)
        - Norm Anderson's assessment contacts
        - Pollen Sense sites
    - New sources
        - Equip allergists to collect data (this is the foundation of Pollen Sense)
        - Co-locate Pollen Sense sites with all NAB sites, than add other Pollen Sense sites
        - Mobile collection (Andy Johnson has more detail)
        - Interpolation modeling in between NAB sites (Norm Anderson has more detail)
        - Add new stations that feed data into a hub model

- Criteria for adding new sources
  - Location criteria
    - Persons per monitor
    - Area per monitor
    - By climate zone
    - By geophysical zone
    - By air quality zone
    - Something else?
  - Other criteria/considerations
    - Collecting/counting function
    - Speciation
    - MOU/contract
    - Cost
    - QA/QC (quality assurance/quality control)
    - Frequency

- **Making the case for why to contribute data**
  - Perform data analysis for sources
  - Forecasting (e.g. allergists)
  - Information/education packaged for specific groups (e.g. hospitals, schools)
  - Data to support mission or return on investment (e.g. insurance companies lower exposure and increase worker productivity)

Next Steps for Collecting

- ✓ Merge and map the lists we have
- ✓ Build case and legitimacy
- ✓ Identify incentives for each unique group (e.g. schools, clinicians, home weather buffs)
- ✓ Design solid MOU for how data is used, credited, and/or exchanged
- ✓ Cost analysis: is it better to bring in existing or create new
- ✓ Finalize criteria for adding new sites
- ✓ Explore pilot site
  - Operational model for health and research folks
  - Show value
- ✓ Build relationships
- ✓ Identify who we can each talk to
- ✓ Integrate collection of spores in model (we shouldn't be ignoring them)

B. Storing

- Models
    - Environmental Public Health Tracking Network (CDC)
    - National Center for Environmental Information (NCEI) – could be more structured/archival but there are new ways to add/share
    - (Application Programming Interface (API) – pulling data from multiple sources (syndromic surveillance)
    - Cloud/Network – federated database
    - Private model
    - Academic partner
    - Non-profit (NADP model)/consortium – subscription service
- **Other considerations**
    - Citation crediting
    - How will we access and what are the agreements/MOUs
    - Harmonization of data is important to consider as soon as possible

Next Steps for Storing

- ✓ Asthma & Allergy Workgroup
    - Ongoing discussions plus specific calls with other partners to assess and decide
    - Jessica (CSTE) will solicit new members to join Workgroup
- ✓ June: position statement voted on – this is where the vision resides
- ✓ July: Norm Anderson's white paper analysis completed
- ✓ End of 2016: Working model developed

C. Sharing

- Considerations
    - We need to put our information into context
    - How can we integrate aero-allergen information with other alerts (e.g. heat)
    - NAB
        - Is this a function NAB would take on?
        - Is NAB a credible messenger?
        - NAB has liability concerns
        - NAB doesn't do forecasting
        - NAB could be a baseline reference – a higher level of standardization and quality control would be helpful

Next Steps for Sharing

- ✓ MOUs developed within 5 years

Small Group #1: Design Specifications, Research & Analysis

A. What we have

- NAB data
- Len Bielory's data
- Norm Anderson's data
- Phenology Network
- Public capacity

B. What we need (gaps)

- Population layer
- Weather layer
- Climate layer
- Eco-regions
- Other monitoring stations – pollen and non-pollen

C. What we are building

- Network by type of data and collection device/source

See Appendix F for the draft model developed in small group #1

Strategies Recommended by Group #1

- ✓ Build webpage to support network building (CDC hosts?)
- ✓ GIS analysis/value-added of existing "pollen normal" by calendar and by region
- ✓ QA/QC
    - Pollen Sense could run all machine imaging sources to validate
    - Quantify collection techniques
    - Delineate data by source and collection device
        - Could add validation of collectors
        - Could we add an opt-in without ranking (don't want to offend partners)?
    - Short-term: source field with consumer choice (descriptions of quality control for each data source are provided)
    - Long-term: QA/QC quantification/ranking system
    - Phases
        - Phase I: Collect and source
        - Phase II: Normalize
        - Phase III: Alerts, forecasting
- ✓ How do we make data fields consistent? Do we "normalize"? (group agreed: "not for now")
- ✓ We'll need help – people and funds – to bring in new sites and process paper data (CDC might be able to support some of this)
- ✓ Bringing in existing data
    - NAB not likely to provide data but individual sites could join
    - OR, we need to add value for NAB
    - Ohio State Mesonet model – ingest all data and use algorithm to standardize
- ✓ CDC would have Information Technology (IT) capacity
- ✓ Repository/Tracking Hub – where could this live?
    - CDC – yes
    - Pollen Sense – no
    - Consortium – yes
    - University – probably
- ✓ Federated data system could be built
    - Build website
    - Buy database
    - Piggy back onto existing

Small Group #2: Structure & Systems, Partnerships & Collaborations, Funding

A. Partners

- Framework
  - Tier One: planners and deciders
  - Tier Two: Regularly engaged
  - Tier Three: Interested parties
- What we have
  - Asthma & Allergy Workgroup
  - Contracts
  - CSTE - funding
  - CDC staff, intern and funding
- What we need (gaps)
  - Non-profits (AAAAI, etc)
  - Industry/tech

B. Repository

- Model Options
  - NAB
  - CDC tracking
  - Subscription-based
  - Learn from existing efforts (NADP)
  - National vs. regional
- Future Funding
  - Multiple agencies in a workgroup
  - Grant proposals for federal funding

Year One Strategies Recommended by Group #2

- ✓ Expand Asthma & Allergy workgroup
- ✓ Subset(s) of workgroup explore repository options
- ✓ Develop white paper
- ✓ Collaboration with CDC
- ✓ Document collaboration
- ✓ Contact federal climate and health groups
- ✓ Create subgroup focusing on mold
- ✓ Continue developing metadata on existing sites (could an intern do this?)
- ✓ Specific small group call on metadata and research

Year Two Strategies Recommended by Group #2

- ✓ Getting, cleaning, storing data
- ✓ Pollen indicator review – how are we using the system?
- ✓ Federal research agenda
  - Regional/local – tie in to leverage funding
  - Climate and health could include pollen
- ✓ MOUs for existing data and targets
- ✓ Start monitoring, planning metrics and evaluation process
  - Plan health and clinical evaluation
- ✓ Funding (universities?)
- ✓ Partner engagement, research
- ✓ Publications, e.g. American Journal of Public Health
- ✓ New technology options – assess
- ✓ How do we want data to be used? Is that our role/desire or do we just put it out there and let others take action?

Finalizing the Plan: Ongoing Systems and Structure for Continuing our Work

A. Lead Entity

- Asthma & Allergy Workgroup will continue to convene group to plan pollen monitoring network
- Jessica (CSTE) will invite all Summit attendees to join Asthma & Allergy Workgroup

B. Internal Communications

- Email alerts to list-serve (CSTE)
- Google Group (or similar) to share documents (CSTE)

C. Topics for further discussion and planning

- Design specifications: collect, store, share
  - Network
  - Repository
  - Utilization/Data-Sharing System
  - Alert System
- Research & Analysis (what do we have/need?)
- Outreach: partnerships and collaborations
- Funding

- Communications and messaging
- Education and promotion (clinicians, families, communities)
- Decision-maker education

Timeframe for implementation of a national pollen monitoring network

- **Phase One: 2016 – 2017**
  - Inventory complete
  - Network model developed
  - Repository: model developed and data harmonized
  - Outreach plan developed and implementation begins
- **Phase Two: 2018 – 2022**
  - Network model implemented
  - Repository model implemented
  - Data-sharing model developed
  - Alert system model developed
  - Outreach ongoing
- **Phase Three: 2023 – 2027**
  - Data-sharing MOUs developed and model tested
  - Alert system model tested
  - Outreach ongoing
- **Full Implementation: 2035**

APPENDICES

APPENDIX A: About CSTE

CSTE is an organization of member states and territories representing public health epidemiologists. CSTE works to establish more effective relationships among state and other health agencies across a wide range of public health disciplines. For more information about CSTE, please visit www.cste.org. For questions about the Pollen Summit or CSTE's Asthma & Allergy Workgroup, please contact Jessica Wurster at jwurster@cste.org.

APPENDIX B: Summit Agenda

Wednesday, February 17, 2016

8:30 Meet at CDC Roybal Campus to go through security - Bring ID!

9:00 – 9:15 Welcome

- Judy Qualters, CDC Division of Environmental Hazards and Health Effects
- George Luber, CDC Climate and Health Program
- Wendy Brunner, Arie Manangan, Jessica Wurster, CSTE Asthma & Allergy Workgroup

9:15 – 9:45 Introductions

9:45 – 10:00 Setting the Stage

- Review meeting objectives and agenda
- Review pollen-related activities of Asthma Work Group
- Review of 2015 Pollen Summit Recommendations

10:00 – 10:45 The Many Faces of Pollen 2.0 – What's Happening in the Field

- Andrea Nurse, University of Maine Climate Change Institute
- Frances Coates, Aerobiology Canada
- Lewis Ziska, USDA Agricultural Research Service

10:45 – 11:00 Break

11:00 – 11:45 The Many Faces of Pollen 2.0 (continued)

- Shubhayu Saha, CDC Climate and Health Program
- Theresa Crimmins and Jake Weltzin, National Phenology Network

11:45 – 12:15 Discussion

12:15 – 1:30 Lunch (on your own – many options available across the street at Emory Point)

1:45 – 3:00 Position Statement

- Review current draft
- Revise as needed
- Next Steps

3:00 – 3:15 Implementation Plan Framework

- Review and discuss draft framework template

3:15 – 3:30 Break

3:30 – 4:30 Pollen Assessment (Norm Anderson)

- Review goals and objectives
- Review and discuss status and initial results

4:30 – 4:45 Review and Update Stakeholder/Collaboration Map

4:45 – 5:00 Review plan for Day Two (including small group self-selection)

5:00 Adjourn

Thursday, February 18, 2016

8:30 Meet at CDC Roybal Campus to go through security – bring ID!

8:45 – 9:15 Implementation Planning: Pollen Monitoring Network

- Review 2015 topline agreements for what, how, when
- Review process for discussing and capturing small group plans

9:15 – 10:30 Small Group Implementation Planning

- Group One:
  - Design Specifications
  - Research & Analysis (what do we have/need)
- Group Two:
  - Structure & Systems (decision-making, info-sharing, admin)
  - Partnerships and Collaborations
  - Funding
- Group Three:
  - Education & Promotion (clinicians, families, communities)
  - Decision-maker Education

10:30 – 10:45 Break (option: groups can break for 15 minutes when most convenient to discussion)

10:45 – 12:00 Small Group Implementation Planning (continued)

12:00 – 12:45 Working Lunch

- Landon Bunderson, Pollen Sense

12:45 – 1:30 Next Steps

- Implementation Planning: identifying group leads, who will knit sections together, how will full group be able to review, overall timeline to finish planning and kick-off implementation
- Position Statement: identifying agencies

1:30 Adjourn

APPENDIX C: CSTE Asthma & Allergy Workgroup Work Products and Articles of Interest

Work Products

- Pollen White Paper: Does Available Scientific Evidence Support the Inclusion of Pollen as a Nationally Consistent Data and Measure Indicator on the Environmental Public Health Tracking Network?
- Webinar: Pollen Seasonality – A Methodology to Assess the Timing of Pollen Seasons Throughout the US (recording is available in the CSTE Webinar Library)
- Poster Presentation: Analysis of 2009 Pollen Readings in Atlanta, GA, Baltimore, MD and Madison, WI
- Poster Presentation: Evaluation of American and European Pollen Data Sources to Identify Essential Attributes of a New National Pollen Surveillance System in the United States

Articles of Interest

- United States Global Change Research Program Climate & Health Assessment
- The Relation of Stroke Admissions to Recent Weather, Airborne Allergens, Air Pollution, Seasons, Upper Respiratory Infections, and Asthma Incidence, September 11, 2001 and Day of the Week
- Pollen Overload Seasonal Allergies in a Changing Climate
- The National Allergy Bureau: Pollen and spore reporting today

- The Associations between Daily Spring Pollen Counts, Over-the-Counter Allergy Medication Sales, and Asthma Syndrome Emergency Department Visits in New York City, 2002-2012

APPENDIX D: DRAFT Summary of CSTE 2016 Pollen Monitoring Assessment

Background

In January, 2016, the Council of State and Territorial Epidemiologists (CSTE) Asthma and Allergy Workgroup developed and distributed an online assessment among its members to gauge CSTE's current state of knowledge regarding pollen monitoring activities. This assessment was sent to the state epidemiologists, the CSTE environmental health subcommittees as well as the principal investigators of the CDC Environmental Public Health Tracking, Climate and Health, and Asthma Control Programs.

The assessment included questions regarding;

- the timing and operations of the monitoring stations;
- the inclusion of mold analysis;
- whether they were certified by the National Allergen Bureau;
- whether they planned to continue monitoring;
- how they disseminate their results; and
- their willingness to share data with a CSTE sanctioned data repository

The workgroup realized at the outset that most CSTE members are not directly involved with pollen monitoring. While listings of certified pollen monitoring stations are available through the National Allergen Bureau, the CSTE Asthma and Allergy workgroup was interested in identifying pollen monitoring activity even if the station was not certified. The workgroup viewed this assessment, therefore, as the initial step of an ongoing assessment of needs and assets necessary for engaging the public health community on this issue. Further, this assessment will be combined with the outreach efforts being implemented by Dr. Leonard Bielory at Rutgers University. (See Appendix A for a copy of the survey instrument.)

Summary of Results

Overall, CSTE received responses from members in 20 states, as well as Puerto Rico and Canada. Of these responses, 15 documented knowledge of pollen monitoring and 5 reported no knowledge of pollen monitoring.

Further, as the timing and intensity of pollen seasons varies with climate, CSTE recognizes the importance of considering both political and geographical boundaries in understanding the distribution of these responses. Climatologically, there are various ways to characterize regional boundaries – climate zones, plant hardiness zones, biophysical zones. Ultimately, the categorization such as the one below combines a bioregional perspective within defined state boundaries.

The breakdown of responses according to this regional schema is described below. (Note: states marked in red are those states in which no pollen monitoring stations were identified.)

Northeast	Southeast	Midwest	Southwest	West
Maine	Kentucky	Minnesota	New Mexico	Nevada
Rhode Island	Alabama	Missouri		Oregon
Maryland	North Carolina	South Dakota		Idaho
Pennsylvania	South Carolina			Alaska
New Jersey	Virginia			
Vermont	Tennessee			

In all, respondents identified 38 monitoring stations over 17 states and Puerto Rico. Detailed information was provided for 21 of these 38 stations.

Region	Number of States	Number of Stations with Detailed Information
Northeast	4	7
Southeast	3	6
Midwest	2	2
Southwest	1	3
West	1	2
Puerto Rico	1	1
TOTAL	12	21

A summary of the state specific findings is presented below. (See Appendix B for the raw notes on all 38 stations identified.) As seen in the table, most of the stations listed are NAB certified. The Asthma and Allergy workgroup knows, however, from separate outreach conducted by Dr. Bielory, that many non certified stations also exist. Further, while many of the stations have data going back several years, it was unclear from the assessment responses whether or not the stations would be willing to share the data. Also, while not shown in the table, most of the stations indicated that they planned to continue pollen monitoring in the future. Those stations that were uncertain of future activity were mostly non NAB certified stations (e.g., Maine, North Carolina) due to possible cutbacks in funding support.

Station	Year Started	Pollen Season	Speciation	Willing to Share Data
Fairbanks, AK **	2000	4/15 through 8/15	None	Yes
Anchorage, AK *	2013	5/1 through 9/30	Yes	Yes
Santa Fe, NM	2011	3/1 through 10/31	Yes	Yes
Las Cruces, NM	2000	All Year	Predominant	No
Albuquerque, NM *	Early 1980s	3/1 through 11/1	Predominant	Yes
Berkeley, MO	Pre-1989	All Year	Yes	Yes
Minneapolis, MN	1993	March to the first frost	Predominant	Yes
Bangor, ME *	1980s?	4/1 through 10/31	Predominant	Yes
Presque Isle, ME*	2005?	4/15 through 10/31	Yes	Yes
Pittsburgh, PA	2003	3/1 through 11/15	Yes	Yes
Erie, PA	1989	4/1 to variable end date	Yes	Don't know
Philadelphia, PA	1994	3/14 to 10/28	Predominant	Don't know
Springfield, NJ	?	Mid March to early-mid November	?	Don't know
Owings Mills, MD	1996	3/1 through 10/31	Yes	Don't know
Lexington, KY	1991	3/1 through 10/31	Yes	Don't know
Lexington, KY	2012	2/20 through 11/1	Yes	Don't know
Florence, KY	2014	2/1 through 11/15	Yes	Don't know
Raleigh, NC*	1999	variable	Predominant	Yes
Charleston, SC	1991	unknown	Yes	Don't know
Greenville, SC	Prior to 1997	variable	Yes	Yes
San Juan, PR	2005	All Year	Yes	Don't know

*Not NAB certified

** Seeking NAB certification

Finally, the assessment sought to identify ways in which the pollen stations communicate their results. These include a variety of mechanisms.

- Raw data upon request
- Local television, radio
- Social media (facebook, twitter)
- Email
- Websites
- National Allergen Bureau
- The Weather Channel/Accuweather
- Phone messages
- List serve
- University Public Relations

These dissemination mechanisms will be further discussed in the subsequent white paper. This white paper will put forward recommendations for the establishment of a national aeroallergen monitoring network.

Concluding Remarks

This pollen assessment is part of the CSTE effort to lay the foundation for a national aeroallergen monitoring network. Along with this assessment and a companion assessment by Dr. Bielory, CSTE has developed a draft position statement on the need for an aeroallergen monitoring network for consideration at the 2016 CSTE Annual Conference and will be developing a white paper.

There are several findings from this assessment that warrant further follow-up. As noted above, CSTE obtained information from only a small percentage of pollen monitoring stations. Initial follow-up will focus on obtaining

information from the 17 sites identified but without any detailed information. It is our hope that subsequent assessments will identify even more stations, especially as the workgroup better identifies the providers of the aeroallergen monitoring data. It is nonetheless encouraging, however, that at least some monitoring stations have been identified in all regions of the United States. Outreach efforts will likely become easier as the need and benefit of a data repository become more generally recognized among the aeroallergen monitoring community. Finally, through the white paper, the workgroup will clarify the need for the monitoring network, as well as the assurances that can be given to the data providers to motivate sharing of information through a proposed data repository.

APPENDIX E: FINAL CSTE Position Statement

Submission Date: March 22, 2016

Committee: Environmental Health

Title: Developing a National Aeroallergen Tracking Network

I. Statement of the Problem:

The prevalence of allergic rhinitis, also known as hay fever, in the U.S. population has increased from 10% to 30% from 1970 to 2000, and this condition affects approximately 40% of children (Meng et al., 2016; O'Connell, 2004; Oswalt & Marshall, 2008). Further, approximately 25 million people in the United States currently have asthma, and the numbers are expected to grow (Akinbami, Moorman, Liu, & National Center for Health Statistics, 2011; Bahadori et al., 2009; Masol et al., 2004). Outdoor aeroallergens such as pollen and mold exacerbate health conditions including asthma, allergic rhinitis, chronic obstruction pulmonary disease (COPD), and conjunctivitis (Bush et al., 2006; Knutsen et al., 2012; National Asthma Education and Prevention Program, 2007; Wallace & Dykewicz, 2008). In recent decades, cutaneous sensitivities to various aeroallergens have increased (Meng et al., 2016). While not having a significant effect on mortality, aeroallergens have large effects on morbidity, well-being, school attendance, work productivity, and are associated with increasing health care costs (Bahadori et al., 2009; O'Connell, 2004).

The burden of allergic respiratory disease has been increasing, in part, due to increasing exposure to aeroallergens as plants respond to warmer temperatures and higher atmospheric carbon dioxide concentrations (Lang-Yona et al., 2013; Levetin & Van de Water, 2008; Shea et al., 2008; Takaro, Knowlton, & Balmes, 2013; Wolf et al., 2010; Ziska et al., 2003; Ziska et al., 2011). Increased carbon dioxide can elevate pollen production in plants such as ragweed, and increase the spore abundance and allergenic activity of mold (Lang-Yona et al., 2013; Wolf et al., 2010; Ziska et al., 2003). Warmer annual average air temperatures can contribute to a shift in the timing and extend the duration of pollen seasons (Luber et al., 2014; Ziska et al., 2011). The adverse effects of aeroallergens on human health may be exacerbated as the intensity, frequency, and duration of air pollution episodes increase with a steadily warming climate (Cecchi et al., 2010; Takaro, Knowlton, & Balmes, 2013).

Despite the large and increasing percentage of the U.S. population with allergic respiratory disease, reliable and geographically-specific pollen and mold measurement data are often unavailable to patients, public health practitioners, health care providers, or researchers. At present, aeroallergen monitoring (i.e., regular, validated observation) is geographically and temporally limited and dependent on individual collectors who are often self-funded and do not report data to a centralized network. Therefore, specific questions related to tracking aeroallergens need to be addressed, such as optimal spatial (e.g., spacing of stations) and temporal (e.g., frequency of pollen collection) resolution, level of speciation required, and the most appropriate sampling and analysis equipment to use. Models have been developed to fill in gaps in the observed data and forecast the potential impact of climate change on aeroallergens (Zhang, 2013; Zhang, 2015); however, details regarding models and their validation are generally lacking. There is potential to develop more accurate models using alternative indicators for tracking aeroallergens and exposure based on satellite imagery, temperature and precipitation data, phenology tracking, and health data (e.g., over-the-counter

antihistamine purchases and insurance claims). However, these indicators need to be validated, a task that requires robust aeroallergen data.

There is a need for a coordinated, cross-disciplinary effort to collect, catalogue, and analyze pollen and mold data to allow for improved diagnosis and treatment of patients with allergic respiratory diseases, public health tracking, research on the effects of climate on aeroallergens and health, development of evidence-based interventions, and dissemination of key findings.

II. Statement of the desired action(s) to be taken:

CSTE recognizes that exposure to aeroallergens has significant public health implications and that human exposure is changing in response to our changing climate. A coordinated, **national aeroallergen tracking network**, which incorporates both new and existing stations identified through an **inventory**, and an accessible **data repository** should be a public health priority at the national, state, territorial, tribal, and local levels. **Applications of the data** collected may include public health tracking, clinical diagnostics and treatment, academic research, and near-term forecasting. In addition, there is a need to develop **evidence-based interventions and guidance** to reduce the burden of allergic respiratory disease and to conduct related **outreach** activities.

To this end, CSTE recommends that:

1) CSTE, American Academy of Allergy, Asthma & Immunology (AAAAI), American College of Allergy, Asthma & Immunology (ACAAI), and other partners should support the ongoing effort to conduct an **inventory** of existing aeroallergen monitors, which includes identifying and engaging potential partners and locating existing stations.

2) Centers for Disease Control and Prevention (CDC), National Institute of Environmental Health Sciences (NIEHS), United States Environmental Protection Agency (EPA), current data collectors, and other partners should support the development of a **national aeroallergen tracking network**. This network should be open to any counting station meeting minimum quality requirements developed collaboratively by participating partners. Direct support and outreach is necessary for existing stations, which should be the foundation of a comprehensive and sustainable aeroallergen tracking strategy. This strategy may also require the initiation of new, strategically-located stations.

3) CDC, National Oceanic and Atmospheric Administration (NOAA), and other partners should support the development and maintenance of a **data repository** to house data collected by the national aeroallergen tracking network and which incorporates auxiliary exposure data, such as meteorological and climatological metrics. Development of IT infrastructure should be flexible enough to accommodate existing and emerging data collection methods and include collection of metadata and an online portal. The repository should be secure but easily accessible to partners in national, state, territorial, tribal, and local public health and environmental agencies. Access may also be granted to academic, health care, and pharmacological users meeting predefined criteria.

4) CDC, EPA, NIEHS, NOAA, CSTE, and other partners should support the **application of data** collected by the network and stored in the data repository. Public health partners should be encouraged to focus on environmental tracking, including the development of pollen and mold indicators that are flexible enough to incorporate local health outcome data. Indicator development should also include the development of guidance on using data appropriate in a public health context. Health care providers should have access to aeroallergen data to support the diagnosis and treatment of patients with allergic respiratory disease. Academic partners should be encouraged to use aeroallergen data for research, including, but not limited to, analysis of thresholds at which counts may be harmful to human health and development of near-term forecasts.

5) CDC, EPA, NIEHS, NOAA, and other partners should develop **evidence-based interventions and guidance** to reduce the burden of allergic respiratory disease. The value of hazard communications, including an aeroallergen alert system, should be evaluated. If developed, alerts should be location-specific and based on predefined threshold criteria. Other

interventions may be related to building and urban design. Information should be disseminated to public health and environmental agencies, health care providers, and concerned members of the public.

6) CDC, CSTE, AAAAI, ACAAI, National Phenology Network, and other partners should foster **outreach** activities, including engaging citizen scientists in data collection and developing educational resources about aeroallergens and health outcomes for various audiences. Data should be disseminated in multiple forms, including data visualizations that make it accessible and understandable to the general public.

III. Public Health Impact:

The data collected by a national aeroallergen tracking network will be used for tracking and forecasting. There is a need for the development of better indicators, more accurate predictive models which can be used both to provide modeled data where no monitors exist, and additional research into the health impacts of pollen and mold. Aeroallergens are considered leading indicators of climate change, and the development of this network will allow researchers to better predict future changes in pollen and mold counts and seasons associated with warming temperatures and increasing atmospheric carbon dioxide levels.

A national network will positively benefit those who suffer from allergic disease. More comprehensive data will provide both patients and health care providers with more accurate and timely information about the onset and duration of pollen and mold seasons. Providers can use information about current pollen and mold conditions for diagnostic purposes and use forecasts for treatment plans. Informed and educated patients can take a more active role in their care. Further, the development of an alert system, analogous to the EPA's Air Quality Index, could expand the reach of hazard communications regarding high aeroallergen levels to public health and environmental agencies and the public.

Finally, a national network will improve the efficacy of public health actions to reduce the burden of allergic disease. Data can be used to inform interventions, such as the timing of aeroallergen early warning messaging, the design and operation of building filtration systems, and planting less allergenic tree species in urban areas. It will complement and inform public health systems and programs concerned with air quality, asthma, and COPD. Overall, both individual and population-level health benefits will be derived as public health practitioners, health care providers, patients, and researchers have access to a robust national aeroallergen tracking network.

IV. Revision History

V. References

Akinbami, L. J., Moorman, J. E., Liu, X., & National Center for Health Statistics (U.S.). (2011). *Asthma prevalence, health care use, and mortality: United States, 2005-2009*. Hyattsville, MD: U.S. Dept. of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics.

Bahadori, K., Doyle-Waters, M. M., Marra, C., Lynd, L., Alasaly, K, Swiston, J., & FitzGerald, J. M. (2009). Economic burden of asthma: a systematic review. *BMC Pulmonary Medicine, 9*(24), doi: 10.1186/1471-2466-9-24

Bush, R. K., Portnoy, J. M., Saxon, A., Terr, A. I., & Wood, R. A. (2006). The medical effects of mold exposure. *The Journal of Allergy and Clinical Immunology*, 117(2), 326-33.

Cecchi, L., D'Amato, G., Ayres, J. G., Galan, C., Forastiere, F., Forsberg, B., ... Annesi-Maesano, I. (2010). Projections of the effects of climate change on allergic asthma: the contribution of aerobiology. *Allergy, 65*(9), 1073-1081.

Knutsen, A. P., Bush, R. K., Demain, J. G., Denning, D. W., Dixit, A., Fairs, A., … Wardlaw, A. J. (2012). Fungi and allergic lower respiratory tract diseases. *The Journal of Allergy and Clinical Immunology*, 129(2), 280-91.

Lang-Yona, N., Levin, Y., Dannemiller, K. C., Yarden, O., Peccia, J., & Rudich, Y. (2013). Changes in atmospheric CO2 influence the allergenicity of *Aspergillus fumigatus*. *Global Change Biology*, 19(8), 2381-8.

Levetin, E. & Van de Water, P. (2008). Changing pollen types/concentrations/distribution in the United States: Fact or fiction?. *Current Allergy and Asthma Reports, 8*(5), 418-424.

Luber, G., Knowlton K., Balbus J., Frumkin H., Hayden M., Hess J., … L. Ziska, (2014) Ch. 9: Human Health. Climate Change Impacts in the United States. *The Third National Climate Assessment*, J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 220-256. doi:10.7930/J0PN93H5

Masoli, M., Fabian, D., Holt, S., Beasley, R., & Global Initiative for Asthma (GINA) Program. (2004). The global burden of asthma: Executive summary of the GINA Dissemination Committee report. *Allergy, 59*(5), 469-78.

Meng Q., Nagarajan S., Son Y., Koutsoupias, P., and Bielory, L. (2016). Asthma, oculonasal symptoms, and skin test sensitivity across National Health and Nutrition Examination Surveys. *Annals of Allergy, Asthma & Immunology, 116*(2):118-25.

National Asthma Education and Prevention Program. Expert Panel Report 3 (EPR-3). (2007). *Guidelines for the diagnosis and management of asthma*. (NIH Publication No. 07-4051). Retrieved from http://www.ncbi.nlm.nih.gov/books/NBK7232/

O'Connell, E. J. (2004). The burden of atopy and asthma in children. *Allergy, 59*(*Suppl*. 78), 7-11.

Oswalt, M. L, & Marshall, G. D. (2008). Ragweed as an Example of Worldwide Allergen Expansion. *Allergy, Asthma, and Clinical Immunology, 4*(3), 130–135.

Shea, K. M., Truckner, R. T., Weber, R. W., & Peden, D. B. (2008). Climate change and allergic disease. *Journal of Allergy and Clinical Immunology, 122*(3), 443-453.

Takaro, T. K., Knowlton, K., & Balmes, J. R. (2013). Climate change and respiratory health: Current evidence and knowledge gaps. *Expert Review of Respiratory Medicine, 7*(4), 349-361.

Wallace, D. V., & Dykewicz, M. S. (2008). *The diagnosis & management of Rhinitis: An updated practice parameter*. Retrieved from http://www.allergyparameters.org/published-practice-parameters/alphabetical-listing/rhinitis-download/

Wolf, J., O'Neill, N. R., Rogers, C. A., Muilenberg, M. L., & Ziska, L. H. (2010). Elevated atmospheric carbon dioxide concentrations amplify *Alternaria alternata* sporulation and total antigen production. *Environmental Health Perspectives*, 118(9), 1223-8.

Zhang, Y., Bielory, L., Mi, Z., Cai, T., Robock, A., & Georgopoulos, P. (2015). Allergenic pollen season variations in the past two decades under changing climate in the United States. *Global Change Biology, 21*(4), 1581-1589.

Zhang, Y., Isukapalli, S. S., Bielory, L., & Georgopoulos, P. G. (2013). Bayesian Analysis of Climate Change Effects on Observed and Projected Airborne Levels of Birch Pollen. *Atmospheric Environment, 68*, 64-73.

Ziska, L. H., Gebhard, D. E., Frenz, D. A., Faulkner, S., Singer, B. D., & Straka, J. G. (2003). Cities as harbingers of climate change: Common ragweed, urbanization, and public health. *Journal of Allergy and Clinical Immunology, 111*(2), 290-295.

Ziska, L.H., Knowlton, K., Rogers, C., Dalan, D., Tierney, N., Elder, M. A., … Frenz, D. (2011). Recent warming by latitude associated with increased length of ragweed pollen season in central North America. *National Academy of Sciences, 108*(10), 2448-2451.

VI. Coordination

Agencies for Response:

(1) American Academy of Allergy, Asthma & Immunology
Thomas A. Fleisher, MD, FAAAAI
President
555 East Wells St, Suite 1100
Milwaukee, WI 53202
(414) 272-6071
tfleishe@mail.nih.gov

(2) American College of Allergy, Asthma & Immunology
Bryan L. Martin, DO
President
85 West Algonquin Rd, Suite 550
Arlington Heights, IL 60005
(847) 427-1200
bryan.martin@osumc.edu

(3) Centers for Disease Control and Prevention
Tom Frieden, MD, MPH
Director
CLFT Bldg. 21, Rm 1200
MS D14
Atlanta, GA 30333
(404) 639-7000
txf2@cdc.gov

(4) National Institute of Environmental Health Sciences
Linda S. Birnbaum, PhD
Director, NIEHS & NTP
P.O. Box 12233
Mail Drop B2-01
Research Triangle Park, NC 27709
(919) 541-3201
birnbaumls@niehs.nih.gov

(5) National Oceanic and Atmospheric Administration
Kathryn D. Sullivan, PhD
Under Secretary of Commerce for Oceans & Atmosphere and NOAA Administrator
1401 Constitution Ave NW, Room 5128
Washington, DC 20230
(202) 482-3436
kathryn.sullivan@noaa.gov

(6) USA National Phenology Network
Jake Weltzin, PhD
Executive Director
1311 E 4th St
Tucson, AZ 85721
(520) 626-3821
jweltzin@usgs.gov

(7) United States Environmental Protection Agency
Gina McCarthy, MS
Administrator
William Jefferson Clinton Building
1200 Pennsylvania Ave NW
Mail Code: 1101A
Washington, DC 20460
(202) 564-4700
mccarthy.gina@epa.gov

Agencies for Information:

(1) Aerobiology Research Labs
Frances Coates
President and CEO
81 Auriga Dr., Unit 39
Ottawa, Ontario K2E7Y5
(613) 226-9820
aerobio@aerobiology.ca

(2) Air and Waste Management Association
Stephanie Glyptis
Executive Director
One Gateway Center, 3rd Floor
420 Fort Duquesne Blvd
Pittsburgh, PA 15222
(412) 904-6006
sglyptis@awma.org

(3) Allergy and Asthma Network
Tonya Winders
President & Chief CEO
8229 Boone Blvd., Suite 260
Vienna, VA 22182
(800) 878-4403
twinders@allergyasthmanetwork.org

(4) American Association for Respiratory Care
Tom Kallstrom
Executive Director and CEO
9425 N. MacArthur Blvd.
Irving, TX 75063
(972) 243-2272
kallstrom@AARC.ORG

(5) American Lung Association
Susan J. Rappaport, MPH
Vice President, Research and Scientific Affairs
21 West 38th Street
New York, NY 10018-2254
(212) 315-8791
susan.rappaport@lung.org

(6) American Public Health Association
Georges C. Benjamin, MD
Executive Director
800 I St. NW
Washington, DC 20001
(202) 777-2430
georges.benjamin@apha.org

(7) Association of State and Territorial Health Officials
Sharon Moffatt
Interim Executive Director
2231 Crystal Dr., Suite 450
Arlington, VA 22202
(571) 522-2306
smoffatt@astho.org

(8) Asthma and Allergy Foundation of America
Cary Sennett
President and CEO
8201 Corporate Dr., Suite 1000

Landover, MD 20785
(202) 466-7643 x233
csennett@aafa.org

(9) Environmental Coalition of States
Alexandra Dapolito Dunn
Executive Director and General Counsel
50 F St. NW, Suite 350
Washington, DC 20001
(202) 266-4929
adunn@ecos.org

(10) National Association of Clean Air Agencies
S. William Becker
Executive Director
444 N. Capitol St. NW, Suite 307
Washington, DC 20001
(202) 624-7864
bbecker@4cleanair.org

(11) National Association of County and City Health Officials
Lamar Hasbrouck
Executive Director
1100 17th St. NW, Seventh Floor
Washington, DC 20036
(202) 507-4247
lhasbrouck@naccho.org

(12) National Atmospheric Deposition Program
David Gay
Program Coordinator
Illinois State Water Survey
2204 Griffith Dr.
Champaign, IL 61820-7495
(217) 333-7871
nadp@isws.illinois.edu

(13) United States Global Change Research Program, Crosscutting Group on Climate Change and Human Health (CCHHG)
John Balbus, MD, MPH
CCHHG Co-Chair and NIEHS Representative
National Institute of Environmental Health Science
31 Center Dr.
Claude D Pepper Building
Bethesda, MD 20892
(301) 496-3511
john.balbus@nih.gov

Fabien Laurier, PhD
CCHHG Co-Chair and OSTP Representative
Office of Science and Technology Policy
Executive Office of the President
Eisenhower Executive Office Building
1650 Pennsylvania Ave.
Washington, DC 20504
(202) 288-2879
Fabien_J_Laurier@ostp.eop.gov

George Luber, PhD
CCHHG Co-Chair and CDC Representative
Centers for Disease Control and Prevention
4770 Buford Hwy NE
CDC Chamblee Campus Building 106
Mailstop F59
Chamblee, GA 30341-3717
(770) 488.3429
gluber@cdc.gov

Juli Trtanj, MES
CCHHG Co-Chair and NOAA Representative
National Oceanic and Atmospheric Administration
1401 Constitution Ave. NW, Room 5128
Washington, DC 20230
(301) 734-1214
juli.trtanj@noaa.gov

VII. Submitting Author:

Meredith A. Jagger, MS, MPH
All Hazards Epidemiologist
Oregon Health Authority, Public Health Division
800 NE Oregon St, Ste. 772
Portland, OR 97232-2187
(971) 673-3343
meredith.a.jagger@state.or.us

Co-Authors:

(1) Norman Anderson
Environmental Public Health Consultant
Anderson Environmental Health
31 Pat St.
Winslow, ME 04901
(207) 649-6145
andersonenvironmentalhealth@gmail.com

(2) Leonard Bielory, MD
Professor
Rutgers University
400 Mountain Ave.
Springfield, NJ 07081
(973) 912-9817
bielory@envsci.rutgers.edu

(3) Wendy M. Brunner, PhD
Epidemiologist Principal
Minnesota Department of Health
85 E. 7th Place
P.O. Box 64882

St. Paul, MN 55164
(651) 201-5895
wendy.brunner@state.mn.us

(4) Lauren Thie, MSPH
Environmental Program Consultant
Division of Public Health, Occupational and Environmental Epidemiology
North Carolina Department of Health and Human Services
2001 Mail Service Center
Raleigh, NC 27699-2001
(919) 707-5931
lauren.thie@dhhs.nc.gov

APPENDIX F: Network Sketch from Small Group #1