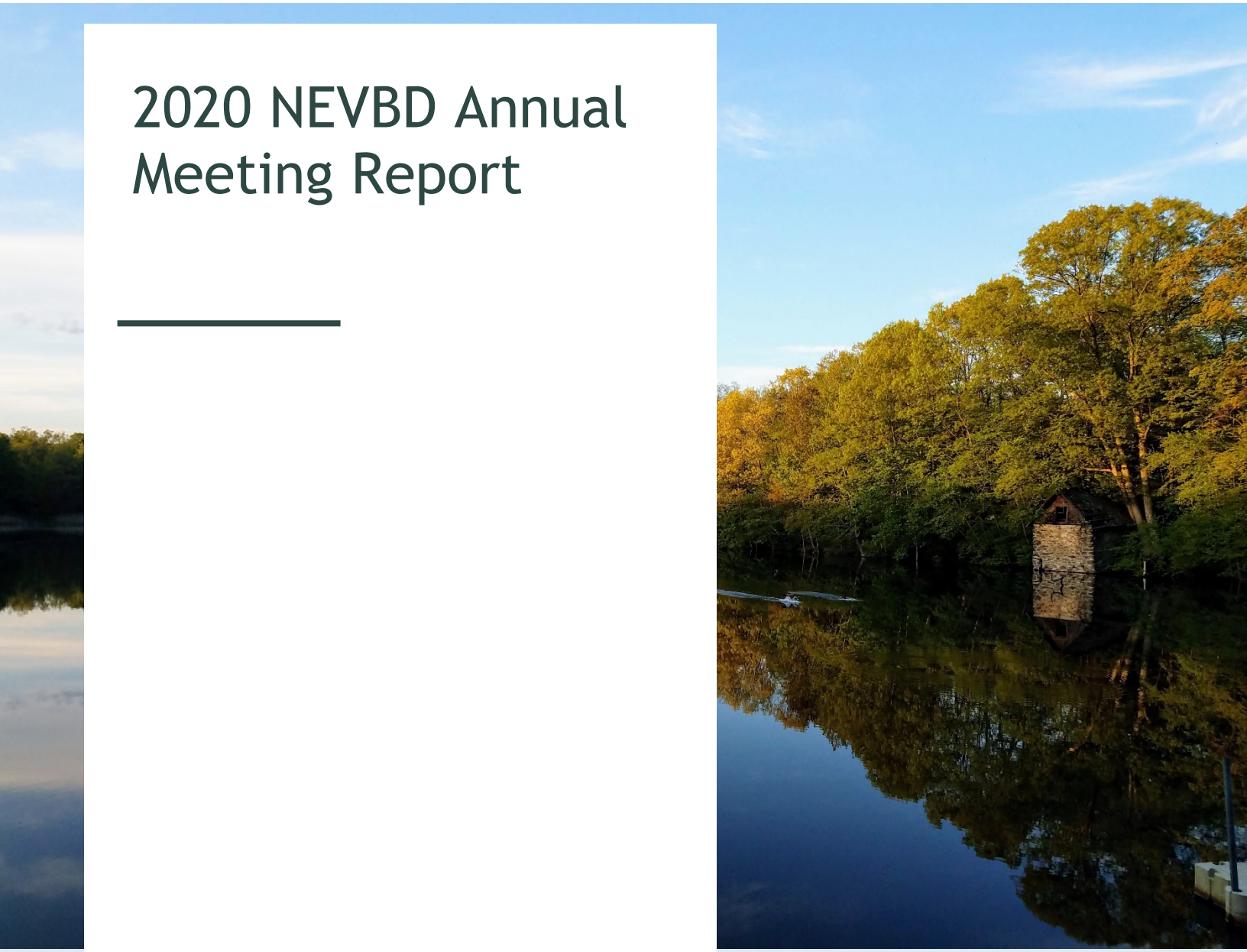
2020 NEVBD Annual Meeting Report



Northeast Regional Center for Excellence in Vector-Borne Diseases

Overview

The Northeast Regional Center for Excellence in Vector-Borne Diseases (NEVBD) membership convened 23 January – 24 January 2020, at the Connecticut Agricultural Experiment Station campus in New Haven, Connecticut. Laura C. Harrington, Program Director, presided at this third annual meeting for the NEVBD network. A full list of meeting attendees is reported in Appendix A.

The agenda for the first day of the meeting featured research updates from NEVBD core collaborators through oral presentations and a poster session. The second day included a smaller subset of meeting attendees, who participated in a series of strategic planning sessions. The discussions followed a break out group format, wherein attendees were able to participate in each of the following four break out group discussions:

- Needs of Community Partners and Training
- Modeling for Public Health Action
- Eastern Equine Encephalitis: Challenges and Issues
- Other Emerging Issues for the Northeast

During each break out group session, attendees reviewed key issues for the discussion topic area, identified priorities and opportunities for the NEVBD to address these issues, and reported a summary of the discussion to the wider group. Full findings and recommendations from the planning session are reported in Appendix B.

The full meeting agenda is listed below in Figure 1. Attendees were also asked to complete event evaluation forms. Summary responses to the event evaluations can be found in Appendix C.

Figure 1.2020 NEVBD Annual Meeting Agenda

Thursday January 23, 2020

7:30 am	**Arrival and Registration, with Breakfast Refreshments**
8:30 am	**Greetings and Event Introduction**
8:40 am	**Applied Research Updates – Vector-Borne Disease Modeling**
	Passive and Active Tick Surveillance as Predictors of Disease Risk (**Maria del Pilar Fernandez**, Columbia University)
	West Nile Virus Modeling (**Alexander Keyel**, SUNY Albany, Wadsworth Center)
9:00 am	**Applied Research Updates – Pathogen-Vector Interactions and Genetics**
	Transmission of Arboviruses by Mosquito Vectors to Live Vertebrate Hosts is Underestimated by In Vitro Assays (**Philip Armstrong**, Connecticut Agricultural Experiment Station)
	Population Genetics of Aedes albopictus in New England and Neighboring States (**Andrea Gloria-Soria**, Connecticut Agricultural Experiment Station)
9:15 am	**Applied Research Updates – Vector Biology, Behavior, and Overwintering**
	Host Association, Abundance, and Distribution of the Invasive Asian Tiger Mosquito, Aedes albopictus (**Goudarz Molaei**, Connecticut Agricultural Experiment Station)
	On the Edge of Uncertainty: How Invasive Aedes albopictus Mosquitoes Respond to Variable Temperature Cues Under Traditional Diapause Conditions (**Talya Shragai**, Cornell University)
	Overwintering Survival of Adult Amblyomma americanum (Acari: Ixodidae) in Connecticut and Maine (**Kirby Stafford III**, Connecticut Agricultural Experiment Station)
9:55 am	**Applied Research Updates – Chemical Control and Integrated Vector Management**
	Field Evaluation of an Oral Reservoir-Targeted Vaccine Against Borrelia burgdorferi in White-Footed Mice (**Kirby Stafford III**, Connecticut Agricultural Experiment Station)
	Update on an Integrated Tick Management Project with 4-Posters, Bait Boxes, and Metarhizium anisopliae in Connecticut (**Scott Williams**, Connecticut Agricultural Experiment Station)
10:15 am	**Applied Research Updates – Asian Longhorned Tick Monitoring and Control**
	Determining the best collection method for H. longicornis (**Phurchhoki Sherpa**, Cornell University)
	Association of Asian Longhorned Ticks with Mesomammals on Staten Island, NYC (**Danielle Tufts**, Columbia University)
	Insecticide Application Timing to Control Asian Longhorned Ticks in a Park in Northern New Jersey (**Matt Bickerton**, Bergen County New Jersey Department of Health, Rutgers University; **Alvaro Toledo**, Rutgers University)
	Brief Update on Asian Longhorned Tick Pathogen Testing (**Laura Goodman**, Cornell University, New York State Veterinary Diagnostic Center)
11:00 am	**Poster Pitches and Session**
12:15 pm	**NETWORKING LUNCH (meal provided)**
2:00 pm	**Community of Practice – Pesticide Efficacy and Resistance Monitoring**
	NEVBD Pesticide Resistance Monitoring Program (**James Burtis**, Cornell University)

	Efficacy Evaluations of Two Mosquito Control Product Delivery Methods (**Scott Crans**, New Jersey Mosquito Control Commission)
	ARENA Based Acaricide Trials (**Moses Cucura**, Suffolk County Department of Public Works, Division of Vector Control)
3:00 pm	**Community of Practice – Eastern Equine Encephalitis Virus**
	Reflections on the Ecology and Epidemiology of Eastern Equine Encephalitis Virus in the Northeastern US (**Theodore Andreadis**, Connecticut Agricultural Experiment Station)
	Massachusetts EEE Monitoring and Control (**Matthew Osborne**, Massachusetts Department of Public Health)
4:00 pm	**Community of Practice – Tick Surveillance in the Northeast**
	Brief Review of Tick Surveillance Practices in the Northeast Survey Results (**Emily Mader**, Cornell University)
	Citizen Science Tick Surveillance to Monitor Geographic Expansion of Ticks and Emergence of Tick-Borne Diseases (**Saravanan Thangamani**, SUNY Upstate Medical University)
	Passive Tick Surveillance in Connecticut (**Goudarz Molaei*bi*,** Connecticut Agricultural Experiment Station)
	Updates on the Smartphone TickApp (**Maria del Pilar Fernandez**, Columbia University)
	Assessing Knowledge, Attitudes, Practices and the Risk of Tick Exposure of Park Visitors on Staten Island, New York (**Erin Hassett**, Cornell University)
	Emerging Issues: Amblyomma Expansion (**Charles Lubelczyk**, Maine Medical Center Research Institute)
5:00 pm	**Adjourn**

Friday January 24, 2020

7:30 am	**Arrival and Registration, with Breakfast Refreshments**
8:30 am	**Review and Updates for NEVBD Priority Working Areas from 2019**
9:30 am	**Break Out Group Discussion 1 – Needs of Community Partners and Training**
10:45 am	**Break Out Group Discussion 2 – Modeling for Public Health Action**
12:00 pm	**NETWORKING LUNCH (meal provided)**
1:00 pm	**Break Out Discussion Group 3 – Eastern Equine Encephalitis: Challenges and Issues**
2:30 pm	**Break Out Discussion Group 4 – Other Emerging Issues for the Northeast**
3:45 pm	**Consensus Building for NEVBD 2020 Working Priorities**
4:45 pm	**Closing Remarks and Adjourn**

2020 Action Plan

The NEVBD will focus on the following objectives in calendar year 2020. These targets were identified through a synthesis of the discussion sessions, planning session outcomes, and feedback generated through program evaluations completed by meeting attendees. Please reference Appendix C to review full details on planning group discussions.

Research

I. Vector Surveillance Applied Research

Our collaborative team of researchers will work to enhance predictive models for tick and mosquito abundance and range expansion. This effort will fulfill our goal to be responsive to the needs of the public health community through inclusion of relevant model parameters, such as environmental conditions, infection rates, and development of easy-to-access model output. NEVBD will also endeavor to incorporate veterinary surveillance data into descriptive and predictive models, as well as increase communication between the public health and veterinary community.

NEVBD will continue to support the expansion of tick and mosquito surveillance capacity in the region, through both applied research and development of resources for public health stakeholders. Applied research programs will focus on emerging vectors of importance, including *Amblyomma* ticks, *Haemaphysalis longicornis*, and mosquito arbovirus bridge vectors. We will also provide resources for programs seeking to implement tick surveillance activities, including species-specific guidance and best practices for program infrastructure. Our collaborative team of researchers will continue applied projects on rare viruses in the Northeast, including LaCrosse encephalitis, Cache Valley, Jamestown Canyon, and Eastern equine encephalitis viruses, including surveillance of vectors, assessments of vectorial capacity, and genetic sequencing of local virus isolates.

II. Vector Control Applied Research

Our collaborative team of researchers will continue and initiate new trials in collaboration with regional partners on pesticide efficacy for mosquito control in the Northeast. Where feasible, these efficacy assessments will evaluate the impact of control activities on human risk and incidence of vector-borne disease.

NEVBD will continue to support the expansion of pesticide resistance monitoring in the Northeast. Resources will continue to be provided for *Culex pipiens* and *Aedes albopictus* resistance monitoring. If resources allow, we will develop resistance curves and additional resources to monitor resistance in *Culiseta melanura* populations. NEVBD will also communicate with regional partners to develop guidance on risk assessment measures and action thresholds for control activities.

Training

I. Expanding Access to Vector Biology Boot Camp Materials

NEVBD will explore opportunities to provide content developed for the Vector Biology Boot Camp program to broader audiences in the Northeast. Potential options include collaborating with professional society organizations to host in-person workshops and hosting web-based seminars on selected topics.

II. Training for Healthcare Providers

NEVBD will explore opportunities to develop and support vector-borne disease educational opportunities for healthcare providers. This will include promotion of existing resources developed by the Centers for Disease Control and Prevention, national professional societies, and state-specific resources for medical providers. Where feasible, NEVBD collaborators will provide direct education to healthcare providers within the Northeast region.

III. Engagement and Training for Pest Control Operators

NEVBD will broaden our connections to the private pest control community. Our goals are to gain a broader understanding of their vector-borne disease knowledge level, connect them to existing resources, and support training programs focused on the needs for pest control operators working in the Northeast.

Community of Practice

I. NEVBD serves as a repository for information, communication tools, and resources for public health programs in the region

NEVBD will use multiple mechanisms to provide up-to-date resources to public health programs in the Northeast, including hosting resources on our website and providing platforms for broad communication. Our goal will be to provide real-time updates during the surveillance season, cross-promote existing resources from professional organizations, and serve as a central repository for vector-borne disease response plans and reports.

II. Translate and Disseminate Research Results to the Community

NEVBD will support multiple efforts to translate research findings into products that can be shared with legislators and the public. These communication efforts may include engaging with communication specialists to create public messaging resources, producing templates that can support consistency in messaging across multiple entities in the Northeast, cross-promoting effective messaging developed by regional partners, drafting impact statements of research results, providing NEVBD support to public agencies and developing case studies on efficacy of applied programs.

III. Support Implementation of Operational Research Results with Public Health Agencies

NEVBD will establish mechanisms to expand regional public health program capacity to utilize their applied research findings to inform and execute public health action. Public health stakeholder resources may include production and sharing of standard operating procedures (SOPs) and materials to support operational research and program implementation. NEVBD will also explore the feasibility of supporting a 'reach a colleague' program to connect public health programs to subject matter experts in the region, and development of targeted disease- and vector-specific roundtables.

Appendix A. Meeting Participants

NEVBD Principal Investigator Team

- **Laura C. Harrington**, Professor of Entomology, Cornell University
- **Theodore Andreadis**, Director, Connecticut Agricultural Experiment Station
- **Bryon Backenson**, Epidemiologist, Director, Investigations and Vector Surveillance Units, Bureau of Communicable Disease Control, New York State Department of Health
- **Maria Diuk-Wasser**, Associate Professor of Ecology, Evolution and Environmental Biology, Columbia University
- **Dina Fonseca**, Professor of Entomology, Rutgers University
- **Laura Kramer**, Director, Arbovirus Laboratory, Wadsworth Center, New York State Department of Health
- **Emily Mader**, Program Manager, Cornell University

CDC Division of Vector-Borne Diseases

- **Lars Eisen**, Research Entomologist, Technical Advisor and Collaborator for the Northeast Center of Excellence in Vector-Borne Diseases, CDC Division of Vector-Borne Disease
- **Kristine Lindell**, Public Health Advisor and Project Officer, CDC Division of Vector-Borne Diseases
- **Joanie Kenney**, Biologist, Technical Advisor and Collaborator for the Northeast Center of Excellence in Vector-Borne Diseases, CDC Division of Vector-Borne Disease
- **Courtney Nawrocki**, Epidemiologist, CDC Division of Vector-Borne Disease
- **Ann Powers**, Virology Lead, Technical Advisor and Collaborator for the Northeast Center of Excellence in Vector-Borne Diseases, CDC Division of Vector-Borne Disease
- **Amy Ullman**, Public Health Advisor, CDC Division of Vector-Borne Diseases

NEVBD Trainees

- **James Burtis**, Postdoctoral Researcher, Cornell University
- **Constentin Dieme**, Postdoctoral Researcher, Wadsworth Center
- **Maria del Pilar Fernandez**, Postdoctoral Researcher, Columbia University
- **Julia Gonzalez**, Postdoctoral Researcher, Rutgers University
- **Erin Hassett**, Graduate Student, Cornell University
- **Alexander 'Sasha' Keyel**, Postdoctoral Researcher, Wadsworth Center, SUNY Albany
- **Eliza Little**, Postdoctoral Researcher, Connecticut Agricultural Experiment Station
- **Joseph McMillan**, Postdoctoral Researcher, Connecticut Agricultural Experiment Station
- **Maria Onyango**, Postdoctoral Researcher, Wadsworth Center, NYSDOH
- **Rohit Sharma**, Postdoctoral Researcher, Connecticut Agricultural Experiment Station
- **Phurchhoki Sherpa**, Graduate Student, Cornell University
- **Talya Shragai**, Doctoral Student, Cornell University
- **Danielle Tufts**, Postdoctoral Researcher, Columbia University
- **Meredith VanAcker**, Doctoral Student, Columbia University

NEVBD Partners & Collaborators

Philip	Armstrong	Connecticut Agricultural Experiment Station
John	Badger	Delaware Division of Fish and Wildlife, Mosquito Control Section
Matthew	Bickerton	Bergen County NJ Dept. of Health, Rutgers University
Sarah	Bonello	Connecticut Agricultural Experiment Station
Doug	Brackney	Connecticut Agricultural Experiment Station
Angela	Bransfield	Connecticut Agricultural Experiment Station
Scott	Campbell	Suffolk County Department of Health Services
Patti	Casey	Vermont Agency of Agriculture, Food & Markets

Alex	Ciota	Wadsworth Center Arbovirus Laboratory New York State Department of Health
Matthew	Combs	Columbia University
Neeta	Connally	Western Connecticut State University
Duncan	Cozens	Connecticut Agricultural Experiment Station
Scott	Crans	New Jersey Mosquito Control Commission
Nicholas	DeFelice	Icahn School of Medicine at Mount Sinai
Elena	Diskin	Virginia Department of Health
Alan	Dupuis	Wadsworth Center Arbovirus Laboratory New York State Department of Health
Gillian	Eastwood	Virginia Tech
Jody	Gangloff-Kaufmann	New York State Integrated Pest Management
Daniel	Gilrein	Cornell Cooperative Extension, Suffolk County
Andrea	Gloria-Soria	Connecticut Agricultural Experiment Station
Laura	Goodman	Cornell University
Nathan	Grubaugh	Yale University
Olivia	Harriott	Fairfield University
Brandi	Hopkins	Massachusetts Department of Health
Christopher	Horton	Northeast Mosquito Control Association
Noelle	Khalil	Connecticut Agricultural Experiment Station
Catherine	Knott	Vermont Department of Health
Natalie	Kwit	Vermont Department of Health
Joellen	Lampman	New York State Integrated Pest Management
Charles	Lubelczyk	Maine Medical Center Research Institute
Thomas	Mather	University of Rhode Island
Kathleen	McDonough	Wadsworth Center Arbovirus Laboratory New York State Department of Health
Charles	McGinnis	Rhode Island Department of Health
Michael	Misencik	Connecticut Agricultural Experiment Station
Goudarz	Molaei	Connecticut Agricultural Experiment Station
Tom	Moran	Delaware Division of Fish and Wildlife, Mosquito Control Section
Angel G	Munoz	Columbia University
Matthew	Osborne	Massachusetts Department of Health
Tanya	Petruff	Connecticut Agricultural Experiment Station
Joe	Poggi	Cornell University
Daniela	Quilliam	Rhode Island Department of Health
Ilia	Rochlin	Rutgers University
Zahir	Shah	New York City Department of Health
John	Shepard	Connecticut Agricultural Experiment Station
Haris	Sohail	Maine Center for Disease Control
Kirby	Stafford	Connecticut Agricultural Experiment Station
Saravanan	Thangamani	SUNY Upstate Medical University
Alvaro	Toledo	Rutgers University
Chantelle	Vogel	Yale School of Public Health
Scott	Williams	Connecticut Agricultural Experiment Station
John	Zuzworsky	New York City Department of Health

Appendix B. Planning Session Findings and Recommendations

GROUP 1: Needs of Community Partners and Training

Discussion Format

Four breakout groups discussed the following topics related to needs of NEVBD community partners and training.

1. What are the primary barriers to information sharing and collaboration?
2. What are the pressing challenges to filling organizational gaps in jobs and/or agency responsibilities?
    a. What gaps do you currently perceive in your organization?
3. What community engagement/communication issues do vector-borne disease practitioners experience?
    a. What are the issues related to translating scientific information to the public audience?
4. How can the NEVBD support these needs in the coming year?
5. What are gaps in training that NEVBD could fill in the coming year?

Discussion Summary

BARRIERS TO INFORMATION SHARING AND COLLABORATION

Barriers to Sharing Information with the Public

- Participants felt that the largest barriers to sharing information with the public were:
    - Determining the scale and content of data to make available to the public
    - Loss of control on messaging once data is released
    - Demands of the public for data before it is ready to be shared in a usable format
    - Difficulty making contact with targeted audiences who are not actively seeking vector-borne disease information
- Ideas and strategies to address these barriers included:
    - Potential platforms for sharing data with the public included smartphone apps (e.g., TickApp), and increased public support and engagement with health department materials.
    - Continued communication with local agencies about research and surveillance results
    - Providing strong surveillance data in any public-facing materials
    - Developing written state response plans
- Participants discussed ways in which NEVBD can contribute to addressing these barriers in the coming years, identifying the following strategies:
    - Continue calls with follow-up emails and meeting minutes, trying to include everyone on the same call
    - Shared approaches to disseminating information between departments
    - Support consistency in risk assessment measures between states and defining thresholds

    - Developing risk maps with a standard "low", "medium", "high" threshold designation
    - Documenting which areas have and have not conducted surveillance

Barriers to Sharing Information with Collaborators

- Participants reported that communication from states to counties and towns can be complicated, and will vary state-to-state. Some common issues identified included:
    - Other health issues taking precedence
    - Conflicting messages on risk factors at the national vs. regional scale
    - Conflicting messages from federal groups
- Participants also highlighted the following constraints to sharing data across states and with non-public entities:
    - Issues over intellectual property and ownership recognition
    - Slow processes to gain access to state-owned data
    - Uncertainty in what entity determines rules for data sharing in circumstances with multiple contributors to data collection and funding
    - Poor communication between data owners and those who would like access to the data
- Ideas and strategies to address these barriers included:
    - Developing data use agreements prior to collecting data
- Participants discussed ways in which NEVBD can contribute to addressing these barriers in the coming years, identifying the following strategies:
    - Hiring a dedicated data manager through the NEVBD to coordinate data sharing if funding becomes available
    - Development of an umbrella NEVBD data sharing agreement that can be tailored to specific data types

Issues Translating Scientific Information to Public Audiences

- Participants discussed the following issues related to translating scientific information to public audiences:
    - Inclusion of too much jargon in public education material
    - Difficulty explaining risk-related information
    - Broken and/or inconsistent communication between state and local departments
    - Conflicting opinions on control measures by the public
    - Mismatched expectations between residents and health officials (nuisance vs. vector control)
    - 'Getting people to care' about informational materials made available
- Ideas and strategies to address these barriers included:
    - Citizen Action Through Science programs (e.g., http://vectorbio.rutgers.edu/CitizenAcTSMD.htm)
    - Adding vector-borne disease materials and activities to school curricula, community groups, and fairs
    - Including materials in community health classes
    - Development of additional phone apps and small informational materials

CURRENT ORGANIZATIONAL GAPS IN JOBS AND/OR AGENCY RESPONSIBILITIES

- Participants discussed several themes related to challenges to filling organizational gaps in jobs and responsibilities.
    - Given funding limitations, participants described needing to be a 'jack of all trades' to fill positions in state health departments.
        - If given sufficient funding, multiple individuals could be hired.
        - With funding constraints, programs often seek one person with diverse skills, including a background in entomology, data collection, and data analysis
    - Hiring qualified individuals can prove difficult when available compensation does not match job expectations
    - Individuals with entomological training are needed at county and local levels
    - Longer seasons put a strain on available staff.
        - Seasonal surveillance needs conflict with academic schedules and availability of student help
    - Operational costs of control also hinder the ability to meet agency responsibilities
- Ideas and strategies to address these barriers included:
    - Increasing academic and state partnerships
    - Using social media to build partnerships
    - Providing funding for pilot projects (application based)
    - If applied research is not published, make it available in additional formats
- Participants discussed ways in which NEVBD can contribute to addressing these barriers in the coming years, identifying the following strategies:
    - Help disseminate information across jurisdiction levels
    - Harness the NEVBD website to support a 'find a colleague' feature
    - Serve as a central repository for program and state-specific resources, including customizable materials that can be adapted from other agencies
    - Advocate for sustainable funding and trained personnel, with particular focus on the need for state and local support for surveillance
    - Increase awareness of vector-borne diseases for health officials
    - Highlight alternative careers options for students

GAPS IN TRAINING NEVBD CAN ADDRESS IN 2020

- Participants identified the following areas where NEVBD can contribute to training gaps in the Northeast region in 2020:
    - Physician/practitioner trainings and webinars. Programs ideally informed by surveys in these communities to identify gaps, focusing on ticks, Lyme and other tick-borne diseases. NEVBD can cross-promote educational programs developed by CDC among this target population.
    - Contribute to medical student education and training
    - Provide seminars on tick identification and arboviral spread
    - Host social media workshops
    - Share research resources among partners via peer-to-peer training

GROUP 2: Modeling for Public Health Action

Discussion Format

Four break-out groups discussed one of the following topic areas for modeling:

- Modeling tick-borne disease (2 groups)
  - Participants asked to discuss utility of modeling, needs, and gaps from four perspectives: general public/physicians, county health departments, state health departments, and federal health departments. Discussion groups reviewed how officials can structure a surveillance strategy to reduce human cases of Lyme disease, and discussed the following targeted questions:
    - How can modeling inform public health decision making?
    - Do different stakeholders require different information? At a different scale?
    - What are some barriers to using models for vector control decisions?
    - What data are most useful for modeling efforts?
    - What priorities do we need to address in the coming year to align modeling with public health practice?
- Modeling West Nile virus and Eastern equine encephalitis virus(1 group)
  - Participants were given maps of West Nile virus and Eastern equine encephalitis virus human cases for 2018 and 2019, from CDC ArboNET. The group then discussed how useful model information would be to inform control decisions in a given field season, and what improvements are needed for models to be ideally informative for surveillance and control programs.
- Aedes suitability models (1 group)
  - Participants were presented with the AeDES Climate and Health Maproom, with demonstrations on how the program can adjust output by desired parameters, and reviewing key features including forecasts, observations, and how the content can be used to make decisions. The discussion then focused on how useful similar models tailored for mosquito vectors in the Northeast can be optimized to inform surveillance and control programs.

Discussion Summary

MODELING TICK-BORNE DISEASE

Structuring Surveillance Strategies:

- Participants felt that it is within the purview of federal and state public health agencies to develop and/or support systems to fill gaps in the presence and distribution of ticks by species, as well as develop education and communication campaigns for clinicians and the public.
  - Federal strategies that could support this work:
    - Establishment of a tick surveillance branch within CDC
    - Support for passive surveillance in less-risky areas of the nation
    - Increased allocation of funding for programs in the highest risk areas
  - State strategies that could support this work:
    - Providing nuanced information to physicians on emerging and existing threats
    - Developing a species-specific response plan.

- Several gaps were identified for county-level risk assessment and outreach regarding tick and tick-borne disease expansion.
    - Counties face personnel capacity limitations, and require additional funding to conduct surveillance.
    - Counties would also benefit from more granular data at the local level; however, producing models at this scale is difficult.
- Ideas to address capacity limitations within state and county programs included creating one-point tick submission stations in each county for passive surveillance activities, and encouraging programs within emerging at-risk jurisdictions to inform their surveillance strategies by observing species-specific approaches taken in nearby endemic areas.

Barriers to Utilizing Models to Inform Public Health

- Concerns were raised on model limitations:
    - Lack of measurement for tick management activities
    - Difference between predicting cases vs. informing risk and timing of risk through modeling
    - Within these limitations, suggestions to improve the utility of models included the incorporation of environmental factors, tick infection rate data, and highlighting differences between counties.
- Participants felt that modelers and public health programs need to acknowledge the potential for misinterpretation of results by stakeholder audiences and how this can negatively influence personal protection behaviors.
    - An example of this is a situation in which a map has white space for a county from lack of data, and a public data user interprets this not as missing data, but rather a lack of Lyme disease in that county.

How Statistical Models Align with Public Health Practice

- Participants felt that messaging for physicians and the public needs to be clear, concise, and simple, and that it is important for physicians to know the local risk for their county residents.
    - Suggestions to improve outreach and education:
        - County vector-borne disease professionals improving public education and outreach through extension programming
            - Providing guidance for travel to endemic areas
            - Providing physician training
            - Increasing personal protection and landscape management advice provided to the public.
- Statistical models can also enhance public communication approaches by providing a support for talking points.
    - Public-facing models should be grounded in surveillance, and be guided by the goal of communicating risk areas and risk timing (phenology) to clinicians and their communities
    - Model output should communicate the big picture on regional expansion
- Simplifying model output into tools where individuals can use drop-down menus to show the risk level within a state by county, or show a radar for growing risk in a region, would enhance risk communication.

MODELING WNV AND EEE

Utility of Model Information to Inform Control Decisions

- Participants felt that receiving predicted human cases for WNV and EEE before the start of a season would be extremely useful, but questioned the ability to have this information available at the right time of the year.
- Pre-season models would be difficult to obtain, but modeling based on early season, real-time data may help to initiate or implement programs later in the season.
- Using this information will depend on what programs are in operation in a given jurisdiction.
    - States with robust existing programs may view these models as useful information, but may not alter their protocols or strategies.
    - Newer programs or jurisdictions seeking to start programs can benefit from this information for direct planning purposes.
- Concerns identified from WNV and EEE public-facing models is that if a model indicates a given year will be below-average for mosquito abundance and/or virus prevalence, people may ease off protective behaviors due to a sense of reduced risk.

Improvements to Make Models Ideally Informative

- A challenge to WNV and EEE modeling is that incidence of these viruses is rare/low.
    - WNV can use historical data to develop models (i.e., using parameters from the past) to inform choices on initiating control interventions for future seasons.
- Participants felt models need improvements to be used for decision-making.
    - Weather forecasts are not sufficient for predicting mosquito activity and disease risk.
        - Other important variables include seroprevalence for viruses, larval population abundance, herd immunity, and water table level, among others.
    - Useful models may provide a likelihood of observing cases or risk levels when certain environmental conditions are met.
- Participants also felt that county-level models may not be sufficient for their needs.
    - Inclusion of fine-scale data at the zip code level on mosquito populations, climatic conditions, mosquito pathogen infection, age of residents, housing facility information (e.g., screens, homeless population), and land use will be necessary in order for model output to reach the level of certainty needed for enhanced public communication.
    - HIPAA laws pose a challenge to collecting granular information on human cases and cannot be avoided.

AEDES SUITABILITY MODELS

Constraints on Current Models

- Models of environmental suitability will be more useful if they can incorporate mosquito abundance information. However, one issue in pairing climate indicators with mosquito abundance estimates is the lack of surveillance site data.
    - As mosquito surveillance programs are limited by capacity, many at-risk communities could be missed by the model due to the lack of site-specific surveillance data.
- Participants also felt there is a need for higher-resolution data that program planners can trust. However, the signal-to-noise ratio is a constraint on the ability to make models at this scale for focal control decisions.

- Knowing adult population risk in March would be ideal for planning purposes. However, it is difficult to predict conditions for microhabitats and other contributors to vectorial capacity.

Improvements to Make Models Ideally Informative

- Environmental suitability models are currently available for *Aedes* species, and can be tailored to additional mosquito species of interest.
- Participants felt that environmental suitability maps are good tools for communication with policy makers.
- Given existing constraints, participants felt that temperature and rainfall predictions are the most important for vector control decision making.
    - Parameters include onset, duration, volume (for rainfall), soil moisture, and evaporation.
    - Currently, robust mosquito surveillance programs make decisions by following week-to-week surveillance data, and consider winter mosquito populations, spring climate, and larval counts as signals for adult population risk.
        - These programs try to make these assessments 2-months in advance of control operations to allow for enough time to complete logistic steps necessary for control to take place.
    - Model output with 3-month projections would be the most useful.
- Some participants felt that currently available small-scale data can tell us if it will be 'a bad year' or 'high-risk' year, and that it would be more useful to incorporate human behavior into the environmental suitability models to anticipate epidemic risk (i.e., travel and areas for likely travel-related cases).

GROUP 3: EEE Challenges and Issues

Discussion Format

Four breakout groups discussed the following topics related to challenges and issues the Northeast region faces from Eastern equine encephalitis virus.

1. Risk assessment and communication
    a. Assess human risk of infection and communicate to the public
    b. Interpretation of surveillance findings & triggers for response
2. Sharing of samples for genetic analysis and validation
    a. Virus availability (PCR vs isolation)
    b. Select agent issues for storage and shipping
3. Delays in laboratory diagnosis of human infection
    a. Concerns with commercial labs and false negatives
    b. Delays in test confirmation
4. Prevention and control
    a. Personal protective measures – effectiveness?
    b. Preseason preemptive treatments of *Cs. melanura* breeding sites with larvicides – can it be done effectively?
    c. Effectiveness of truck-mounted and aerial pesticide applications
    d. Difficulties with public acceptance – environmental issues
    e. Delays in implementation and high costs
    f. What level of control is needed to reduce human risk of infection?
    g. How do we measure effectiveness?

Discussion Summary

RISK ASSESSMENT AND RISK COMMUNICATION FOR EASTERN EQUINE ENCEPHALITIS VIRUS

Assessing Human Risk and Communicating to the Public

- Participants discussed elements related to risk assessment and risk communication for EEE in the following targeted categories:
    - Surveillance for mosquitoes is a necessary component of risk assessment:
        - *Cs. melanura* emergence in the spring will need to be gauged using long-term trap sites or weekly traps.
        - Questions remain on issues regarding gaps in recordkeeping, what information is needed to submit for recordkeeping, efficiency regarding larval sampling (crypts, edge water level), and sampling for additional bridge vector species
        - Evaluating precipitation and weather patterns will be a component to mosquito surveillance and risk assessment
    - Human risk assessments, and actions taken in response, will be determined by a variety of factors, including:
        - Understand if and where EEE virus is overwintering, as well as the influence of migratory birds on virus amplification
        - Evaluation of additional bridge vectors outside of *Cs. melanura*
        - Assessing animal activity prior to human infection (parks, sentinel birds, wildlife deaths)

        - Human risk assessments are negatively impacted by poor serology and the inability to predict risk season to season
    - Risk communication strategies and approaches included:
        - Immediate press releases and prevention messaging
        - Avoidance of activity from dawn to dusk
        - Prevent public use of common breeding areas
        - Talking with politicians, using models as talking points
        - Messaging around large public events like fairs
    - Interpretation of surveillance findings and determining triggers for response will include a focus on:
        - Determining the minimum field infection rate
        - Monitoring bridge vectors
        - Monitoring the prevalence of *Cs. melanura* infection
        - Ability to conduct a spray event and choose an appropriate product

SHARING SAMPLES FOR GENETIC ANALYSIS AND VALIDATION

- Participants were asked to discuss barriers and potential solutions to gathering and sharing virus isolates for genetic analysis and validation. Issues identified for this effort centered on the fact that EEE virus is on the select agents list, and many diagnostic laboratories are not certified to possess this virus and must therefore destroy samples upon identification. Shipping select agents to a registered laboratory is another option, but is it prohibitively expensive, time consuming, and burdensome. The end result is that many of these samples are destroyed, as occurred during the 2019 EEE outbreak. The discussion touched on strategies to increase the availability of EEE isolates for viral genetic comparisons.
    - Working with select agent labs
        - Identify which state and university laboratories have the ability to receive, store, and work with EEE
        - Identify diagnostic laboratories that possess or test samples for EEE, but are not registered with the select agents program
    - Developing a new protocol that is validated, and includes converting regulated material (live virus or viral RNA) into cDNA for sequencing. The cDNA is not infectious and therefore not considered a select agent. It could be stored in non-registered laboratories and readily shipped for sequencing.
        - Assist laboratories who have the option to make cDNA from virus isolates
        - Each lab must validate their methods and prove that they have destroyed or removed viral RNA from the sample
    - Identifying state labs that can conduct sequencing in-house
        - Develop and share protocols with these labs
    - Establishing a positive control sharing network for EEE-positive samples
        - Long-term storage facilities of viral RNA, virus isolates, and positive mosquito pools and vertebrate tissues
        - Virus cultures for sequencing and experimental studies
        - Developing and sharing protocols that are safe and comply with federal regulations

- Participants also discussed issues related to the cost of shipping and storing EEE as a select agent. Suggested strategies included:
    - Hand transportation of EEEV isolates. Must inform and transfer within 7 days of reporting to CDC if only the recipient lab is SA registered. If both labs are registered, the time limit for transfer is 30 days.
    - Ship through World Courier
        - This is expensive and has lots of paperwork. Better to use USA Courier, which is much cheaper and easier to use.
    - Diagnostic samples workaround
        - Send sample before testing from an area where EEEV has been active to a Select Agent registered lab for virus testing and identification. If a sample has not been tested yet it is still an unknown and can be sent to a registered lab for testing.
            - This would work, but is an added burden to testing lab in terms of cost and effort.
        - Consolidate samples into a single shipment. This would require holding/storing, so a problem if not an SA approved lab. The samples could only be held for 7 days before shipment if they are known EEEV positive and the lab is not SA approved.
    - Survey select agent cleared labs and coordinate between labs before the next field season. Best idea.

DELAYS IN LABORATORY DIAGNOSIS OF HUMAN INFECTION

- Participants discussed concerns with commercial laboratories analyzing serology and reporting false negatives for human cases of EEE. Given that state labs are often working at capacity, participants reviewed alternative options to explore.
    - There was high concern that commercial testing was unreliable, given the false positives in Connecticut in 2019. Diagnostics were most striking in their experience because all four human cases initially tested sero-negative through a large commercial laboratory. These tests lack plaque reduction neutralization tests (PRNT). Clinical samples were then referred to the CDC and identified as sero-positive during follow-up testing.
    - Suggestions to explore included establishment of a regional CDC lab, or referral of testing to CDC or other regional state labs.
        - Coordination between capable labs and their diagnostic processes would be important in this scenario
        - Identify state labs that can expedite testing and can accept samples from other states

EEE PREVENTION AND CONTROL

Mosquito Control Considerations

- Participants evaluated several methods to combat *Cs. melanura* populations to reduce human risk of EEE. These methods and considerations included:
    - Whether pre-emptive treatments of *Cs. melanura* populations could be done effectively

        - Is it feasible to reduce *Cs. melanura* populations with adulticide late in the prior season?
        - Evaluating the pre-season treatment window will need multiple years of historical data, and multiple replicates with a large sample size to determine efficacy
        - High vector abundance does not always translate to disease risk for EEE
    - Effectiveness of truck-mounted and aerial pesticide applications
        - Are aerial sprays worth the money required?
        - Truck sprays are not likely to be effective due to cryptic habitats
        - Products and sprays are not effective in tree canopy areas
        - Weather will always be an uncontrollable factor. Dependence on contracted sprayers make it difficult to change spray dates to accommodate changes to weather.
    - What level of control is needed to reduce human risk of infection?
        - For West Nile virus, the goal is always to keep the vector population abundance low. However, with EEE, it is a challenge to understand the natural cycling of vectors in the absence of surveillance and control measures.
- Participants also discussed issues surrounding how we measure effectiveness for mosquito control and human disease reduction. Ideas to tackle this problem included:
    - Developing a resistance curve for *Cs. melanura* to pyrethroids so we can track resistance status of field populations
    - Conducting efficacy trials, such as cage trials before and after treatments. Efficacy trials will also need strong controls, with greater variability between sites.
        - These trials will benefit from increased cooperation between control agencies and research partners during spray applications
    - Providing mosquito colonies through our network for use in efficacy trials during a disease outbreak.
    - Create SOPs for mosquito control

Public Outreach and Education

- Participants reviewed approaches to EEE prevention that centered on personal protective measures. There was some question as to the efficacy of personal protection messaging on reducing human cases.
- Participants also reviewed issues with public acceptance of control efforts. There are limited products available that are effective and accepted by the public. Participants identified and discussed environmental externalities that limit what products can be used in which environments:
    - Methoprene larvicide presents a particular challenge. Participants felt that they needed more data on efficacy to justify application in the context of push-backs from administrators and the public. This is difficult to quantify.
    - Conservation efforts to increase wetland habitats limit ability to apply pesticide.
    - The Massachusetts beaver population is expanding wetlands, and could be potentially expanding *Cs. melanura* habitat as well.

GROUP 4: Other Emerging Issues for the Northeast

Discussion Format

Four breakout groups discussed the following topics related to other emerging issues in vector-borne diseases for the Northeast region not otherwise covered in the break-out group discussions.

1. Other than EEE, what are the top emerging VBD issues in our region?
    a. Including pathogens, vectors, environmental/ecological, molecular, and other areas
2. Is the field of vector-borne disease and public health resilient to emerging threats?
    a. What tools do professionals have and need to combat emerging issues?
3. What can NEVBD do in the coming years to address these emerging issues?

Discussion Summary

EMERGING VECTOR-BORNE DISEASE ISSUES IN THE NORTHEAST

Emerging Vectors and Vector-borne Diseases

- Participants identified several mosquito-borne disease issues facing the Northeast. Topics of particular interest focused on increased surveillance for these targets.
    - Pathogens included Jamestown Canyon virus, re-emergence of West Nile virus, St. Louis encephalitis virus, and LaCrosse encephalitis virus.
    - The primary vector of interest was *Ae. albopictus*
- Participants identified several tick-borne disease issues facing the Northeast.
    - Pathogens included:
        - Powassan virus. Topics of interest included a comparison of POWV lineage II seroprevalence across regions, and understanding the focal emergence of POWV
        - *Anaplasma phagocytophilum*. Topics of interest included *Erhlichia* cases misdiagnosed as anaplasmosis, and evaluation of various *Anaplasma* strains and their pathogenicity
        - Alpha-gal. Topics of interest included prevalence and reporting of the allergy, and the changing case definition
        - Bourbon virus, Heartland virus
        - *Babesia microti* emergence into new areas
        - *Ehrlichia muris*
        - Lyme carditis
    - Vectors included:
        - *Amblyomma americanum*
        - *Amblyomma maculatum*, and implications for *R. parkeri*
        - *Haemaphysalis longicornis*
        - *Dermacentor variabilis*

Emerging Issues Related to Environmental Changes & Molecular Methods

- Participants also identified emerging issues related to environmental changes and molecular work.
    - Warming temperatures are bringing the active seasons both earlier and later in the year, and are associated with increased vector abundances and range expansion.

    - Molecular issues centered on a need to expand testing for a broader array of pathogens, address the limited capacity to store and test ticks for pathogens, and increase pesticide resistance monitoring.
        - For human surveillance, molecular considerations focused on variability in lab diagnoses, issues of undiagnosed cases, and general reporting issues from clinical providers and labs.
- Participants also highlighted a need to incorporate veterinary surveillance data into comprehensive assessments of vector-borne disease risk, and increase communication with state public health veterinarians, state veterinarians, and veterinary practitioners on vector-borne disease issues and strategies.

RESILIENCY OF PUBLIC HEALTH TO EMERGING THREATS

- When discussing resiliency, participants reported that main constraint was lack of funding to respond quickly and appropriately to new threats. Other tools that can help public health respond to vector-borne disease threats include:
    - Improved interaction between public health and clinical provider communities
    - Improved ability to detect new threats through comprehensive surveillance programs
    - Pre-emptive plans to address pesticide resistance before it occurs (i.e., what to do if you detect resistance)

HOW NEVBD CAN CONTRIBUTE

- Participants felt that NEVBD could contribute by conducting research on rare viruses (with funding), supporting regional cooperation and collaboration, setting guidelines for the types of professional positions and skills needed for robust vector-borne disease public health programs, and helping the community be proactive through services like the Pesticide Resistance Monitoring Program.
- Specific recommendations on concrete activities included:
    - Development of recommendations for tick surveillance programming, including an outline of baseline financial requirements, benefit to public health, and proof of concept
    - Helping to define protocols for conducting tick surveillance on private property in response to human cases of disease
    - Making stronger connections to commercial pest control operators to understand their knowledge of vector-borne disease risk and connect them to existing resources.

Appendix C. Summary of Annual Meeting Evaluations

Day 1: Network Research and Program Updates

NEVBD Annual Meeting Day 1 attendees were asked to complete an evaluation form, with 35 participants providing feedback (summarized in Table A below). Ratings of meeting aspects were generally very positive. Participants were particularly satisfied with the event for providing a forum for exchange with other NEVBD members, and with the organizational arrangements for and during the event. One potential area for future improvement may be to focus on helping participants apply information learned at the meeting to their work in the field.

Table A. Attendee Response Distributions for the Day 1 Evaluation

Question Item	Response Distributions				
	Very Satisfied	Somewhat Satisfied	Neutral	Somewhat Dissatisfied	Very Dissatisfied
Please indicate your overall satisfaction with this event	31	4	0	0	0
	Extremely	Very	Moderately	Slightly	Not At All
To what extent was attending this meeting worth your time?	24	8	2	0	0
	Excellent	Good	Fair	Poor	Very Poor
The relevance of presentation contents to my work	21	13	1	0	0
Quality of presentations	24	10	1	0	0
Providing a forum for information exchange with other participants	30	3	2	0	0
Quality of material circulated by the organizers	25	10	0	0	0
Registration process	25	10	0	0	0
Organizational arrangements for and during the event	26	6	1	0	0
Dates of the event	21	9	2	0	1
Convenience of meeting venue location	20	11	2	1	0
Ability to acquire lodging near meeting venue location	20	8	3	0	0
Event venue/facilities comfort and size	24	9	1	0	0
	A Lot	Quite A Bit	Some	A Little Bit	Not At All
To what extent do you think you will apply the information presented today to your work?	16	11	7	0	0

When asked what was most valuable about the meeting, 20 of 32 respondents mentioned the networking opportunities they encountered during the event. Many attendees reported appreciating the quality of presentation topics and the updates from a variety of different fields. Table B, below, summarizes attendee responses on this topic. Some respondents provided multiple answers.

Table B. Attendee Responses: Most Valuable Aspect of 2020 NEVBD Annual Meeting

Response Category	# of Respondents	% of Respondents
Networking opportunities	20	62.5%
Quality of research talks/topics	10	31.25%
Updates from variety of fields	7	21.88%
Sharing/comparing useful info w/ others in field	3	9.38%
Planning priorities	1	3.13%
Poster sessions	1	3.13%

Attendees were asked what they found least valuable about the meeting. Many respondents said "N/A" or did not answer this question, but six of 15 respondents said they felt that either the breaks in the day or the day itself could be shorter. Two respondents also felt that the format of the poster sessions could be improved, and two said that the applied research topics were not applicable to their work.

Attendees were asked what topics or themes should be addressed at the next NEVBD meeting. Responses to this question varied widely. The two most common responses were that there should be a continued focus on emerging diseases and vectors of concern (five of 20 responses), and that there should be material geared toward public education campaigns (four of 20 responses).

Day 2: Strategic Discussion & Planning Session

NEVBD Annual Meeting attendees who participated in the Day 2 Strategic Discussion & Planning sessions were asked to complete an additional evaluation form, with a total of 25 participants providing feedback (summarized in Table C below). In general, participants responded positively to the Strategic Discussion & Planning session, citing informative and relevant topics and satisfaction with their break-out group discussions. Several respondents expressed that potential improvements could include a shorter day or a narrower range of discussion topics.

Participants were asked what kind of follow-up activities to the discussion session would be helpful. The most frequently requested follow-up item from eight of 15 respondents was for a summary of top priorities and actionable items for 2020; a summary of the content of group discussions was the second-most common request. When asked for feedback about upcoming work for the NEVBD in 2020, respondents prioritized a focus on communication with the public and lawmakers, and on emerging vector control and vector-borne disease issues.

Participants were asked to indicate one thing they plan to do as a result of their participation in the session. Out of 12 respondents, four said they plan to pursue more communication and collaboration with other NEVBD members and neighboring states. Evaluation of testing and control efficacy and practices was also mentioned in four respondents' plans.

Table C. Attendee Response Distributions for the Planning Session Evaluation

Question Item	Response Distributions		
	Strongly Agree	Neutral	Strongly Disagree
The objectives of the break out discussion sessions were clear to me	17	7	0
My break out groups had the necessary people involved to complete our objectives	19	5	0
My break out group facilitators encouraged participation	18	4	1
My break out group facilitators respected my knowledge and experience	22	0	1
My break out group facilitators helped the group establish priorities	10	14	0
I feel my voice was heard in the break out group discussions	18	3	0
I am comfortable with the recommendations provided by my break out groups	18	4	0
The break out group format was a useful way to gain feedback from NEVBD partners	18	5	0
The large group was able to effectively identify priorities for 2020 by the end of the meeting	8	8	1
The 2020 priorities identified at the end of the meeting reflect the consensus built during the break out group discussions	15	2	1
The 2020 priorities identified at the end of the meeting are relevant to the Northeast region	17	0	1
The 2020 priorities identified at the end of the meeting are achievable in the next two years	9	9	0

Question Item	Response Distributions				
	Very Satisfied	Somewhat Satisfied	Neutral	Somewhat Dissatisfied	Very Dissatisfied
Please indicate your overall satisfaction with the planning session	13	10	1	0	0