ID: 87869542
Infectious Diseases, Environmental Health - Host Site Description
Tennessee Department of Health

Assignment Location: Nashville, US-TN
Tennessee Department of Health
Communicable and Environmental Diseases and Emergency Preparedness

Primary Mentor: Abelardo Moncayo, M.S., Ph.D.
Director, Vector-Borne Diseases
Tennessee Department of Health

Secondary Mentor: Melissa Dulcey, DVM PhD DACVPM
Public Health Veterinarian
Tennessee Department of Health

Work Environment
Hybrid

Assignment Description

The CSTE fellow will fully integrate into Vector-borne Disease Program and the Waterborne and Zoonotic Disease Program in TDH's Communicable and Environmental Disease and Emergency Preparedness (CEDEP) division. They will gain a detailed understanding of vector-borne, waterborne and zoonotic disease surveillance and outbreak response activities and the national programs that support these efforts.

The Vector-Borne Diseases (VBD) Program coordinates the surveillance of over 20 different vector-borne disease conditions in the State of Tennessee. The program is housed in the TN State Laboratory and has a large VBD BSL-2 laboratory space with an insectary and staff/fellow/student room. The VBD Program is a multi-disciplinary program engaging in the epidemiology, laboratory, and ecological aspects of the vector-borne diseases. The fellow will be trained using the VBD Handbook to understand the VBD surveillance process including case definitions for each pathogen (including laboratory and clinical evidence), case review, and notification to CDC. Past VBD fellows have been trained to conduct case investigations and have served in various CDC led working groups to generate position statements on new VBD national case definitions. This has been an excellent introduction to health policy. The fellow will also work with our partner universities such as Vanderbilt, the University of Florida, etc. and the various CDC Regional Centers of Excellence in VBDs, Training and Evaluation Centers, as well as CDC VBD colleagues.

The Waterborne and Zoonotic Disease Program is responsible for surveillance and outbreak response for reportable waterborne pathogens (Cryptosporidium, Legionella), zoonotic pathogens (Rabies, Brucellosis, Hansen's Disease, Plague, Q Fever, Tularemia) and other conditions in coordination with other CEDEP programs (botulism, anthrax, viral hemorrhagic fever). The program also includes private water safety initiatives and wastewater surveillance. Tennessee's wastewater surveillance program includes 11 wastewater utility partners and testing is conducted at the State Public Health Laboratory and through WastewaterSCAN, with an additional laboratory partner expected in 2026. The fellow will participate in weekly team meetings and will be added to the meeting facilitation schedule so that they will have multiple opportunities to facilitate this meeting. The fellow will be trained on the surveillance process for each pathogen and will support surveillance activities, including surveillance data entry, review, and visualization. The fellow will gain an understanding of the funding mechanisms for the program, including the Epidemiology and Laboratory Capacity, Environmental Health Capacity and CSTE Public Health Emergency Preparedness cooperative agreements.

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Past CSTE and PHAP fellows have been trained to conduct rabies risk assessments to determine the need for animal rabies testing or human rabies treatment; we expect to train the new fellow to answer calls from the public, veterinarians, healthcare providers, and local health departments about rabies risk and provide recommendations for exposure treatment and animal rabies testing. The fellow will also be integrated into outbreak response, including participation in site visits. Past EISO supported all aspects of a Legionella investigation linked to a church baptismal font. Similarly, the fellow will be expected to participate and lead aspects of an outbreak investigation, including questionnaire design, interviewing, data collection and management, data analysis, after-action reviews, and report writing. Collaboration with local, regional, and state health department staff, as well as agencies outside of TDH will be necessary.

The fellow will also be integrated into CEDEP cross-cutting and emergency response activities as they arise. CEDEP prioritizes opportunities for fellows to contribute to or lead responses, including outbreaks and natural disasters. Our past PHAP fellow led the division-wide collection of continuity of operations planning data with the Emergency Preparedness Program. Previous CSTE fellow also initiated the division-wide effort to catalog, store and summarize historical outbreak reports from the 1940s-2000s. We expect our fellow to be integrated into cross-cutting and emergency response activities during their placement.

The fellow will be fully supported to complete projects and take on responsibilities that will influence statewide activities. We plan for the fellow to meet together with all three mentors weekly. In addition, they will receive training and support for each project and activity by the appropriate program staff member or subject matter expert.

DAY TO DAY ACTIVITIES

- Work on assigned projects.
- Participate in Vector-borne Diseases and Waterborne and Zoonotic Diseases Program routine meetings.
- Participate in weekly CEDEP Surveillance meetings.
- Attend all statewide epidemiology trainings including monthly CEDEP conference calls and face-to-face meetings.
- Meet weekly together with all three mentors and individually with mentors as needed.
- Participate in case interviewing and support or lead vector-borne, waterborne and zoonotic disease outbreak investigations.
- Serve as a consultant for local and regional health department staff on questions regarding vector-borne disease outbreak investigations.
- Provide data analysis and report writing support to local and regional health departments.
- Provide epidemiological support to local and regional public health staff throughout Tennessee.
- Conduct special studies to include aspects of study design, implementation, and analysis.
- Prepare presentations and publications and deliver them at state and national meetings.
- Support emerging responses and cross-cutting initiatives in CEDEP.

Describe Statistical and Data Analysis Support, Such as Databases, Software, and Surveillance Systems Available to the Fellow

The Communicable and Environmental Disease and Emergency Preparedness (CEDEP) division of TDH employs over 60 epidemiologists. Epidemiologists from various programs often meet and consult on how to best analyze data, set up databases and report results. Our fellow will be integrated within this epidemiology network and will be given the trainings and opportunities all epidemiologists at TDH receive. The fellow will be able to participate in SAS, R, GIS, REDCap and Tableau training delivered in CEDEP. They will also be either introduced and/or trained on CEDEP's various surveillance systems including NEDSS, TennSurv, ArboNET, etc.

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Projects

Surveillance Activity Title: Evaluate Legionnaires' disease cases from 2015-2025

Surveillance Activity Description:
Legionnaires' disease is a serious lung infection that results in pneumonia. The bacteria grow naturally in water, including water systems, and people can get sick when they breathe in water droplets that contain the bacteria. Cases of Legionnaire's disease continue to increase in Tennessee with some recent increases localized to specific regions in the State. To improve detection of subtle increases in case counts at the local level, this project will analyze monthly Legionnaires' disease case data per county for the past 10 years (2015-2025).

Surveillance Activity Objectives:
- Determine the monthly incidence rate by county & region, for each of the 95 counties in Tennessee
- Determine an average monthly incidence rate and identify when case counts exceeded the expected rate in each county.
- Determine if there is temporal increase of cases associated with different counties or regions.
- Identify plausible risk factors associated with timing of increased Legionella case counts and their location.
- Create a table, dashboard, or visualization that highlights counties and regions where the incidence is higher is higher than average for the month
- Present findings at a division or program meeting.

Surveillance Activity Impact:
This project will provide the framework for TDH to recognize subtle increases in Legionnaires'disease on a more local level which will help inform resource allocation and the need for focused public health messaging. The summary of data and the development of visualizations will also provide local health departments the ability to make evidence-based decisions and enhance collaboration across jurisdictions and regions. The information gained through this project will further develop TDH's Legionnaires' disease predictive models, enabling TDH to identify vulnerable populations and implement proactive prevention strategies to reduce the risk of exposure.

Surveillance System Evaluation Title: Evaluation of Ehrlichiosis Surveillance in Tennessee

Surveillance System Evaluation Description:
The Tennessee Department of Health uses the National Electronic Disease Surveillance System (NEDSS) Base System (NBS) to conduct Ehrlichiosis surveillance in Tennessee. While this is the same platform TDH uses for other tickborne and reportable conditions, Ehrlichiosis presents distinct surveillance challenges. Many cases are identified through serology, which can complicate case classification and result in incomplete or delayed reporting. Variable provider awareness, coupled with seasonal increases in laboratory results, has created data quality and timeliness concerns. Additionally, opportunities exist to strengthen standardization in case investigation practices and interpretation of laboratory results. The fellow will engage stakeholders, including epidemiologists, laboratorians, local and regional health department users, and system administrators. The fellow will describe key attributes of the existing system, with a particular focus on its simplicity, sensitivity, data quality, timeliness, and stability. Findings will be presented to CEDEP staff at a division wide or statewide meeting, providing valuable information to support improvements in Ehrlichiosis surveillance processes for both central office and regional users.

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Simplicity: Is the case definition of Ehrlichiosis being applied appropriately? This will be assessed by reviewing the case classification based on the laboratory reports. In the absence of laboratory data, epidemiological data will be assessed for epi-linked cases.

Data quality: Was the data collected and recorded on the Ehrlichiosis case report form and in NBS/REDCap complete and valid?

Timeliness: What is the time interval between the onset date/isolate date and reporting/investigation of Ehrlichiosis cases?

Sensitivity: How does Tennessee's Ehrlichiosis surveillance system help in identifying clusters and outbreaks of Ehrlichiosis?

Surveillance System Objectives:

- Describe the number and rate of Ehrlichiosis cases in TN from 2000-2024
- Describe the top Ehrlichiosis species since 2000
- Compare rates among age, race, and ethnicity groups to identify disparities in infection
- Identify cases with serious outcomes (hospitalization or death) from Ehrlichia infection
- Identify geographic locations where Ehrlichia infections have been highest in TN since 2000 by top 5 serotypes
- Interview local public health staff and VBD Interview Team who conduct Ehrlichiosis investigations and document their process and document successes and barriers to completing the Ehrlichiosis case report form and conducting other components of the investigation
- Interview members of the CDC RZDB to identify successes and barriers associated with Ehrlichiosis surveillance activities
- Evaluate the completeness of the 2023 and 2024 Ehrlichiosis case report forms
- Review the last five years of testing to identify laboratory testing method changes
- Determine the percentage of Ehrlichiosis samples sent to the Vanderbilt for Ehrlichia ewingii testing
- Monitor Ehrlichiosis clusters
- Complete a surveillance evaluation report with suggestions on how to improve reporting and investigation of Ehrlichiosis
- Develop an abstract describing the surveillance system project to submit to the CSTE Annual Meeting
- Work with local and regional health departments to identify methods to educate populations most affected by Ehrlichiosis

Surveillance System Impact:
This project will allow TN's VBD program to better understand characteristics of Ehrlichiosis cases reported in Tennessee. The project will also allow us to determine areas of TN where Ehrlichiosis infections by species are most prevalent and attributes of cases with serious outcomes (hospitalization or death). The information gained from the surveillance project will allow VBD staff to describe barriers to interviewing cases and identify ways to target educational efforts toward groups at high risk for contracting Ehrlichiosis and/or developing serious complications.

Major Project Title: Implementation of an Alpha-gal Syndrome Surveillance System

Major Project Description:
Alpha-gal syndrome (AGS) is a hypersensitivity reaction to galactose-α-1,3-galactose (alpha-gal), found in non-primate mammalian meat and their derivative products. AGS has been reported worldwide, but in the United States, is most closely associated with the bite of a lone star tick (Amblyomma americanum).

Patients with this syndrome may experience life threatening anaphylaxis, and due to lack of awareness, many go undiagnosed for years. Tennessee has seen a significant proportion of alpha-gal specific IgE positive test results. Currently, we know we have other conditions transmitted by the same tick, but we do not know the burden of AGS. AGS became reportable in Tennessee in mid-2025 and a surveillance system is being developed and implemented. TDH will use the 2022 case definition for classification of cases. TDH will receive provider and laboratory reports for AGS and enter them into the National Electronic Disease Surveillance System (NEDSS) Base System (NBS). The patient will be sent an interview form via text to complete. Interview data will be transferred and stored in NBS.

The fellow will support implementation, review and improvements to the newly developed surveillance system. Public health and healthcare provider education messages will be important to diagnose early, provide accurate treatment recommendations, and prevent potentially life-threatening anaphylaxis. Messages to patients may include (1) avoiding ticks, (2) removing mammalian meat from diet to allow patients a slow reintroduction of meat into their diets and (3) avoiding exposure to other alpha-gal containing products such as vaccines (made with gelatin), heparin, antivenoms and xenotransplants. Understanding where AGS is occurring across the US, is also important for better elucidation of the disease process, and guidance.

Major Project Objectives:

- Review the existing AGS surveillance process and support the implementation and improvement of the AGS surveillance system for Tennessee
- Complete a surveillance evaluation report with suggestions for how to improve reporting and investigation of AGS
- Evaluate completeness of AGS interviews from Tennessee
- Describe the number and rate of Alpha-gal cases in TN
- Monitor Alpha-gal clusters and identify areas with high AGS burden
- Compare rates among population demographics to determine at-risk groups
- Identify cases with confirmed tick-bite exposures
- Identify cases with serious outcomes from AGS
- Work with local and regional health departments to facilitate outreach and tick prevention education to at-risk populations and healthcare providers
- Develop an abstract for the new AGS surveillance system in Tennessee and submit to the CSTE Annual Conference
- Generate a manuscript for publication summarizing these data

Major Project Impact:

This project will support TN's VBD program in establishing a surveillance system for Alpha-gal, which was recently made reportable in 2025. Though Alpha-gal is a reportable condition in Tennessee, there is no set surveillance system in place to monitor clusters, at-risk groups, or other case-related characteristics. The development and implementation of an AGS surveillance system will allow VBD staff to keep track of case reports and identify areas/populations at risk. Further, increased surveillance for Alpha-gal using this system will drive future prevention efforts such as outreach to at-risk communities and education of healthcare workers in Tennessee.

Additional Project #1 Title: Consolidation and Visualization of Tennessee Tick and Tick-borne Pathogen Data
Project #1 Type: Surveillance Activity

Project #1 Description:

Tennessee is home to many different species of tick and tick-borne pathogens (TBPs) that are responsible for hundreds of cases of human disease each year. Each year, new questions or concerns lead to new opportunities to study Tennessee ticks and TBPs.

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For the past 20 years, the Tennessee Department of Health has been involved in numerous studies surrounding tick vectors and TBPs in the state, however, much of the data from these studies are decentralized and difficult to query effectively. Mosquito and Mosquito-borne Pathogen data collected in Tennessee is kept in a centralized location and updated frequently via VectorSurv. This platform allows for easy access to past data for analysis and visualization, which is an important feature for identifying year-to-year vector and/or pathogen trends. The consolidation of all TDH tick data into one location will allow for efficient visualization and querying of these valuable data sets for analysis and to inform new projects.

This study will be focused on 1) consolidating Tennessee tick and TBP data into VectorSurv and 2) visualizing consolidated vector and pathogen data. This project will allow for retrospective analysis of tick and TBP trends from past data sets and help to inform new studies in Tennessee.

Project #1 Objectives and Expected Deliverables:

- Review and consolidate the last 20 years of tick and tick TBP surveillance done by TDH
- Describe trends in tick and TBP prevalence in Tennessee from the past 20 years
- Describe the most detected ticks and TBPs in Tennessee
- Creation of a centralized, consolidated database of tick and TBP results from TDH
- Evaluate the usage of a centralized database for querying specific tick/TBP data
- Identify new established populations of tick species using CDC guidelines
- Identify county-level presence and prevalence of human pathogens in tick species of public health importance
- Estimate the density of host-seeking (infected) tick species of public health importance
- Identify species-specific phenology for ticks in Tennessee
- Work with federal partners to report new established populations of ticks/TBPs in Tennessee
- Develop a report on tick/TBP trends in Tennessee over the last 20 years to present at the Tennessee Mosquito and Vector Control Association (TMVCA) conference or other conferences.
- Generate a manuscript for publication summarizing these data

Project #1 Impact:
This project will allow TDH's Vector-Borne Diseases program to gain insight into the trends of tick and tick-borne pathogen surveillance that has occurred for the past 20 years. The VBD program keeps up-to-date records of mosquito/mosquito-borne pathogen surveillance, and this project aims to help the tick/TBP data catch up. Having this data consolidated is extremely important for querying and visualizing trends that have occurred in Tennessee. Access to a centralized database will allow us to better understand how tick/TBP presence has changed over time and help to inform future studies in our state. With the creation of this resource, VBD staff will be able to understand the landscape of Tennessee's vectors and their associated diseases better to predict risk and drive prevention efforts.

Additional Project #2 Title: Identify Action Thresholds and Areas of High-Risk WNV Exposure in Shelby County, Tennessee
Project #2 Type: Surveillance System Evaluation

Project #2 Description:
West Nile virus (WNV) is a mosquito-borne disease that can cause a diversity of symptoms from fever to neurologic deficits. In the U.S., the number of reported WNV cases fluctuate annually as a result of intermittent outbreaks. Control of WNV in humans has been limited to mosquito control. Various calculations using mosquito and arboviral testing data have been used to estimate risk of WNV transmission to humans. However, further research is needed to understand the temporal and spatial application of these WNV risk calculations to approximate the risk of WNV transmission to humans. There also needs investigation how environmental factors (weather, landscape, etc.) play a role in the transmission of WNV from mosquito to humans.

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This study will use data on known WNV cases and mosquito trapping and arboviral data between 2005 to 2025 to better understand the spatial and temporal relationship between mosquito trapping data and WNV cases and to explore relationships between environmental factors and the occurrence of disease within Tennessee.

Project #2 Objectives and Expected Deliverables:

- Describe trends in arboviral emergence during in Tennessee during the past 20 years
- Describe the relationship among arboviruses found in Culex mosquitoes
- Creation of a centralized, consolidated database of mosquito and arboviral data for TDH
- Evaluate the influence of environmental factors (temperature, precipitation, and mosquito infection rates) in predicting the risk of WNV transmission in mosquitoes and disease in humans
- Evaluate the influence of land cover and demographic factors in predicting the risk of WNV transmission in mosquitoes and disease in humans
- Identify action thresholds for WNV transmission
- Use project results to inform preparedness plans for WNV transmission
- Identify areas of high risk in Shelby County where most of our WNV activity occurs annually
- Create maps to visualize areas of risk in Shelby County
- Develop a manuscript for publication on the drivers of WNV transmission in Memphis, TN describing the effects of weather, mosquito infection, social and biological conditions including association with other arboviruses tested.

Project #2 Impact:
The scientific knowledge gained from this study will identify appropriate mosquito surveillance indices and high-risk areas where future WNV cases are likely to occur in Tennessee. This will in turn provide guidance for prevention measures to decrease the burden of WNV. The study will also provide information that will allow for the identification of areas where WNV disease risk is currently high. Recognizing high-risk areas will help focus surveillance efforts to provide a greater understanding of the burden of WNV within Tennessee and inform/guide resource allocation to better control the disease.

Additional Project #3 Title: Wastewater West Nile Virus Pilot
Project #3 Type: Surveillance Activity

Project #3 Description:
Wastewater-based surveillance (WBS) has emerged as a valuable tool for tracking pathogens at the population level. WastewaterSCAN, which collaborates with the CDC through the National Wastewater Surveillance System, added West Nile virus (WNV) as a testing target in October 2025 and has begun generating data at select sites nationwide. WBS has been shown as a reliable signal for WNV activity monitoring but its utility for surveillance in Tennessee has not been explored. This project will compare WastewaterSCAN data to data obtained through traditional mosquito pool surveillance to assess temporal and spatial correlations between wastewater WNV signals and mosquito pool positivity (WNV and Flanders virus, a sentinel for WNV). This study will determine if WBS can provide earlier or complementary insights into WNV activity in Tennessee and support its use as a surveillance tool to inform public health intervention.

Project #3 Objectives and Expected Deliverables:

- Compare WastewaterSCAN WNV signals from 2 Tennessee wastewater treatment sites with mosquito surveillance data collected from similar locations and time points.
- Evaluate relationship of WNV wastewater signals to mosquito positivity to identify its use as an indicator of WNV activity in Tennessee.
- Create weekly/monthly reports on WNV wastewater data compared to mosquito positivity

- Interpret findings and prepare an investigation report including a standard operating procedure for interpreting WNV wastewater signal data in Tennessee.
- Develop a public health response framework for WNV wastewater detections that outlines how wastewater data could be integrated with mosquito surveillance, syndromic surveillance, and existing response activities, and identifies key considerations for communication with local health departments and the public.

Project #3 Impact:
This project will bridge WNV wastewater surveillance with more traditional methods of surveillance historically used in TN. This will help determine the utility of WNV wastewater-based surveillance in Tennessee and improve WNV surveillance capacity and response planning in the state.

Additional Project #4 Title: Evaluation of Rabies Post-Exposure Prophylaxis Disparities
Project #4 Type: Other

Project #4 Description:
Rabies is caused by a virus most commonly spread by the bite of an infected animal. If a person is exposed, rabies infection is almost always fatal if the person does not receive timely post-exposure prophylaxis (PEP). In Tennessee, PEP is primarily available at hospital emergency departments and the only location that stocks human rabies immune globulin (HRIG), the biologic required to initiate post-exposure prophylaxis. Numerous counties do not have an emergency department and PEP costs can be highly variable, with HRIG ranging from around $2,000 to over $10,000 depending on location. This project will summarize availability and cost of PEP at Tennessee emergency departments by county and region to identify opportunities to address disparities in access to treatment.

Project #4 Objectives and Expected Deliverables:
- Determine and cost of HRIG at emergency departments across Tennessee.
- Analyze and create a summary of PEP availability and cost by county and region, for each of the 95 counties in Tennessee.
- Create a toolkit to estimate rabies vulnerability based on regional rabies epidemiology and PEP availability and cost. Identify counties and regions with increased rabies vulnerability.
- Create a visualization showing the availability and cost of PEP by county and region, and the variation of rabies vulnerability.
- Present findings at a TDH division or program meeting.

Project #4 Impact:
This project will determine the availability and cost of PEP in Tennessee by county and region to address disparities in access to treatment. The creation of a rabies vulnerability toolkit will also enable a consistent and data-driven method to identify potential high-risk populations that can be used to inform resource allocation and public education to reduce the risk of rabies transmission across the state.

Please Describe the Fellow's Anticipated Role in Preparedness and Response Efforts – Include Activities and Time Allocation (Required Competency of Fellowship)

Vector-borne, waterborne and zoonotic disease preparedness and response will be an important role for our fellow. Our programs are responsible for preparedness and response for multiple pathogens (H5N1, new world screwworm, viral hemorrhagic fever, etc.). The fellow will be trained on programmatic preparedness activities and become familiar with response protocols. Our past PHAP fellow led the division-wide collection of continuity of operations planning data with the Emergency Preparedness program. The incoming fellow may develop a response plan for Lacrosse Virus detections or develop a response framework as part of the wastewater project aimed at West Nile Virus.

In addition to programmatic support for building and sustaining preparedness for these pathogens the fellow will be integrated into outbreak response and emergency preparedness as opportunities arise. Our teams routinely serve in leadership roles during emerging division-wide initiatives, and our fellow will be able to work with frontline public health staff and collaborate with state and local agencies on investigation and outbreak response. They will become familiar with the State Health Operations Center and receive training in Incident Command Systems for public health emergencies, which include outbreaks and natural disasters. Fellows have supported Ebola, Sudan virus, COVID-19, E-cigarette or Vaping Product Use-Associated Lung Injury, Zika and more. The fellow will serve as surge capacity during any CEDEP-related outbreaks and emergency response activities outside of vector-borne, waterborne, and zoonotic outbreaks.

Time allocation: 8-12 hours/month.

Please Describe the Fellow's Anticipated Role in Cluster and Outbreak Investigations – Include Activities and Time Allocation (Required Competency of Fellowship)

The zoonotic and waterborne team is regularly involved with cluster and outbreak responses and our fellow would have the opportunity to participate and be encouraged to lead these investigations with support and mentorship. The fellow will be trained on investigations and will be given the opportunity to lead an outbreak investigation or presumptive healthcare-associated Legionella investigation. As the lead, they will be responsible for communicating among the disciplines (epi, lab and environmental health) and with local public health partners. They will be instrumental in providing updates and will be responsible for developing a final report. If appropriate, they will develop an abstract/manuscript describing at least one investigation they led. In 2025, the vector-borne team responded to a detection of Eastern Equine Encephalitis (EEE) in a horse. Response included mosquito trapping and testing, and fellows and interns participated in the initiative, including our recent PHAP.

Our programs also work closely with other CEDEP programs. Our fellow would have the opportunity to integrate into other program investigations including the Foodborne and Enteric Disease Program where they would participate in cluster meetings where the FED outbreak team reviews molecular subtyping data to visualize human, animal, and environmental isolates' genetic relatedness to determine the need for an outbreak investigation. This would give our fellow exposure to the use of genetic epidemiology in outbreak identification and response. Additionally, we urge our fellows to participate in investigations across CEDEP. Past CEDEP fellows have participating in cluster and outbreak investigations outside of their home team. Past vector-borne CSTE fellow supported Mpox response and led TDH's participation in a CDC study investigating Mpox in pets. Other fellows have supported COVID-19, E-cigarette or Vaping Product Use-Associated Lung Injury, Zika and other emerging responses and outbreaks.

Time allocation: 8-12 hours/month.