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Improving Foodborne Disease Surveillance and Outbreak Detection and Response Using Peer Networks—The Integrated Food Safety Centers of Excellence

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Abstract

Context: Foodborne disease surveillance and outbreak investigations are foundational to the prevention and control of foodborne disease in the United States, where contaminated foods cause an estimated 48 million illnesses, 128 000 hospitalizations, and 3000 deaths each year.

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Surveillance activities and rapid detection and investigation of foodborne disease outbreaks require a trained and coordinated workforce across epidemiology, environmental health, and laboratory programs.

Program: Under the 2011 Food Safety Modernization Act, the Centers for Disease Control and Prevention (CDC) was called on to establish Integrated Food Safety (IFS) Centers of Excellence (CoEs) at state health departments, which would collaborate with academic partners, to identify, implement, and evaluate model practices in foodborne disease surveillance and outbreak response and to serve as a resource for public health professionals.

Implementation: CDC designated 5 IFS CoEs in August 2012 in Colorado, Florida, Minnesota, Oregon, and Tennessee; a sixth IFS CoE in New York was added in August 2014. For the August 2019-July 2024 funding period, 5 IFS CoEs were designated in Colorado, Minnesota, New York, Tennessee, and Washington. Each IFS CoE is based at the state health department that partners with at least one academic institution.

Evaluation: IFS CoEs have built capacity across public health agencies by increasing the number of workforce development opportunities (developing >70 trainings, tools, and resources), supporting outbreak response activities (responding to >50 requests for outbreak technical assistance annually), mentoring students, and responding to emerging issues, such as changing laboratory methods and the COVID-19 pandemic.

Keywords

foodborne illnesses; infectious disease outbreaks; public health capacity

Foodborne disease surveillance and outbreak investigations are foundational to the prevention and control of foodborne disease in the United States, where contaminated foods cause an estimated 48 million illnesses, 128 000 hospitalizations, and 3000 deaths each year.¹ Primarily led by public health professionals at state and local health departments, surveillance activities and rapid detection and investigation of foodborne disease outbreaks require a trained and coordinated workforce across epidemiology, environmental health, and laboratory programs.^{2,3} Moreover, cross-jurisdictional collaboration (ie, collaboration among states and federal partners) can enhance surveillance and outbreak activities. Jones et al⁴ found that states reporting more collaboration with other states and federal partners also reported more outbreaks.

Foodborne disease surveillance and outbreak investigations are becoming more complex, requiring investigators well versed in genomics and bioinformatics with the introduction of advanced technologies, including whole genome sequencing (WGS).^{5,6} Profound changes in the production, distribution, and consumption of food require more complex, multidisciplinary solutions and a workforce capable of critical thinking, problem solving, and the ability to translate research findings into practice.^{3,7-9} Given these evolving needs and well-documented challenges of workforce attrition,¹⁰ there is an essential need to train and support the workforce to effectively conduct surveillance and outbreak investigations.

Considering the threats to public health capacity and the increasing complexities of US surveillance systems as well as the food supply, the Food Safety Modernization Act (FSMA)

was signed into law in 2011 to protect population health by strengthening the food safety infrastructure. Rapidly detecting and responding to foodborne disease outbreaks are critical to not only stopping current outbreaks but also preventing future outbreaks and ultimately reducing the overall incidence of foodborne disease. To this end, as part of FSMA, the Centers for Disease Control and Prevention (CDC) was tasked with establishing Integrated Food Safety Centers of Excellence (IFS CoEs) at selected state health departments in collaboration with academic partners. The mission of IFS CoEs is to identify, implement, and evaluate model practices in foodborne disease surveillance and outbreak response and to serve as a resource for local, state, and regional public health professionals. Here, we describe the development and implementation of the IFS CoE program, highlight the approach and impact of IFS CoEs, and discuss the future role of IFS CoEs in strengthening foodborne disease surveillance and outbreak detection and response infrastructure in the United States.

Program Development and Implementation

Food Safety Modernization Act

FSMA focuses on the prevention of food safety threats and recognizes the importance of a strong foodborne disease outbreak surveillance and response system. As such, IFS CoEs “serve as resources for federal, state, and local public health professionals to respond to foodborne illness outbreaks,” which would not duplicate other federal foodborne disease response efforts.¹¹ Eligible entities included state health departments partnered with 1 or more academic institutions. Under the administrative leadership of CDC, FSMA dictated IFS CoEs participate in the following activities: provide resources, analyze the timeliness and effectiveness of surveillance outbreak response, conduct workforce training, support future epidemiological and food safety leaders, and conduct research (see the Box for a full list of activities).

Program implementation

IFS CoEs were selected through a competitive award process via CDC’s Epidemiology and Laboratory Capacity for Prevention and Control of Emerging Infectious Diseases (ELC) cooperative agreement. CDC designated 5 IFS CoEs in August 2012 in Colorado, Florida, Minnesota, Oregon, and Tennessee; a sixth IFS CoE in New York was added in August 2014. For the August 2019-July 2024 funding period, 5 IFS CoEs were designated in Colorado, Minnesota, New York, Tennessee, and Washington. Each IFS CoE is based at the state health department, which partners with at least one academic institution (Table 1). IFS CoEs work with CDC to design work plans that address core activity areas and collaborate with other IFS CoEs via working groups to coordinate and implement planned activities.

Regionalization and target audience

Unlike other CDC-funded foodborne disease programs (eg, FoodCORE, FoodNet), IFS CoE activities are not focused within the IFS CoE state. Rather, the goal is for IFS CoEs to help build national capacity at all levels of government (local, regional, state, federal, and territorial) across the multiple disciplines engaged in foodborne surveillance and outbreak investigation activities (epidemiology, environmental health, laboratory, and others). IFS

CoEs achieve this by creating cross-jurisdictional, peer communities and collaborations using a regional model (Table 1). The regional model is leveraged into a national network, with IFS CoE coordinators serving as navigators for states and jurisdictions within their regions. States are encouraged to collaborate with IFS CoEs in other regions based on the availability of specialized expertise or resources (contact information for coordinators is available from [cdc.gov/foodsafety/centers](https://www.cdc.gov/foodsafety/centers)) that meet the state's needs at any given time. IFS CoE coordinators communicate regularly across IFS CoEs, creating a national peer-to-peer network for resource sharing, outbreak assistance, and collaboration.

Academic partnership

There are well-recognized divisions between academic public health research and the applied public health research needs of public health agencies.¹² The collaborative and integrative partnership between governmental public health agencies and academic public health faculty, staff, and students in IFS CoEs offers a bidirectional bridge across this divide. IFS CoEs rapidly identify needs or gaps in practice; collaborate with academic partners to evaluate and analyze current practices; identify and implement evidence-based recommendations into practice via tools, technical assistance, and education; and evaluate the use and effectiveness of such interventions (Figure 1). This feedback loop allows for the rapid development of evidence-based trainings, tools, and guidelines to address immediate public health needs.

Approach and Impact

IFS CoEs build capacity across public health agencies by evaluating current surveillance and outbreak investigation practices and providing resources, training, and technical assistance to aid and advance foodborne (and other enteric) disease surveillance and outbreak investigations. Here, we summarize major contributions of the IFS CoE program to date.

Providing relevant and timely training and continuing education opportunities

Increasing access to training and continuing education has been a cornerstone of the IFS CoE approach. IFS CoEs have dramatically increased the number of workforce development opportunities available (developing >70 trainings, tools, and resources), rapidly assessing and responding to workforce needs and providing timely training opportunities on current and emerging topics such as WGS. The trainings offered by IFS CoEs are provided free of charge and targeted to both discipline-specific and multidisciplinary audiences; trainings can be accessed at [FoodSafetyCoE.org](https://www.FoodSafetyCoE.org). Informed by needs assessments conducted both formally and informally with public health professionals in each IFS CoE region, IFS CoEs work closely with other entities, including CDC, the National Environmental Health Association (NEHA), the Association of Public Health Laboratories (APHL), CDC National Center for Environmental Health (NCEH), the Council for State and Territorial Epidemiologists (CSTE), the National Association of County and City Health Officials (NACCHO), the National Network of Public Health Institutes (NNPHI), and the food industry, to coordinate training opportunities.

An example of a multidisciplinary training offered through the IFS CoE program is Epi-Ready Team Training. This course, initially developed in 2003, is a 2-day, typically in-person training that focuses on how to respond to a foodborne outbreak using a team-based approach, bringing together staff from the multiple disciplines involved in outbreak response. Since 2017, IFS CoEs have delivered 49 Epi-Ready Team Trainings to groups of public health professionals from more than 36 states. Recognizing the evolution of foodborne surveillance and outbreak response, IFS CoEs played a key role in revising the course to incorporate advances in genomic and molecular methodologies, such as WGS and culture-independent diagnostic tests (CIDT), updated investigation practices, and a train-the-trainer module. In addition to Epi-Ready Team trainings, IFS CoEs have developed and delivered a variety of in-person trainings, including Applied Outbreak Investigation Training, Outbreak Response (Interviewing Skills) Training, and customized training modules based on jurisdictional needs (Table 2).

Although in-person trainings are often preferred, IFS CoEs identified barriers to in-person trainings, including a lack of funding for travel and insufficient staff time.¹³ Accordingly, IFS CoEs have developed a variety of synchronous and asynchronous online trainings (Table 2) and have strived to make traditionally in-person content (eg, Epi-Ready) more widely accessible using alternative modalities. IFS CoEs have used synchronous “live learning” online trainings to bring the desired “face-to-face” learning experience to a more accessible online forum using bidirectional video. This training model connects professionals with each other and subject matter experts and uses examples (eg, outbreak scenarios) as a platform for in-depth discussion.^{14,15} This model has been particularly useful in preparing epidemiologists and laboratory scientists for transitioning to WGS-based subtyping for cluster detection and tackling nuanced topics such as hypothesis generation.¹⁶ Additional training opportunities offered by IFS CoEs include just-in-time trainings, asynchronous on-demand trainings, case studies and tabletop exercises, and training programs customized for specific agencies or jurisdictions (Table 2).

Recognizing the diversity of the public health workforce disciplines (epidemiology, public health nursing, environmental health, laboratory sciences), experience, state structure (centralized vs decentralized), and agency size, IFS CoEs have developed a conceptual framework with 3 tiers to qualitatively describe the workforce (Figure 2): tier 1 investigators recognize and participate in outbreak investigations at agencies with low outbreak frequency or in entry-level positions at larger agencies; tier 2 investigators routinely detect, investigate, and respond to outbreaks at agencies with medium to high outbreak frequency; and tier 3 investigators innovate and advance outbreak response in senior positions at agencies with high outbreak frequency. In addition, IFS CoEs developed core competencies for public health professionals in environmental health and epidemiology to both facilitate standardization of workforce capabilities and assist with development of individual- and agency-level training plans. Existing trainings were mapped to the competencies to develop a curriculum that guides practitioners to targeted trainings and identifies areas where training development is needed (Training Roadmap available at foodsafety.utk.edu).

Providing technical assistance through peer mentorship and by enhancing peer networks

Peer learning has been shown to build confidence, increase collaboration, and reduce professional isolation.^{14,17} IFS CoEs have leveraged the regional model to build relationships and strengthen peer networks among state-level foodborne disease investigators both formally (eg, NY Regional Learning Collaborative) and informally (eg, regional meetups at conferences or remotely on Zoom). These connections foster sharing and collaboration by peers, complementing the more hierarchical coordination and leadership from CDC, and leading to a sense of regional community. Peer networks have also been built through training activities that connect professionals from across the region or country during in-person workshops or during multisession live learning opportunities that use bidirectional video and interactive, discussion-based activities. In addition, IFS CoEs host regional communities of practice and office hours to discuss timely topics such as the implementation and interpretation of genomic data.

Building on peer networks, IFS CoE staff provide technical support during active outbreak investigations. IFS CoE staff work with jurisdictions to connect investigators with topic area experts, collaboratively troubleshoot challenging investigation scenarios, and provide guidance on technical components, including study design, questionnaire design, interviewing, database management, specific tools (eg, Epi Info, REDCap, SEDRIC), data analysis, WGS, shopper card data, environmental and food sampling techniques, and traceback activities. The type of technical support offered ranges from short telephone consultations to ongoing one-on-one mentorship sessions and site visits. Collectively, IFS CoEs respond to 50 to 100 requests for technical support per year. After outbreak investigations, IFS CoEs have facilitated postoutbreak assessments, or “hotwashes.” Offered in person or via bidirectional video, hotwashes are facilitated discussions between all people involved in the investigation; sessions are brief (approximately 2–3 hours in duration) but intensive.

IFS CoEs also conduct site visits, or reverse site visits, to connect with investigators from other jurisdictions, providing a forum to discuss strategies and tools for best practices in enteric disease surveillance and outbreak response. In-person visits are typically conducted over 2 to 3 days and include tailored trainings to support the needs of the jurisdiction. Site visits are generally multidisciplinary, involving IFS CoE health department subject matter experts in epidemiology, environmental health, and laboratory sciences, as well as academic partners. Notably, IFS CoEs used this approach to support foodborne disease investigators in Puerto Rico and the US Virgin Island as part of CDC’s hurricanes Irma and Maria response activities.

Evaluating current practices to improve timeliness and effectiveness

IFS CoEs work with state and local health departments and with national-level data to evaluate and analyze the timeliness and effectiveness of foodborne disease surveillance and outbreak response activities. The purpose of such evaluation and analysis efforts is to identify gaps and evaluate practices that can help focus training efforts, tools, and resources.

IFS CoEs have used quantitative and qualitative methods to evaluate surveillance and outbreak activities at public health agencies. For example, IFS CoEs have facilitated Council to Improve Foodborne Outbreak Response (CIFOR) performance evaluations, which identified specimen collection as an opportunity for improvement in multiple states. IFS CoEs used this information to prioritize resources to improve capacity for specimen collection, promote the use of stool specimen collection kits, and survey local public health jurisdictions to better understand barriers. In its third edition, CIFOR began promoting the use of existing surveillance program metrics to evaluate and improve performance of surveillance activities.¹⁸ IFS CoEs are currently working to develop approaches to benchmark the performance of surveillance activities against these established metrics. As states improve their abilities to detect and investigate outbreaks, IFS CoEs evaluate those improvements to promote model practices and identify additional training and resource needs.

IFS CoEs evaluate and analyze novel practices that could be implemented by individual health departments or at a systems level. Often these novel practices have been developed in response to challenges arising in the field. For example, the increased use of CIDs has resulted in an increase in case counts, placing a larger interview burden on health departments. To address this, IFS CoEs developed, implemented, and evaluated the use of online surveys to supplement routine telephone-based case investigations.¹⁹ In another example, IFS CoEs developed a statistical model using outbreak characteristics and demographics from past outbreaks to determine likely outbreak sources and translated this into a user-friendly, publicly available online tool for investigators to use when generating hypotheses during an enteric illness outbreak.^{20,21} IFS CoEs have evaluated the use of binomial trials as a way to explore hypotheses and supplement time-intensive analytic studies, including using existing *Salmonella* and Shiga toxin-producing *Escherichia coli* (STEC) sporadic case exposure data to create background consumption estimates for use in binomial probability calculations during outbreak investigations.²² In collaboration with NEHA, IFS CoEs have demonstrated the importance of local environmental health program practices on foodborne illness complaint reporting and detection of outbreaks.^{23,24} In collaboration with the Interagency Food Safety Analytics Collaboration (IF-SAC), IFS CoEs have evaluated state-level variation of outbreak reporting to CDC.²⁵

Developing future public health professionals in foodborne disease

To develop the future workforce, IFS CoEs provide training and practice-based learning opportunities for students. IFS CoEs provide courses for academic credit through their university partners, including a multisite seminar-style course—*Theory and Practice in Foodborne Disease Outbreak Detection, Investigation, and Control*—that brings together students from multiple IFS CoE partner universities, as well as other field epidemiology courses focused on outbreak investigation and surveillance. Students connect with each other, with faculty, and with practicing foodborne disease epidemiologists to learn about outbreak investigation practices and emerging topics in the field. In addition to academic courses, IFS CoEs offer students short courses on outbreak investigations and interviewing techniques. For example, the Foodborne Outbreak Challenge, a 1-day simulated outbreak

investigation event modeled on public health case competitions, was developed with material to support its implementation in other sites.²⁶

Mentorship is a crucial complement to classroom-based learning.⁹ IFS CoEs support 20 to 30 students per year in a range of capacities, including internships, undergraduate and graduate student stipends, practicums, and capstones. Many of these students have gone on to work in governmental public health agencies. In particular, engaging students in student interview teams has proven to be a mutually beneficial model, providing practice-based learning opportunities to students, who may become long-term public health workers, while also providing capacity to public health agencies.²⁷ IFS CoEs offer multiple models for student outbreak and interview teams, including on-demand teams for surge capacity during investigations and/or permanent teams that conduct routine enteric disease interviews. Although student interview teams have been developed to support foodborne disease surveillance in many states, IFS CoE teams have 2 distinct features: (1) the existing integration between academia and health departments in IFS CoEs facilitates student recruitment, training, and coordination without additional contractual arrangements, which can be a barrier²⁸; and (2) some IFS CoE student teams have the ability to provide surge capacity to other states or local health departments.

Impact of the IFS CoE model on emerging issues

The transition from pulsed-field gel electrophoresis (PFGE) to WGS has revolutionized foodborne disease surveillance and cluster detection, similar to PFGE in the late 1990s.⁵ The utilization of this laboratory technology, as well as the parallel innovation in epidemiological methods, required both comprehensive training of public health professionals and the development of model practices to interpret WGS results for cluster detection and investigation. To address this gap, IFS CoEs were instrumental in designing and disseminating resources; delivering national and regional live learning series and webinars; developing on-demand learning modules and videos; providing regional peer support during regularly scheduled office hours, community of practice learning sessions, and on-demand technical support consultations; and publishing WGS analyses.^{29,30}

During the COVID-19 pandemic, IFS CoE academic partners were able to rapidly provide support to public health professionals who were responding to the crisis, including deploying student interview teams; developing and implementing methods for supplementing routine interviews with online surveys; developing guidance and providing forums for collaborative information exchange among industry partners; adapting existing trainings to online and remote formats; modifying existing IFS CoE resources to assist with the COVID-19 response; and evaluating the impact of COVID-19 on enteric disease surveillance and outbreak detection. As public health capacity continues to be challenged by COVID-19 response efforts, IFS CoEs are well positioned to provide stability and support to regional partner state/jurisdictions. This collaborative, cross-jurisdictional support is crucial during public health crises and should be leveraged to further build capacity. Furthermore, the pandemic has exacerbated gaps in public health infrastructure and innovation, which has highlighted the utility and flexibility of IFS CoE regional and academic-health department collaborations.

The future of IFS CoEs

In upcoming years, IFS CoEs' envision growth in the following 3 areas. First, while IFS CoEs have focused outreach activities on foodborne disease surveillance and outbreak response, there is a recognized need to expand beyond foodborne to other enteric pathogens and routes of transmission, including waterborne and zoonotic transmission. While some activities have included zoonoses, there are additional opportunities to integrate across these programs. Second, FSMA language explicitly refers to "conducting research"; however, the funding mechanism for IFS CoEs (the ELC cooperative agreement) prohibits research. To circumvent this barrier, academic partners have sought separate funding sources to support IFS CoE research activities; however, public health surveillance is not a priority area for external funding sources. Given research is a core activity of the program, this has been a limitation. Third, IFS CoEs have primarily focused on training and outreach activities targeting graduate students of public health, but there is a growing need for undergraduate education to meet public health and environmental health workforce needs.^{10,31}

Conclusion

Reducing the burden of foodborne disease in the United States is a complex goal, involving coordination across regulatory partners, public health agencies, and the food industry. As stated in FSMA language, IFS CoEs were created to fill a gap in resources for public health professionals responding to foodborne disease outbreaks while not duplicating other federal foodborne disease response efforts. As such, IFS CoEs have created diverse and prolific partnerships with federal agencies, national organizations, academic institutions, and public health departments. Cross-jurisdictional and interdisciplinary collaboration is essential to effective outbreak investigation and control. IFS CoEs collaborate with many partners, including NEHA, NACCHO, CDC NCEH, IFSAC, NNPHI, and the food industry. The IFS CoE model inherently fosters collaboration and innovation with academic partners. It helps further progress toward public health goals by sharing resources, incorporating new methods into practice, and evaluating their impact on the capacity of foodborne disease surveillance and outbreak response.

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BOX**Integrated Food Safety Center of Excellence Activities Described by the Food Safety Modernization Act Legislation, SEC. 399V-5**

“(c) Activities—Under the leadership of the Director of the Centers for Disease Control and Prevention, each Center of Excellence shall be based out of a selected state health department, which shall provide assistance to other regional, state, and local departments of health through activities that include—

1. providing resources, including timely information concerning symptoms and tests, for frontline health professionals interviewing individuals as part of routine surveillance and outbreak investigations;
2. providing analysis of the timeliness and effectiveness of foodborne disease surveillance and outbreak response activities;
3. providing training for epidemiological and environmental investigation of foodborne illness, including suggestions for streamlining and standardizing the investigation process;
4. establishing fellowships, stipends, and scholarships to train future epidemiological and food-safety leaders and to address critical workforce shortages;
5. training and coordinating state and local personnel;
6. strengthening capacity to participate in existing or new foodborne illness surveillance and environmental assessment information systems; and
7. conducting research and outreach activities focused on increasing prevention, communication, and education regarding food safety.”

Implications for Policy & Practice

- The trainings, tools, and technical assistance offered by IFS CoEs can be used to strengthen the current and future workforce and build peer-to-peer networks among public health professionals engaged in enteric disease surveillance and outbreak response.
- A collaboration between state health departments and academic partners, IFS CoEs are well positioned to evaluate and analyze current practices and identify gaps that can be used to inform the development, evaluation, and promotion of model practices, trainings, tools, and other resources.
- The IFS CoE regional model fosters national peer-to-peer networks and collaboration, reducing professional isolation and increasing the sharing and dissemination of existing resources and model practices.
- IFS CoE programs are designed to be nimble and responsive to systems-level changes in practice and emerging public health issues, as evidenced by the support offered to public health professionals during the transition to WGS for cluster detection and the COVID-19 pandemic.

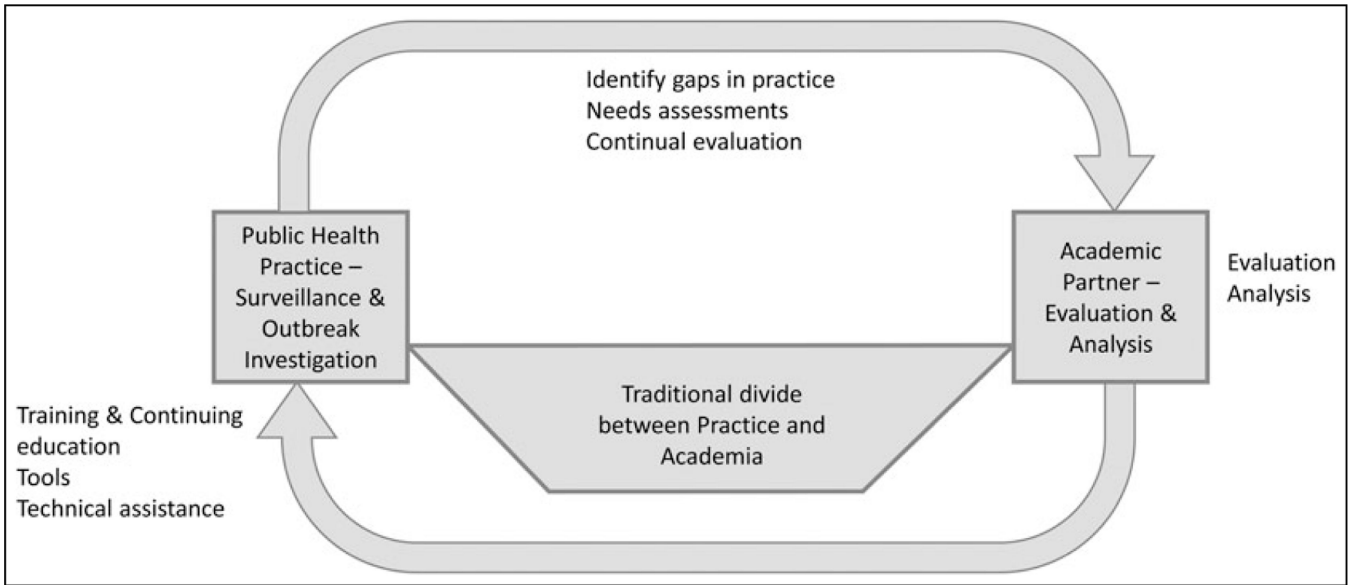


FIGURE 1. The Collaboration Continuum Between Public Health and Academic Partners to Rapidly Identify Public Health Needs, Evaluate and Analyze Surveillance and Outbreak Data, and Inform Practice

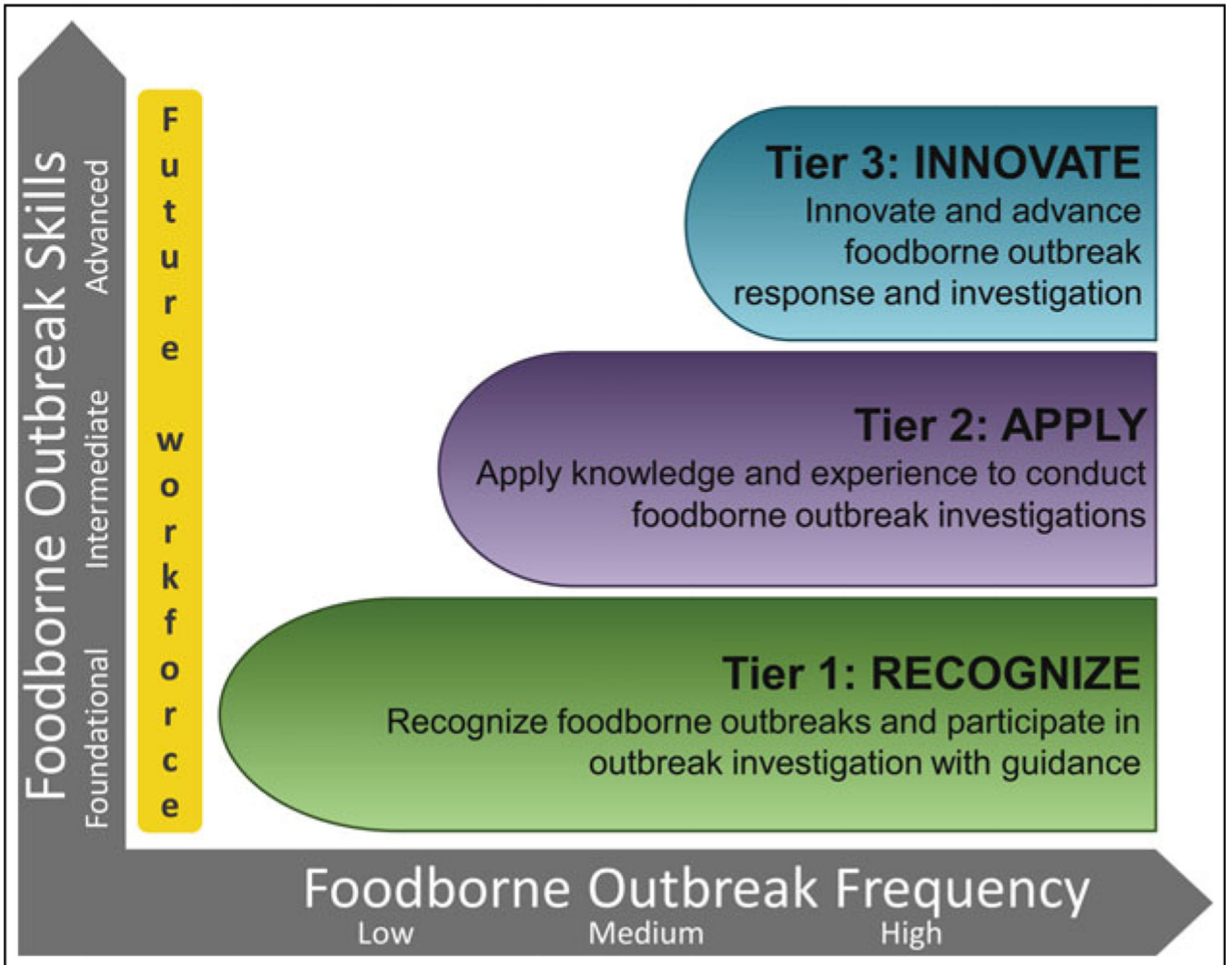


FIGURE 2. Target Audience Framework for Public Health Professionals Who Detect and Investigate Foodborne Disease Outbreaks in the Epidemiology Role

TABLE 1
Regional and Center Characteristics, Integrated Food Safety Centers of Excellence^a

CoE Region	Academic Partner	States/Territories	Total Population ^b	# Decentralized States
Colorado	Colorado School of Public Health	AZ, KS, MT, NE, NM, OK, TX, UT, WY	57 788 351	7
Minnesota	University of Minnesota School of Public Health	IA, IL, IN, MI, MO, ND, OH, SD, WI	63 481 282	7
New York	Cornell University	CT, DE, MA, MD, ME, NH, NJ, PA, RI, VT, WV	65 500 143	6
Tennessee	University of Tennessee	AL, AR, FL, GA, KY, LA, MS, NC, SC, VA, PR, USVI	86 303 950	7
Washington	University of Washington School of Public Health	AK, CA, GU, HI, ID, NV	58 359 491	5

Abbreviation: CoE, Center of Excellence.

^aState contact information is available from cdc.gov/foodsafety/centers/about.html.

^bFrom 2019 US Census population estimates. Total population does not include population estimates for Guam and US Virgin Islands.

TABLE 2
Example Trainings, Resources, Tools, and Technical Support Offered by Integrated Food Safety Centers of Excellence and Available at FoodSafetyCoE.org

Modality	Description	Outputs (2017–2021)
Trainings		
Epi-Ready Team Training	Epi-Ready is a 2-d in-person workshop for epidemiology, environmental, laboratory, and other public health professionals with responsibility for investigation of foodborne illness outbreaks. With a team-based approach to training, Epi-Ready focuses on how to efficiently and effectively respond to an outbreak by understanding the roles and responsibilities of the disciplines involved: Epidemiology, Environmental Health, and Laboratory.	49 trainings attended by staff from 36 states/territories
Applied Outbreak Investigation (AOI)	AOI Training is a 1-d, in-person training for state and local public health agency staff who could potentially work on an outbreak investigation, including epidemiologists, public health nurses, environmental health professionals, emergency preparedness staff, etc. The training is designed to be an intensive, interactive course to teach epidemiological skills during a foodborne outbreak investigation.	13 trainings attended by 313 staff from 5 states/territories
Case Studies	Case studies are interactive group exercises based on actual outbreaks developed to teach outbreak investigation methods.	10 cases studies published
Hypothesis Generation During a Foodborne Illness Outbreak Investigation	This is a 4-session series for foodborne epidemiologists on available data and tools for hypothesis generation.	5 series attended by 75 staff
Cluster Investigation Simulation	An interactive cluster investigation simulation training in which disease investigators conduct interviews on simulated cases (played by CoE staff) and then determine the outbreak setting and vehicle. The simulation focuses on providing experience and feedback on interview and cluster investigation techniques.	4 simulations for 2 jurisdictions
Resources and Tools		
Training needs and capacity assessments	CoEs routinely conduct needs assessments using online surveys, key informant interviews, direct communications, and informal polling.	
Project Hg	Project Hg is a multisite collaboration that utilizes existing <i>Salmonella</i> and STEC case exposure data to create aggregates of background consumption estimates for use in binomial probability calculations during outbreak investigations.	6 states have provided data
Key Points and Toolkits	Key Points documents highlight the key points for various enteric disease topics (eg, creating a team of student workers, cluster prioritization, creating a foodborne complaint system). Toolkits collate existing trainings on a given topic (eg, hypothesis generation, interview, media communication, industry relations)	9 key points documents, 4 toolkits
Environmental Health Sampling	The Environmental Health Sampling resource includes short checklists for environmental health professionals to reference when responding to specific infectious disease situations (eg, responding to a <i>Salmonella</i> outbreak in a restaurant, or responding to a suspected bacterial intoxication outbreak).	7 checklists
Regional Collaboration and Technical Support		
Site visits	CoEs are available to host in-person or reverse site visits to state/jurisdictional public health partners requesting technical assistance. The purposes of the site visits are to troubleshoot issues/concerns in enteric disease surveillance and outbreak detection and response and discuss strategies and tools for best practices.	33 site visits with 17 states/territories

Abbreviations: CoE, Center of Excellence; STEC, *Shiga toxin-producing Escherichia coli*.