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Environmental Assessments: An Important Part of Outbreak Investigations

Editor's Note: The National Environmental Health Association (NEHA) strives to provide up-to-date and relevant information on environmental health and to build partnerships in the profession. In pursuit of these goals, NEHA features this column on environmental health services from the Centers for Disease Control and Prevention (CDC) in every issue of the *Journal*.

In these columns, authors from CDC's Water, Food, and Environmental Health Services Branch, as well as guest authors, will share insights and information about environmental health programs, trends, issues, and resources. The conclusions in these columns are those of the author(s) and do not necessarily represent the official position of CDC.

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Environmental assessments (EAs) help ensure outbreaks are fully understood and addressed to protect health (Brown et al., 2017). Key information about the outbreak—how and why it happened and what interventions should be implemented—is not always obvious and can be challenging to determine. Conducting EAs during an outbreak investigation helps determine control measures to prevent future outbreaks.

Collaborative Efforts Guide Environmental Assessments

Collaboration between environmental, epidemiological, and laboratory investigators helps guide an outbreak response. During an investigation, epidemiologists focus on who got sick (host) and when and where the outbreak happened. Laboratorians analyze clinical

specimens to determine what made people sick (agent). Environmental health specialists collect environmental samples and data to see how the agent was able to infect the host.

Sharing outbreak data can help determine the system failures (contributing factors) and root causes (environmental antecedents) of an outbreak. These data also help investigators recommend actions to stop the outbreak and prevent another one.

Environmental Assessments Help Investigators Learn How and Why an Outbreak Occurs

An EA helps investigators describe where the outbreak happened (outbreak environment). Investigators study the outbreak environment, like a system made up of many parts. They examine how parts of the system—

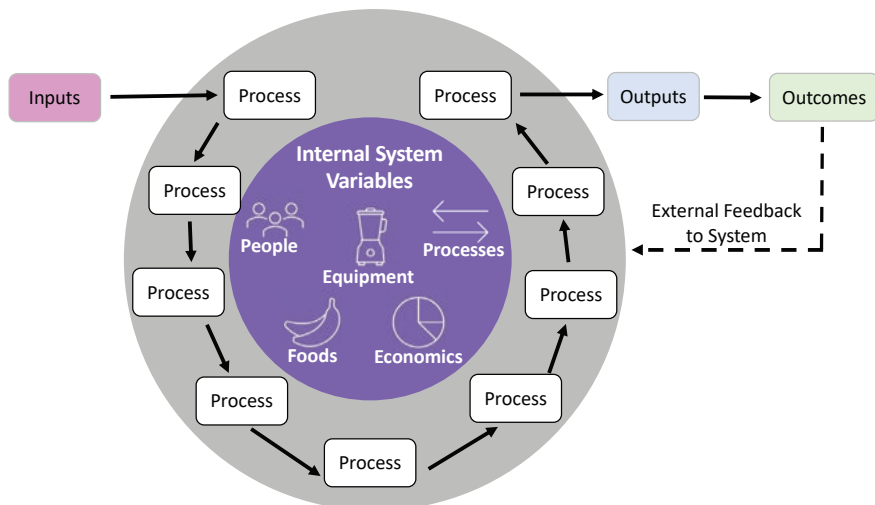
inputs, processes, variables, outputs, and outcomes—influence one another (Figure 1) to determine how the outbreak occurred (contributing factors). They can then examine which variables, such as processes, people, economics, and equipment, are responsible for the outbreak (environmental antecedents).

For example, when recurring outbreaks of acute gastroenteritis occurred on two cruise ships in 2019 (Rispen et al., 2019), investigators suspected norovirus as the agent based on the symptoms experienced and duration of illness. They collected epidemiological data and based on prior knowledge, they focused on frozen berries and fruits most likely consumed in smoothies. The investigators sent suspected frozen fruit items to the laboratory for testing and norovirus was found in the samples. Investigators now knew exactly *what* was causing the illness; however, they did not know *how* and *why* it got into the environment.

During the EA, investigators created a flowchart to map out how the fruit items were prepared for smoothies, which helped determine whether any steps in food preparation on the ship contributed to the fruits being contaminated. The flowchart did not reveal any issues on the ship, so investigators moved their focus to the supplier. The investigators were able to trace the frozen berries back to a single supplier and determined that contamination most likely occurred from this source. As a result, the World Health Organization issued a recall notice for those berries. Without a traceback investigation to confirm a supplier-based outbreak due to contaminated food, people would have likely continued to get sick.

FIGURE 1

Diagram of the Food Safety System



Data Collected During Environmental Assessments Can Help Inform Prevention Efforts

Illness outbreaks are common in food settings. Data from the Centers for Disease Control and Prevention (CDC) show that restaurants with certified kitchen managers had lower rates of foodborne norovirus outbreaks compared to those without certified kitchen managers (Hoover et al., 2020). In addition, EA data from 404 outbreaks showed key gaps in retail food safety practices and outbreak investigations, particularly around sick workers who were noted to be a common source of food contamination and outbreaks (Lipcsei et al., 2019).

EAs can also apply to other settings, like outbreaks related to water. For example, outbreak investigations of Legionnaires' disease require an EA to identify potential sources of exposure (Garrison et al., 2016) and such assessments have shown that water management programs are an effective control strategy for preventing *Legionella* outbreaks (Clopper, Kunz, Salandy, et al., 2021).

Environmental Assessments Are Different From Inspections and Require Different Training

Routine inspections look at regulations, operational violations, and sanitary condi-

tions during normal operations when there is no outbreak. EAs look for clues to understand how factors in the environment led to an outbreak. Since outbreaks can be infrequent in a community, EAs might not be common for health department staff. Everyone needs to know their roles during an outbreak investigation. Training staff before the emergency means they will be ready when an outbreak occurs.

Centers for Disease Control and Prevention Tools to Help Conduct Environmental Assessments

CDC's National Environmental Assessment Reporting System helps food safety programs capture EA data from investigations of foodborne illness. Programs can join for free and use their data to help identify environmental causes of outbreaks and take follow-up actions to reduce or prevent future outbreaks. CDC's Environmental Assessment Training Series provides training on the role of EAs in the context of outbreak investigations and the food safety system.

The *Legionella* Environmental Assessment Form helps investigators assess a facility's water system, determine whether to conduct *Legionella* environmental sampling, and helps investigators design sampling plans.

Quick Links

- Read more about the National Environmental Assessment Reporting System findings from norovirus outbreaks in restaurants: www.cdc.gov/nceh/ehs/nears/norovirus-outbreaks-restaurant-practices.html
- Explore the *Legionella* Environmental Assessment Form, *Legionella* Control Toolkit, and training videos: www.cdc.gov/nceh/ehs/activities/legionella.html
- Find tools to help you conduct assessments after an emergency: www.cdc.gov/nceh/ehs/rra/conducting-assessments.html

Environmental Assessment Data

States, tribes, localities, and territories can adopt the Food and Drug Administration's *Food Code* for their own restaurant food safety rules. The Centers for Disease Control and Prevention's environmental assessment (EA) data show that states that have adopted the *Food Code* provision on certified kitchen managers have fewer norovirus outbreaks.



Data from the National Environmental Assessment Reporting System (NEARS) have also helped us understand the following:

- Why investigators did or did not conduct EAs for outbreaks.
- Practices linked to smaller and shorter norovirus outbreaks in restaurants.
- Traits to outbreaks that helped investigators identify their contributing factors.

Learn more about findings from NEARS at www.cdc.gov/nceh/ehs/nears/publications.htm.

The CDC Toolkit for Controlling *Legionella* in Common Sources of Exposure can further support EAs during public health investiga-

Environmental Health Practitioners Fill Key Roles in Outbreak Investigations

- Assess a specific event that occurred in the past using critical thinking.
- Focus on how and why a pathogen got into the outbreak environment and spread.
- Collect data through interviews, observations, record reviews, and environmental sampling.
- Use data from their assessment, laboratory, and epidemiology findings to inform what should change to stop and prevent future outbreaks.
- Identify contributing factors and environmental antecedents to the outbreak.
- Implement interventions and make recommendations to help stop and prevent future outbreaks.

What Is the Difference Between Contributing Factors and Environmental Antecedents?

- **Contributing factors:** How an outbreak happened—behaviors, practices, and environmental conditions that led to the agent getting into, surviving, or growing in the environment. For example, an *E. coli* outbreak happened because the food worker did not cook a burger long enough or to a hot enough temperature to kill the *E. coli* in the beef.
- **Environmental antecedents:** Why an outbreak happened—conditions that led to the contributing factor(s). For example, it was lunch rush and the worker was in a hurry and did not check to make sure the burger was cooked to proper temperature. Ultimately, this antecedent might be due to a lack of food safety culture or a lack of active managerial control in the restaurant.



Photo 1. The Centers for Disease Control and Prevention’s (CDC) Legionella Environmental Assessment Form, Legionella Control Toolkit, and instructional videos can help investigators learn how to conduct assessments and collect samples. Photo courtesy of CDC.

tions. The toolkit contains essential information regarding design, operation, maintenance, and controls specific to the source of exposure (Clopper, Kunz, & Hannapel, 2021). Investigators can watch educational videos (Photo 1) to learn tips for conducting these EAs and how to interpret results from the form.

Environmental Assessment Data Improve Public Health Outcomes

Outbreak investigations can be complex and difficult to solve. The goal of every investigation is to learn how and why the outbreak is occurring and fix the problem to help prevent more illness. Data collected from outbreaks can inform the most common contributing factors and environmental antecedents. What we learn from EA data can help identify risk factors and stop outbreaks before they occur. Ultimately, this evidence-based information strengthens the science behind the root causes of an outbreak to inform and influence public health practices and policies. 🗣️

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