

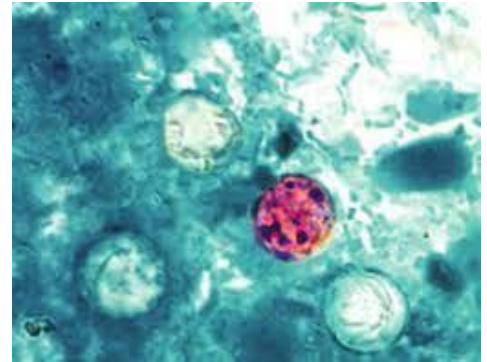
Investigating Fresh Produce *Cyclospora* Outbreaks



Foodborne illness investigations involving *Cyclospora* are more complicated because they are centered around a parasite rather than traditional pathogens. Inspectors are often challenged when investigating *Cyclospora* outbreaks due to the lack of resources and guidance specific to the farm. This guidance is designed to provide considerations, preventive opportunities, and challenges involved in *Cyclospora* related foodborne illness outbreaks.

Introduction

Foodborne illness outbreaks (when two or more people get sick from eating the same food) of *Cyclospora cayetanensis* (referred to as *Cyclospora* in this document) in produce have been linked to various produce items including berries, mesclun lettuce, snow peas, basil, and cilantro. Foodborne illness outbreak investigations involving fresh produce are typically centered around bacterial and viral pathogens. In the case of *Cyclospora*, the agent of contamination is a parasite, not a bacterial or viral pathogen (disease causing microorganism). As a result, it is critical to understand the differences of an investigation and the life cycle of *Cyclospora*, which will facilitate the appropriate communication with farmers, growers, and workers.



Humans, not animals, are the only known source of *Cyclospora*. When investigations occur for a *Cyclospora* parasitic infection outbreak, they focus on the potential of contamination by human waste. Due to the nature of outbreaks, sometimes they are not reported to public health officials until several weeks after the occurrence. Because of the hardiness of the parasite, and its extended survival in the environment, it is important to understand the life cycle of *Cyclospora*, and how contamination of fresh produce might occur.

Cyclospora is a one-celled human parasite that causes the infection known as cyclosporiasis. An oocyst (egg-like life stage) must be ingested by and live inside a human host to survive and multiply. A person infected with *Cyclospora* then passes the parasite oocyst in their feces. Once excreted (shed) from the human body, the *Cyclospora*'s oocyst typically takes 1-2 weeks to mature (sporulate) and become infectious when ingested. The time it takes for an oocyst to mature is called sporulation. It appears that the parasite is not infective immediately after shedding which means that a longer timeframe needs to be examined. An indirect, or delayed, (e.g., contamination that occurred before harvest) fecal-oral route is much more likely than a direct fecal-oral route (e.g., poor handwashing immediately prior to consumption). The fecal-oral route occurs when a person eats or drinks a product, such as raw produce, either directly or indirectly, contaminated with human feces.

People get the infection by drinking water or eating food that is contaminated with the mature (sporulated) oocyst. Because of the time needed for sporulation to occur, direct evidence of fecal contamination may not be obvious. It should also be noted that research shows that the highest risk time for outbreaks in the United States is in the spring and summer (May – August). The reason for this seasonality is not completely understood.



Based on current knowledge, since humans are the only known source of *Cyclospora*, the focus of questions and the investigation are on humans rather than a traditional investigation of a bacterial or viral foodborne outbreak which would also include assessment of manure, compost,

wildlife, domestic animals, and surrounding land use. An investigation for the source will include all employees or other individuals involved during production, including those who planted, weeded, harvested the crop, and individuals involved in other production activities involving the crop. Understanding when and how all workers were associated with the crop, history of diarrheal illness in the weeks and months before the outbreak occurred, and the travel history of those people, will help drive the investigation. The investigation will also focus on other routes of contamination where human feces may be present, including the water source, toilets and handwashing facilities, sewage systems, and living arrangements of employees.

Investigations

Because the focus of the *Cyclospora* outbreak investigation is on humans as a source of the contamination, it is important to understand the jurisdiction within the organization, agency, and sister agencies. *Cyclospora* investigations often involve many different players, including state and local health agencies, state epidemiologists, and will require an awareness of the Health Insurance Portability and Accountability Act (HIPAA) Privacy Rules. Knowing the limits of what your organization can do is critical.

Moving beyond the initial investigation, once the underlying hypothesis (theory) has been determined, an environmental assessment will be initiated and will drive the direction of the investigation. The environmental assessment is highly situationally dependent, and the role of the state investigator will be determined by subject matter experts. Due to the fact that product could be contaminated with *Cyclospora* a month or more before the outbreak, any sampling performed will be different than normal. Because the organism cannot grow in the laboratory, large sample sizes may be necessary so that sufficient numbers of the parasite can be detected. Human feces may be collected for analysis by the jurisdiction having authority. When a water sample is collected, larger quantities of water (up to 150L, via ultrafiltration) must be collected due to the uneven dispersal of *Cyclospora* in the water. Unlike a bacterial investigation, conducting an investigation will not look at the chemical disinfection of water (pre or post-harvest) since it is ineffective at eliminating *Cyclospora*.



Investigative Considerations

- Any portable toilets observed in the field and/or farm production areas.
- Where are the portable toilets serviced and how far is that from the sources of water used by the farm?
- Any signs of toilet paper in fields.
- Any signs of human feces in the fields.
- Any repairs, leaks, or spills to sewerage systems on the farm or portable toilets.
- Any human waste (sewage sludge or bio solids) used on the farm.
- Any recycled or grey water (non-human wastewater such as used hand wash water) used on the farm as irrigation.
- Any potential sources of human waste in or around the farm or water sources (e.g., septic systems, wastewater treatment facilities, landfills, and recreational activities).
- Any flooding event the farm was exposed to. If yes,
 - What was the depth of flooding or depth of coverage to the crop?
 - What was the source of the floodwater?
 - How long did the water remain in contact with the crop?
 - Was the field drained to another field?
 - Could the flooding have caused backup from sewerage lines which could have contacted the produce?

- Where are the field workers sourced from (both pre-harvest and harvest)?
- Who enters the field (both during pre-harvest or harvest) and what activities do they do?
- When did the workers enter the field?
- Are farm or harvest workers housed on the farm or in off-farm worker housing?
- What is the crop harvest method (e.g., bare hand, bare hand with utensils, gloved hand, gloved hand with utensils, automated, other)?
- Do workers bring harvest tools home with them at the end of the day and bring them back the next work day?
- Any history of farm or harvest workers' illness with symptoms related to *Cyclospora*. (e.g., diarrhea) in the weeks or months before the outbreak occurred.
- Any farm or harvest workers who have suffered relapses of symptoms.



Preventive Opportunities

- Train employees in their native language.
- Train farm workers on how to properly use only toilet facilities provided by the farm, including the sanitary disposal of toilet paper inside the toilet.
- Train farm workers on the importance of proper handwashing and use of hand soap.
- Train farm workers on health and hygiene.
- Train farm workers on the criticality of not working with specific symptoms which could indicate an illness.
- Train farm workers if they have sick family members, there is a chance they could be infected but have no symptoms.
- Ensure there is supervisory oversight for farm worker health/hygiene/sanitation.
- Consider the varying cultural practices of farm workers when providing training on produce safety.
- Ensure field workers' own tools are properly cleaned and sanitized before and after work day.
- Consider the potential for contamination during pre-harvest, harvest, and post-harvest by workers/water sources.
- If utilizing a contractor for cleaning and sanitizing the portable toilets, consider using reputable companies that dispose of human waste into an adequate sewage system or through other adequate means.
- Cleaning and maintenance of portable toilets should be done away from the growing environment, including all sources of water.
- Develop a plan to manage and dispose of leakages or spills of human waste to prevent contamination.
- Develop a plan to prevent contamination after a significant event such as a flood or earthquake.
- Locate and map sewage and septic systems, including drain fields, to assist in monitoring for leaking or failing systems that could lead to contamination.
- Locate and map water sources, including nearby and adjacent lands, to ensure they do not have the potential for contamination (such as human feces or leaks through sewage or septic systems), wastewater treatment facilities, landfills, and recreational activities.



Challenges

- The long time periods that may occur between *Cyclospora* contamination, consumption, and symptoms/illness results in delays in detection of cases and outbreaks, which may or may not be reported, and if reported, are often several weeks after exposure.
- Some individuals infected with *Cyclospora* do not show any symptoms.
- Determining which produce item was the vehicle of an outbreak can be difficult because some fresh produce is often served as garnishes or in other relatively inconspicuous ways that are easily overlooked or not remembered by the ill person, and several types of produce are often served together (e.g., in a fruit salad).
- Once oocysts are in the environment, there is a lack of methods or treatments, including chlorine, to eliminate them.
- Unlike outbreaks associated with bacterial and viral pathogens, we do not have the scientific tools (e.g., Whole Genome Sequencing) to genetically link cases of illness. This also means that it's not currently possible to genetically link product or environmental findings with the outbreak strain.
- Short shelf life and lack of brand-name recognition of fresh produce are two factors that complicate trace-back investigations to determine where a produce item was grown.
- A very specific test must be run on a sick employee or ill consumer in order to identify *Cyclospora* as the cause of illness.
- Reoccurrence can occur without appropriate common antibiotic treatment.

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Additional Resources

1. FDA Fact Sheet Cyclosporiasis and Fresh Produce:
<https://www.fda.gov/media/123995/download#:~:text=cayetanensis%20is%20a%20human%20parasite,water%20contaminated%20with%20the%20parasite>
2. Cyclospora: <https://www.fda.gov/Food/FoodborneIllnessContaminants/Pathogens/ucm610936.htm>
3. Cyclosporiasis:
<https://www.cdc.gov/parasites/cyclosporiasis/index.html>
4. FDA Farm Investigation Questionnaire Form

AFDO is an international leader and trusted resource for building consensus and promoting uniformity on public health and consumer protection issues related to the regulation of foods, drugs, devices, cosmetics and consumer products.

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