

A .gov website belongs to an official government organization in the United States. A lock () or https:// means you've safely connected to the .gov website. Share sensitive information only on official, secure websites. CDC investigates each multistate foodborne outbreak thoroughly using a 7-step process. The steps are described in order, but investigations are dynamic and several steps may happen at the same time. Multistate outbreaks are usually identified by PulseNet, but other public health partners also identify them and report them to CDC. PulseNet is CDC's national laboratory network for detecting bacterial enteric (intestinal) disease outbreaks. Multistate outbreaks are usually detected by PulseNet. PulseNet scientists look for groups of people sickened by bacteria with the same DNA fingerprint (strain). Scientists perform DNA fingerprinting on bacteria using a method called whole genome sequencing (WGS). When a group of people get sick from bacteria with the same DNA fingerprint around the same time, it's called a cluster (possible outbreak). When an investigation shows that people in a cluster have something in common, suggesting they got sick from the same source, the group of illnesses is called an outbreak. Local and state health departments and federal partners like FDA and USDA may also receive reports from sick people, healthcare providers, and others about possible outbreaks. Information from these reports is frequently shared with CDC to see if the illnesses might suggest that a multistate outbreak is happening. Finding sick people is important to help public health officials understand the size and severity of a possible multistate outbreak and decide if there is ongoing risk to the public. Outbreak investigators develop a case definition to define which sick people will be included in the outbreak. They also use this definition to search for additional sick people that are part of the outbreak. Case definitions define who will be included as part of the multistate outbreak. Multistate outbreak case definitions usually include details about: Multistate outbreak case definitions do not typically limit who is included in the outbreak based on what state the sick person lives in or demographic characteristics of the sick person, such as age,

gender, or race. The number of sick people that meet the case definition is called the case count. Using the case definition, local, state, and federal investigators search for more cases related to the outbreak. For multistate outbreaks, investigators review DNA fingerprint information on cases reported through PulseNet. State and local officials may also look at other information to find cases that may be part of the outbreak and work to get DNA fingerprinting information, including:

In a multistate outbreak investigation, a hypothesis is a guess about the source of the illnesses based on what information is known. Hypothesis generation is an ongoing process during an investigation. Early in multistate outbreak investigations, it may not even be clear whether the outbreak is caused by a contaminated food or something else, like contact with animals. Many sources of information help to quickly narrow down how people in the outbreak got sick. Basic information about who is getting sick in a multistate outbreak and where and when the illnesses are happening can help investigators narrow the list of possible sources. Investigators use a graph called an epidemic curve or epi curve to track the number of illnesses over time. The pattern of the epi curve helps investigators decide if sick people were exposed to the same source over a short period or if the exposure was over a longer time. Investigators also use maps to mark where sick people live so they can easily see if or how the outbreak is spreading. The timing and spread of illnesses can provide important clues about possible causes of the outbreak, including whether a food causing an outbreak has a short or long shelf life and whether a food is distributed regionally or nationally. Before DNA fingerprinting information is available, state and local health departments already know that a possible foodborne illness has been reported in their state. State and local health departments interview these sick people with standard questionnaires. For many illnesses, like Salmonella, Listeria, and E. coli infections, states collect information on foods and other exposures that caused illnesses or outbreaks in the past. For some germs, the Council of State and Territorial Epidemiologists recommends that state and

local health departments ask sick people about certain foods and other exposures. When investigators suspect that a contaminated food is causing a multistate outbreak, they consider many different foods as the possible source. State and local public health officials interview people to find out what and where they ate in the days or weeks before getting sick. These interviews are called hypothesis-generating interviews, and they usually are much more detailed than routine enteric illness interviews. The time period investigators ask about depends on how long it takes for a germ to cause illness, which varies. CDC works closely with local and state public health officials to ask sick people in the outbreak a common set of questions. Depending on what is already known, interviews may focus on specific foods, but most hypothesis-generating interviews ask about many possible food exposures. View sample questionnaires and surveillance tools. Hypothesis-generating interviews typically include questions on:

Information from prior experience with the strain causing an outbreak can also help investigators narrow the list of possible causes. Sometimes the germ has caused outbreaks in the past or has been found in foods, animals, the environment, or food facilities. These findings can provide clues about the source of an outbreak, but an outbreak source is only confirmed after other types of information support the link between a food and the illnesses. Interviews rely on memory, and it can take several weeks from the time someone gets sick to confirm they are a part of an outbreak. Someone may not remember what they ate many weeks ago. Remembering is harder when the contaminated food is an ingredient such as eggs, spices, or herbs, because people often do not know specific ingredients of the food they ate. These challenges make it harder for investigators to quickly generate a hypothesis, and investigators may need to re-interview people when a new hypothesis is generated. Home visits can be helpful to look at the foods in a sick person's pantry and refrigerator. With permission, investigators may also get information from a sick person's shopper cards and other records of food purchases like receipts. Once investigators have narrowed

down the likely source of the outbreak to a few possible foods, they test the hypotheses. Investigators can use many different methods to test their hypotheses, but most methods entail studies that compare how often (frequency) sick people in the outbreak ate certain foods to how often people not part of the outbreak ate those foods. If eating a particular food is associated with getting sick in the outbreak, it provides evidence that the food is the likely source. Investigators can describe the strength of the association between food and illness by using statistical tests or measures, such as odds ratios and confidence intervals. An illness cluster is when two or more people who do not live in the same household report eating at the same restaurant location, attending a common event, or shopping at the same location of a grocery store before getting sick. Investigating illness clusters can help test hypotheses about the source of an outbreak because an illness cluster suggests that the contaminated food item was served or sold at the cluster location. Conducting epidemiologic studies within illness cluster locations can be an effective way to identify foods that are associated with illness. Case-control and cohort studies can both be used in illness cluster investigations and are especially useful when they assess associations between illness and specific food ingredients. In some multistate outbreaks, investigators identify numerous illness clusters. In those situations, looking for common ingredients that people ate across all the illness clusters can help investigators test hypotheses, even in the absence of an epidemiologic study. Investigators often compare the frequency of foods reported by sick people in a multistate outbreak to data that already exist about healthy people. The most common source for data about how often healthy people eat certain foods is the FoodNet Population Survey, a periodic survey of randomly selected residents in the FoodNet surveillance area. The most recent FoodNet Population Survey was conducted during 2018–2019 and included interviews from 38,743 adults and children. In addition to information on food exposures, the survey also includes questions on demographic characteristics, such as age, gender, race, and ethnicity. Investigators use statistical

tests to determine if people in an outbreak report eating any of the suspected foods significantly more often than people in the survey. Comparing the frequency of foods reported by sick people to existing data is often faster than conducting a formal epidemiologic study. If one or more of the suspected foods under consideration are not included on the FoodNet Population Survey, investigators might need to do an epidemiologic study to determine whether consuming the food is associated with being ill. Several types of studies can be conducted during multistate foodborne outbreaks: There are several reasons why hypothesis testing might not identify the likely source of an outbreak. Even if investigators do not find a statistical association between a food and illness, the outbreak could still be foodborne. If the outbreak has ended, the source of the outbreak is considered unknown. If people are still getting sick, investigators keep gathering information to find the food that is causing the illnesses. Health officials use three types of data to confirm the source of a multistate foodborne outbreak: epidemiologic, traceback, and food and environmental testing. Once the analysis of epidemiologic data indicates a suspected source for the outbreak, traceback and food or environmental testing data are used to confirm whether the food is the source. In addition to helping confirm which food is causing the outbreak, officials use traceback and testing information to help find exactly where contamination occurred. Contamination can happen anywhere along the chain of food production, including during growing, harvesting, processing, transportation, handling, or preparation. Knowing where contamination occurred can help public health officials take actions to stop the outbreak. During multistate foodborne outbreaks, traceback is usually conducted by state and federal food regulatory authorities and involves determining the movement of food through the food production and distribution chain. Traceback usually starts by following a suspected food consumed by a sick person back through the points of distribution, processing, and production to determine the source of the product or its ingredients. When a food reported by several sick people share a

common point in the chain of food production, it can confirm the food is the source of the outbreak and suggests that contamination happened at or before the common point. For example, if several people bought and ate different brands of salad that were packed at a common facility, this suggests that the salads were contaminated at the facility or that the facility received a contaminated salad ingredient. Finding the outbreak strain (germ with the same DNA fingerprint as those making people sick) in a food or in a food-growing or production environment can also confirm the source of an outbreak. Public health officials look for opportunities to test suspected foods in outbreaks, such as leftovers in sick people's homes and suspected foods from restaurants, grocery stores, or in the supply chain. Sometimes foods being tested for other reasons will identify an outbreak strain and help confirm the source of the outbreak. Food testing is most useful when it is driven by results of the epidemiologic investigation. Identifying the outbreak strain in a food cannot by itself confirm that the food is the source of the outbreak. Information from interviews must also show that sick people consumed the contaminated food. Traceback can be challenging for several reasons. Sometimes records documenting the movement of foods through the supply chain are missing, incomplete, or not linkable across companies. Also, if sick people consumed the same food multiple times before getting sick, it can be difficult to know which exposure to trace back. Finally, investigators often don't have enough detail about a food exposure to start a traceback. For example, a sick person might not have information on the specific brand or production date of a food they ate. Food and environmental testing can also be challenging. Investigators need to collect enough epidemiologic information to know which foods or environments to test. Even if they have enough information to test specific foods, it may be difficult to find foods to test if the product has a short shelf life. Sometimes leftover foods in open containers can include a mix of ingredients, which also makes test results challenging to interpret. Finally, only a small fraction of any given food can be tested during an outbreak, so a

negative test does not prove that a food was not contaminated. Investigators must act quickly in multistate outbreaks to prevent more illnesses. If contaminated food isn't removed from store shelves, restaurant kitchens, or homes, more people may get sick. When investigators confirm the source of an outbreak, it usually means they have collected enough information to take actions to stop the outbreak. Sometimes actions can be taken even if a food is only suspected as the cause. Public health officials choose control measures based on the information available to them. Public health officials can sometimes take actions to stop the outbreak based solely on strong epidemiological evidence of the source. They don't have to wait on a laboratory to identify the outbreak strain in the food. As officials learn more during the investigation, they may change, focus, or expand control measures and advice to the public and businesses. It can be difficult to take actions to prevent illness in a multistate outbreak. Public health officials try their best to inform the public about the outbreak and the contaminated or recalled food. However, the advice may not reach everyone, and some people may unknowingly eat the contaminated food. Even when people are aware of the outbreak, it can sometimes be difficult for them to identify the contaminated food. For example, some recalls involve hundreds of products, while some recalls include products of a specific lot code and expiry date. In addition, some recalls of food items, like onions or chicken, can lead to many downstream recalls of products made with those ingredients, such as pizza or deli salads. An outbreak is considered over when new illnesses stop being identified or the contaminated food is no longer on the market or in people's homes. The epidemic curve helps investigators see when illnesses are declining. Even when illnesses from the outbreak appear to have stopped, public health officials continue to monitor for new illnesses for a few weeks. This allows investigators to be sure the control measures were effective and gives time for any additional illnesses to be reported. If the number of illnesses rises again, the investigation continues or restarts. It could mean that the source was not completely eliminated from

the market or people's homes, or a second contamination event has occurred. Public health officials also work to decide whether contaminated food is still available for sale or in people's homes. This involves assessing the shelf life of the product, how quickly it is used, and whether it can be frozen. Investigators also try to determine whether the source of contamination has the potential to affect many food products or foods produced over a long period of time. It takes time for an illness to be confirmed as a part of a multistate outbreak, so investigators are often evaluating information that reflects people who ate the contaminated food weeks ago. This reporting lag can make it difficult to know when illnesses have truly stopped. In addition, some strains of bacteria continually cause illnesses at low levels, so illnesses might never completely stop being reported. Finally, it can be difficult to confirm whether a contaminated product is still on the market. Learn how CDC works with partners to investigate, respond to, and prevent foodborne outbreaks. Languages Language Assistance Languages Language Assistance

