Transcript

00:00:00 Nicole Marshall

It's almost Valentine's Day, and you're in the kitchen whipping up a batch of your favorite cookies.

00:00:05 Nicole Marshall

As you're standing in the kitchen mixing up the batter, you can't help but taste test a spoonful of dough like you do with every batch. Except this time, something's different, something you can't see, or even taste. I'm Nicole Marshall with the Washington Integrated Food Safety Center of Excellence, and this is Foodborne.

00:00:24 Nicole Marshall

Let's rewind to February 2016. There's something unsettling beginning to unfold across the United States. Public health departments across the country start noticing clusters of illnesses. A type of E coli, called STEC O121, is making people sick, and no one knows where it's coming from.

00:00:45 Nicole Marshall

In EPI, a cluster is when there's a higher than expected collection of cases.

00:00:51 Nicole Marshall

Typically, we don't expect to see many cases of E coli at a single given time, but between December 2015 and February 20, 2016, 14 people across 12 states had gotten sick with E coli, raising red flags.

00:01:06 Nicole Marshall

Their ages ranged from 13 to 70, but what really stood out was that the majority were women, 79% to be exact. Now, this isn't the first time E coli has made a national appearance. But this one felt different.

00:01:21 Nicole Marshall

So, public health partners from the CDC and the involved states quickly mobilized to look for the potential culprit.

00:01:30 Nicole Marshall

Before we dive deeper, let's pause for a quick refresher.

00:01:34 Nicole Marshall

What exactly is E coli, E coli, or Escherichia coli? Try saying that 10 times fast. Is a type of bacteria that lives in the intestines of people and animals.

00:01:46 Nicole Marshall

There are more than 700 strains of E coli. Yeah, you heard that right, 700. Luckily for us, most strains are entirely harmless. But some, like the ones responsible for this outbreak, can make you very sick.

00:02:00 Nicole Marshall

These harmful strains produce something called a Shiga toxin, which is where the name Shiga toxin-producing E coli or STEC comes from.

00:02:09 Nicole Marshall

There are many different strains of STEC, but for the purpose of this outbreak, the ones we will focus on today are STEC 0121 and STEC O26.

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Symptoms of an E coli infection can vary, but you'll generally see cases of severe stomach cramps, diarrhea, or bloody diarrhea and vomiting.

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Most people recover within about a week, but in some cases, especially in young children and older adults, the infection can lead to a serious complication known as Hemolytic Uremic Syndrome, or HUS, which damages the kidneys.

00:02:44 Nicole Marshall

So, once it became clear they had an E coli outbreak on their hands, how did public health respond? Well, the public health departments sprang into action, conducting an initial round of interviews using focused questionnaires. They asked patients about foods usually associated with STEC. So leafy greens, vegetables, beef, but nothing seemed to connect.

00:03:06 Sam Crowe

When the results came back, we didn't have honestly much better signal, frankly, than we did going in.

00:03:14 Nicole Marshall

That's Sam Crowe.

00:03:15 Nicole Marshall

He was an Epidemic Intelligence Service, or EIS, officer at the CDC assigned to investigate this outbreak back in 2016.

00:03:24 Sam Crowe

There are some states that really kind of doubling down on some type of leafy green, mainly because it was at the time we were seeing a lot of young females who were case patients and because of that, you know, they're thinking we're healthy foods and there are a lot of weird presumptions that are built into these kinds of decision making processes so as opposed to like a strong B signal, which you might think like middle-aged men, something to that effect.

00:03:47 Sam Crowe

So nothing, nothing really solid yet. So we then had to go to open-ended interviews.

00:03:55 Nicole Marshall

The decision to switch to an open-ended interview style is not a common strategy in the foodborne EPI world. Typically, outbreak interviews are conducted in a structured manner to ensure cases are all asked the same questions. Investigators often use the National Hypothesis Generating Questionnaire or NHGQ, which is a 13-page survey to ask about a variety of food exposures.

00:04:15 Nicole Marshall

Lyndsay Bottichio, an epidemiologist at the CDC who helped coordinate the multi-state outbreak response, explains this decision to switch to the open-ended interview style.

00:04:24 Lyndsay Bottichio

We had onset dates that ranged from just before Christmas of 2015 through just after Valentine's Day of 2016, and I am specifically calling out that there are holidays in there because that actually played a really pivotal point once we started to move on to the open-ended interviews.

00:04:45 Lyndsay Bottichio

We held a second multi-state call with all of the jurisdictions that were involved. And again, we really heard that we were seeing a lot of exposures related to leafy greens, but it wasn't one specific leafy greens, so we kind of were like that might not be getting us the information that we need. We already have kind of narrowed down to a set of vehicles and haven't honed in on something specific. So maybe at this point, the right thing to do is to

pivot to single interviewer open-ended interviews so that it's one person talking to cases and they can hear the things that might be in common amongst that.

00:05:22 Lyndsay Bottichio

I do want to call out that at least by this point, with 25 cases, we were starting to see a little bit of a profile, and that we were seeing more females, and they were a slightly younger age than what we had expected.

00:05:37 Nicole Marshall

To be clear, open-ended interviews aren't often used in outbreak investigations because they take a lot of time, and you're not even guaranteed higher quality results.

00:05:48 Nicole Marshall

An interview with the case may not happen until months after a person was sick.

00:05:52 Nicole Marshall

Quick pop quiz. What did you eat for lunch 6 Tuesdays ago? Ah, can't remember. Yeah, most people have a tendency to forget these types of details pretty quickly. But as Lyndsay mentioned, we were seeing cases come up around Christmas and Valentine's Day, both which serve as small anchors for our memories.

00:06:11 Nicole Marshall

So Sam started conducting one-on-one open ended interviews, asking patients to recount their meals and activities leading up to their illness.

00:06:19 Sam Crowe

The first one actually was in Washington and it was an adolescent female. I spoke to her and her mom, and we had a great conversation; they were very willing to talk to me about it. And we talked, I think, for almost an hour, and she tried to walk through everything that she ate in the week leading up to illness onset, which, for he,r like Lyndsay had just mentioned, was roughly 2 months prior.

00:06:39 Sam Crowe

Interestingly, though, it was the week before she got sick was over Valentine's Day, and sometimes when you have an anchor like that, it's probably all of you know that can jog your memory in terms of what you're doing and what you might have been eating and things of that sort.

00:06:55 Sam Crowe

Well, she had mentioned that she actually was making chocolate chip cookies with her dad and one of her friends. And during the process of making these cookies, she told me. I think it was that she ate nine spoonfuls of raw cookie dough.

00:07:12 Nicole Marshall

Remember when this episode started and we were in the kitchen sneaking a taste of cookie dough? Well, that is exactly what we are getting at. That innocent little taste turned out to carry some serious consequences in this case.

00:07:25 Nicole Marshall

This wasn't the first time E coli had been associated with raw cookie dough; a few years prior, in 2009. Seventy-two people got sick from E coli O157 in raw cookie dough.

00:07:37 Nicole Marshall

Sam remembered this association and asked the young lady and her mother if they happen to still have the bag of flour that was used. As luck would have it, they did.

00:07:46 Sam Crowe

They actually spoke to a woman in Colorado who also was ill around that same time period, and she also had eaten some raw cookie dough, and she sent me her flower bag. And so two flower bags, one day apart from the same facility, from the same company, same facility.

00:08:05 Nicole Marshall

Bingo. Well, almost.

00:08:08 Nicole Marshall

Even though the association was strong, epidemiologic evidence needs to be airtight. The stakes are really high in these kinds of situations. Companies' reputations, public safety, and preventing widespread concern all need to be considered. So even though Sam had a strong hunch about the source, he kept going. He interviewed eight more individuals, all of whom were regular bakers.

00:08:29 Nicole Marshall

Five of them recalled baking shortly before falling ill, and four mentioned sampling their raw batter or dough.

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Of those, three had used flour from the exact same company.

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From here, CDC conducted a case-case analysis. This is an alternative design compared to the classic case-control or cohort studies. You may be familiar with from EPI classes.

00:08:53 Nicole Marshall

A case-case analysis compares exposures of outbreak cases to the exposures of the cases from other foodborne pathogens, such as Salmonella. I'll let Lyndsay explain.

00:09:05 Lyndsay Bottichio

A case-control didn't make as much sense. It would be a lot harder for us to find controls when we have a wealth of information of other foodborne enteric pathogens kind of at our fingertips. So it's why we ended up with a case-case study design. And what we did there is we looked for people that had non-STEC enteric infections, specifically as our comparison.

00:09:27 Lyndsay Bottichio

And we sought four of those per each case in our outbreak so four controls, even though they themselves were cases of other foodborne enteric pathogens.

00:09:40 Nicole Marshall

To summarize, they compared other cases with diarrheal illnesses caused by a different bacteria; two are cases in this outbreak. One major benefit is that this method allows EPIs to use existing data from previous case interviews, rather than having to collect new interview data and potentially slow down the investigation.

00:10:00 Nicole Marshall

The case-case analysis further solidified the thought that flour may be the source, and beyond that, it was flour from one particular brand.

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Most people don't think of flour as a raw product, so it might not be on your radar as something that could carry harmful bacteria.

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Flour, like fruits and vegetables, comes directly from the farm and isn't treated to kill bacteria, which means that any pathogens on the wheat can survive in the flour.

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Since we often use flour in ways that don't involve heat, like in raw dough or batter, it can be a hidden source of contamination.

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Flour's low moisture content does not support bacterial growth, which is why it's considered shelf stable, but it can still carry E coli if the bacteria contaminate the grain while it's still in the field or the flour while it's being made.

00:10:55 Nicole Marshall

So in this case, flour was the perfect hiding place for E coli 0121 and 026, which caused this outbreak.

00:11:04 Nicole Marshall

Remember the bags of flour Sam mentioned earlier? Well, a sample was collected from the patient in Colorado and sent to the state lab for testing.

00:11:12 Nicole Marshall

But they didn't find the E coli strain that was making people sick, at least not at first. Something you should know about E coli O121 is that it's a little bit of a special strain. This strain is harder to detect in the lab compared to other serotypes of E coli.

00:11:28 Nicole Marshall

That's because it has a different chemical makeup, and the tests they use to find other types of E coli don't work as well for this one. On top of that, the delayed growth of the bacteria threw off early detection efforts and allowed the strain to go unnoticed in the initial screenings at the state labs.

00:11:45 Nicole Marshall

The sample was sent to the FDA for further testing, where they used a more advanced analysis method and confirmed that the strain involved was indeed E coli O121.

00:11:55 Nicole Marshall

This testing method also revealed key genetic markers associated with the strains of virulence or ability to damage human cells. Once these characteristics were identified, the FDA realized that the existing testing protocols were inadequate for this particular strain.

00:12:10 Nicole Marshall

So they implemented a new protocol specifically designed to detect E coli O121.

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With this revised approach, more flower samples started testing positive for STEC, including the outbreak strain O121.

00:12:24 Nicole Marshall

Once the strain has been identified, public health officials can take things one step further. To track down the source of the outbreaks, like this one, agencies rely on PulseNet, the National Molecular Subtyping Network for foodborne disease surveillance. In simpler terms, this is a database that stores and compares the DNA fingerprints of sick patients and environmental or food samples.

00:12:45 Nicole Marshall

If these fingerprints closely match across multiple samples, it's a strong clue that they came from the same source.

00:12:52 Nicole Marshall

During this outbreak, there were patient and flour samples that tested positive for STEC O121 or O26 and were shown to be highly related. Thanks to the collaboration of labs submitting results to PulseNet.

00:13:04 Lyndsay Bottichio

In EPI land, what we always say is we are operating on trying to get information to complete a three-legged stool, and that is not a pun associated with stool samples.

00:13:16 Nicole Marshall

Thanks for clarifying that one, Lyndsay.

00:13:18 Lyndsay Bottichio

And that three-legged stool involves EPI, traceback, and laboratory evidence.

00:13:24 Lyndsay Bottichio

At the very end of May, we had all three pieces.

00:13:28 Nicole Marshall

By May 31st, three months after the initial cluster of cases triggered an investigation, the connection to flour was becoming clearer. The flour company recognized that they were the likely source of the outbreak and voluntarily issued a massive recall of 10 million pounds of flour.

00:13:46 Nicole Marshall

They conducted their own tests and found that 5 of 50 samples were positive for STEC, but not the O121 strain that was causing this outbreak.

00:13:56 Nicole Marshall

On July 1st, the company expanded the recall by 20 million pounds. Then, just weeks later, more lab results revealed another strain of E coli O26 in flour. The discovery of multiple strains of E coli in a recalled product is not unique to this outbreak.

00:14:15 Nicole Marshall

During the recall process, companies may do extensive checks to ensure all contaminated products have been removed from the shelves, and occasionally, this leads to the discovery of even more products that have been contaminated.

00:14:28 Nicole Marshall

So on July 25th, the recall expanded yet again, bringing the total to 45 million pounds of flour. To put that in perspective, that's the equivalent of 3,500 African elephants. By the end of it all, the outbreak had sickened 63 people across 24 states. Seventeen people were hospitalized, and one person developed hemolytic uremic syndrome, a serious complication. Fortunately, though, there were no deaths.

00:15:00 Nicole Marshall

This outbreak wasn't just a wake up call for the public, but also for the food industry. It led to increased scrutiny of flour production and sparked conversations about whether flour should be treated before it reaches our kitchens.

00:15:12 Nicole Marshall

The company linked to this outbreak was very cooperative with public health partners and took significant steps to improve their testing and safety protocols to prevent future outbreaks. But getting the message out to the right people can be tricky. Here's Sam again.

00:15:27 Sam Crowe

Often our messaging can be seen as sort of tone deaf by certain segments of the population, and this is the point in terms of how to think critically about making our guidance to the public, our recommendations on how to prevent illness, both understandable and feasible, and acceptable.

00:15:47 Sam Crowe

We had some interviews that we did actually, where I think the criticisms we like you're ruining Christmas or you're ruining Thanksgiving or whatever happens to be. You know, and that I think it's important as public health practitioners, we take that feedback seriously. Like we want to convey the central truth, like eating raw flour can cause illness. Don't do it. But in a way that is more acceptable and maybe feasible to certain audiences.

00:16:08 Sam Crowe

So, reshaping it to say, like, here are the risks. And here are some alternatives that you could try if you really like eating raw batter or dough, for instance.

00:16:19 Nicole Marshall

Basically, we're all going to pick and choose which food rules we adhere to, but we all deserve to pick and choose in an informed way.

00:16:27 Nicole Marshall

That's why the packaging on flour bags often includes a warning to avoid eating raw dough or batter, because raw flour can carry bacteria like E coli or Salmonella.

00:16:38 Nicole Marshall

So the next time you're tempted to sneak a taste of cookie dough, it's worth remembering that that little label on the bag is there for good reason. So, what lessons were learned from the 2016 E coli outbreak linked to raw flour?

00:16:53 Nicole Marshall

First and foremost, it's crucial to remember that some of the most unassuming foods can harbor dangerous pathogens. The main takeaway, always be cautious with raw ingredients. Avoid eating raw dough or batter. Keep raw flour separate from ready-to-eat foods.

00:17:08 Nicole Marshall

And make sure children don't play with raw dough, no matter how tempting it might be.

00:17:13 Nicole Marshall

This outbreak also highlights the incredible work of our public health agencies and food industry and responding to crises and preventing future ones. Their ability to adapt, learn, and improve helps keep all of us safer.

00:17:28 Nicole Marshall

That brings us to the end of this episode of Foodborne. Thanks for joining me on this deep dive into the 2016 E coli and flour outbreak. We would like to thank Dr. Sam Crowe and Dr. Lyndsay Bottichio for sharing their expertise with us. Special thanks to the International Outbreak Museum for their partnership this season.

00:17:48 Nicole Marshall

I'm your host, Nicole Marshall. Foodborne is created and produced by Piper Brase and Nicole Marshall. Our producer and sound designer is Kevin DeVoss. This episode was researched and written by Cayenne Buell with support from Erica Ellis. Foodborne is brought to you by the Washington Integrated Food Safety Center of Excellence, which is a collaboration between the University of Washington, the Washington State Department of Health, and the Northwest Center for Public Health Practice.

00:18:14 Nicole Marshall

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