CDC *Vital Signs* Town Hall Teleconference

When Food Bites Back: Act Locally, Control Nationally

June 11, 2013
2:00–3:00 pm EDT

Coordinator: Welcome, and thank you all for standing by. At this time, all participants are on a listen-only mode. During the question and answer session, please press star 1 on your touchtone phone to ask a question. Today's conference is being recorded. If you have any objections, you may disconnect at this time.

And now I'd like to turn the call over to Dr. Richard Schieber. Sir, you may begin.

Richard Schieber: Thank you and good afternoon, folks. I'm Rich Schieber and I'm the CDC *Vital Signs* Program Coordinator. I'm just delighted that you could all join us today. I'm going to talk about the latest *Vital Signs* report, last Tuesday's report on the deadly food poisoning bacteria, *Listeria*.

Before we get started let me go over some housekeeping details. To follow along with us you can go online and download today's PowerPoint presentation. The web address is www.cdc.gov/stltpublichealth. That's sierra, tango, lima, tango, public health, all one word. And there is a link directly to the *Vital Signs* Town Hall website under Highlighted Products and Resources on the lower-right side of the page.

On this Town Hall page, you can view the bios for each of the presenters and the audio recording and transcript for today's conference will be posted next week.

Listeria is an important public health topic because it's a deadly germ, it's hard to control, and in fact it's the third-leading cause of death from food poisoning. About 90% of the people who get *Listeria* infections are either pregnant women or their newborns, people 65 years or older, or people with a weakened immune system.

Listeria can cause miscarriage and meningitis and what is really striking is *Listeria* is fatal for about every one in five people infected. Our state, territorial, local, and tribal partners are critical in helping us raise awareness about this bacterial infection and how it can be prevented.

So for today's call, we're going to hear from three colleagues. First from a friend of mine here at CDC, Dr. Benjamin Silk, the staff epidemiologist, Division of Foodborne, Waterborne, and Environmental Diseases and the National Center for Emerging and Zoonotic Diseases at CDC. In case that's a mouthful, just remember NCEZID. He will provide a summary of this month's *Vital Signs* report.

Then Dr. Silk will hand the call over to Dr. Hugh Maguire. Dr. Maguire is in the microbiology program as program manager at the Colorado Department of Public Health and Environment in the Laboratory Services Division. And Dr. Maguire will share how Colorado has built capacity and integrated their resources in the environmental microbiology laboratory.

Dr. Maguire will turn the call over to Ms. Melissa Cumming, a senior epidemiologist in the Division of Epidemiology and Immunization at the Massachusetts Department of Public Health. She will discuss how Massachusetts responded to an outbreak of *Listeria* in post-pasteurized milk and the results and lessons learned from that incident.

Following Ms. Cumming's comments there will be time for questions. You can get in the queue at any time to ask a question during the teleconference by pressing star 1 and recording your name when prompted.

I will now turn it over to Dr. Silk. Please begin.

Benjamin Silk: Great. Thanks very much, Rich. Good afternoon everyone. Thank you for attending this teleconference. I'm on slide 4 and now slide 5.

At CDC, our objectives for today are first to summarize demographic and clinical characteristics of patients with listeriosis. Second, to estimate rates of disease overall and in demographic subgroups. And third, to describe foods associated with outbreaks of *Listeria* infection. The point of this work is to highlight what we need to do to better protect people in these vulnerable groups.

Now I'm on slide 6. Let me give you a bit of background on *Listeria monocytogenes*. It is a bacteria that is commonly found in environmental sources like soil and water. It's transmitted through a contaminated food. And certain foods that we don't usually cook like deli meats, soft cheeses, pâtés, and smoked fish make hospitable environments for *Listeria* growth. It can also contaminate foods that we might not usually suspect, like fresh produce.

Importantly *Listeria* strikes hardest at the most vulnerable among us; persons with immuno-compromising conditions and older adults are at risk for bacteremia or meningitis. Pregnant women typically have a febrile illness that may lead to preterm labor, fetal loss, and neonatal infection.

Slide 7. This is a graphic that we developed for the *Vital Signs* campaign and, as Rich mentioned earlier, it includes three important statistics that we're featuring. One, about 1600 people in the United States are estimated to

develop *Listeria* illnesses annually. Two, *Listeria* is the third-leading cause of death from food poisoning. And three, at least 90% of people diagnosed with a *Listeria* infection are either pregnant women or their newborns, people 65 or older, and people with weakened immune systems.

Slide 8. For this *Vital Signs MMWR*, the source of information was our National Surveillance for Enteric Diseases. We have a number of surveillance systems that we like to think of as being similar to smart phone apps. I say that because each one has a specific purpose and a job to do.

We analyze data from three complementary surveillance systems to get a complete picture of illnesses, deaths, and outbreaks of listeriosis in the United States from 2009 through 2011. A system called the *Listeria* Initiative gave us information on patient illnesses, data from the Foodborne Diseases Active Surveillance Network or FoodNet was used to find rates of illness and risk factors. And finally we used the Foodborne Diseases Outbreak Surveillance System, or FDOSS, to find out about the foods associated with outbreaks.

Slide 9. We looked at characteristics of patients with *Listeria* infection reported to the *Listeria* Initiative from 2009 through 2011. First, we found that almost all of the patients reported to CDC were in vulnerable populations. In the first row, you'll see that older adults were most commonly reported with 950 cases. There were 227 pregnancy-associated cases, this category includes both pregnant women and newborns younger than 31 days old, as well as 474 cases in non-pregnant adults under the age of 65.

In the third row, you see that *Listeria* was isolated from cerebrospinal fluid in 10 to 25% of cases in the different risk groups and this, of course, is the hallmark of meningitis. In pregnancy-associated cases, TSF isolates were almost always from the baby. You can also see that almost all patients were

hospitalized and that death or fetal loss was common ranging from 14 to 24% of cases.

In pregnancy-associated cases none of the deaths were in mothers. There were 40 miscarriages or stillbirths and six neonatal deaths in these cases. Also in a very high proportion of pregnancy-associated cases, 43%, the mother was Hispanic. Hispanic ethnicity was also common in non-pregnant patients under 65. This probably relates to food preferences like Mexican-style cheeses among Hispanic patients.

Slide 10. When we look at the rate of laboratory-confirmed cases of *Listeria* infection reported in FoodNet, we see that for older adults the rate is four times higher than for the general population. For pregnant women, it's 10 times higher and for Hispanic pregnant women, it's 24 times higher.

Slide 11. You might also be wondering about non-pregnant patients who are not older adults. Although FoodNet doesn't collect information on patients' health conditions before they got *Listeria* infection regularly, the information can and is reported to us voluntarily. And in fact, one or more significant conditions were reported for 74% of patients in this group including immunosuppressive therapies such as steroids, chemotherapy or radiation, and malignant cancers, as well as other conditions. So in all, over 90% of reported patients were either pregnant, 65 years or older, or had an underlying medical condition.

Slide 12. We found in FDOSS over these three years 2009 to 2011 that 12 outbreaks with 224 cases in 38 states were reported. Cheese is accounted for six of the outbreaks and soft cheese that were made from pasteurized milk and were likely contaminated during cheese-making were associated with five. Four of those five were Mexican-style soft cheeses. Importantly,

pasteurization kills *Listeria* but when sanitation in cheese-making facilities is inadequate, soft cheeses can get contaminated following pasteurization.

In addition, two outbreaks were associated with raw produce. One with pre-cut celery that was an ingredient in chicken salad served in hospitals, and another very large outbreak in 2011 that was associated with whole cantaloupe. So this information points out very clearly where there are some food safety gaps and where improvements are needed.

Slide 13. State and local health department participation is everything when it comes to PulseNet and the *Listeria* Initiative. Many of you are familiar with these systems and I hope that we can discuss them during this call as well. PulseNet in 1998 and the *Listeria* Initiative in 2004 have now been well established and have proven their worth nationally. We've also seen steady gains in participation during the period from 2004 to 2011.

In fact, there's a threefold increase in the percentage of patients whose *Listeria* Initiative report included a pulse field gel electrophoresis sub-typing result or PFGE result increasing from 21% to 69% in 2011. And similarly, there's a fivefold in the number of states reporting *Listeria* cases to CDC up from 10 in 2004 to 47 states in 2011. As you know and understand, rapid outbreak detection and response prevents illness and saves lives.

Slide 14. And so in summary, *Listeria* targets our most vulnerable groups of people. More than 90% of people who get *Listeria* infections are pregnant women and their newborns, older adults, and those with weakened immune systems. And *Listeria* infection is the third-leading cause of death in food poisoning.

We made some progress but rates of *Listeria* infection have not declined in more than a decade. More work is needed to reduce *Listeria* contamination of

soft cheese and raw produce as was done successfully with processed meat a decade ago. Although outbreak detection and response has improved through better surveillance systems like PulseNet and the *Listeria* Initiative more and better information is needed to identify sources of food contamination. We can make process and when we make food safer for people at their most vulnerable ages and stages of life we make it safer for everyone.

Slide 15. And so the data I just reviewed were compelling but, of course, *Vital Signs* is about much more than data. It's about putting the data to work to protect vulnerable people. We think of *Vital Signs* as a call to action on an important health topic—in this case, *Listeria* infections. So it includes the *MMWR* article itself, which we just reviewed, a professionally designed fact sheet for consumer audiences, a dedicated website that mirrors the factsheet, a media release, and a series of announcements through social media tools like Twitter and Facebook.

Slide 16. And here's a screenshot of the factsheet that I just described. It's a four- page summary of some of the most important information that the public needs to know. Page 1 reviews some key statistics in the left and gives an overview of the problem of a *Listeria* infection, the basics of prevention, and an invitation to go farther and learn more. And I'll extend that same invitation to this audience now. You can find the factsheet at www.cdc.gov/vitalsigns.

And that's all I have for now. I'd like to turn it over to Dr. Maguire. Thank you very much.

Hugh Maguire: All right, thank you, Ben. This is Hugh Maguire and if you'll switch to slide 19 this shows you the beautiful view that I get to look at just about every morning as I drive to work. The lab is actually located off the shot to the left but it actually looked just like this this morning as I went to work.

So what I'm going to talk about are some changes that we made as this lab in Colorado has continued to evolve to be more supportive of outbreaks of foodborne illness. And so if you go to slide 20, what I am going to describe is the Environmental Microbiology Unit. And that is where most of our food studies are performed microbiologically.

It is composed of four staff members and three of these are classically trained microbiologists and they have been with the state or with other microbiology entities for about 20 years each. And the fourth member is a technician-level support that can support all of the things that are performed in that lab.

And those things are testing food, milk, water and we do some other environmental swab testing or restaurant inspections with our Division of Environmental Health and Sustainability. As a necessity, we retain certification from both the FDA and the EPA, we perform food, milk, and water testing related to those agencies.

This unit communicates directly with the Public Health Microbiology Unit next door where clinical isolates are received daily and are confirmed or sometimes we've received clinical samples that need to be worked up completely. The two units share some instrumentation, which I'll get into a little bit later.

But the important point of this is that initially, at least a number of years ago, these are all classically trained microbiologists and only a couple had any molecular diagnostic experience whatsoever. Go to slide 21, what we decided was that in order to reach the kind of capacity that we wanted we also needed to develop the capabilities to do the kinds of molecular-based testing that we knew that we would need in order to response to larger outbreaks and develop a higher through put capacity.

That required us to do a little bit of staff reorganization, which wasn't undertaken lightly. We probably kicked this around for three to four months before we actually decided to rotate existing staff into and out of various work units so that we could come up with a group of trained staff that would be amenable to future training as well as coordinate with each other and provide the kind of response team that we would like to have.

We were fortunate that we had APHL Emerging Infection Disease Program fellows as we identified certain key areas that would need support in the lab. We hired temporary staff, which in itself gave us the opportunity to decide if that was an area that needed the support that we thought or if it was just something that could be fulfilled by existing staff. Those two things were key elements in this entire reorganization.

And so once that was established we undertook an intensive cross training program with existing staff in an accelerated way to bring people up to speed with molecular-based diagnostic testing and in this case with food being the substrate or the target starting material to use. We took advantage of some of the technology that was available in other labs and allowed those staff members to cross train in different work units, as well as utilizing and becoming familiar with the instrumentation that was being used for other areas and for other programs.

T The next thing that needed to be developed were methods of transferring the information that would be generated from these new types of testing. And so we modified our internal data management system and developed new ways of sending that data to our epidemiologists who could then extract data from an integrated data repository that was held at our main campus. I should say that the lab is geographically separated from where the epidemiologists do their work.

I was going to try to do this without using the dreaded “F” word, but I don't think there's any way around it. So yes, it depends on Funding. But it was also the flexibility of the funding that we had from a number of sources and I've listed some of them here. Perhaps one of the most useful things for us, as far as early starting, was that we started doing more fee for service testing. This allowed us to support new methods and then to purchase other instruments or at least support through service agreements the instrumentation that we had.

If you'll move to slide 22, what we did was to really look at what kinds of instruments would be useful to us and could be used across various funded activities. We have a number of federal partnerships that provide us with financial support, but none are in-and-of itself sufficient to sustain all of the activities undertaken by the lab. It's often a combined use which I think we all do at some level to allow us to support various aspects of a program that are all ongoing and to retain them.

The most useful one that has always been retained is the PulseNet activities that we do. And that was something that we also expanded training within multiple work units so that we had a large number of staff that could respond.

And the second thing was to utilize the interactions and relationship that we've always had longstanding with our epidemiologists in the Division of Communicable Disease. And that was to let them know as we brought new things on that could be a testing mechanism, so it could be of use to them that would enhance their own surveillance systems that's been suggested.

There has been a lot of work done on the extension of questionnaires that are provided to the affected patients so that we can start more readily linking those patients with particular food items. And the work collaboratively between the epidemiologists and the laboratory staff allows us to approach a

large number of food matrices and then supply the information that then guides the epidemiologic investigation.

But also at the same time in addition to the capacity building that we've done here we also develop federal partnerships, those that are long-term CDC, FDA, and USDA. Those are absolutely crucial to a larger role for smaller public health laboratories because we can share resources. We can do a lot of exchange of information, and it also establishes the relationships that will become absolutely crucial to a larger multi-state outbreak and the response that each individual state makes to that.

Equally important are the relationships that all of us have with our local public health agencies because the local and the public health agencies, I'll assert, that are the ones that are at the forefront of identifying these outbreaks in their early stages as we then integrate other partners into the response.

If you'll go to slide 23, you can exercise and you can do anything you want but the only way to determine if the process that was put in place is successful is to have a live exercise where you are forced to challenge every aspect of the plan that you had put in place and the training efforts of the staff. That came for us in the *Listeria monocytogenes* outbreak that was linked to cantaloupes in Colorado. It was a combined effort of all of us, staff that are here and the temporaries, the existing staff in the environmental microbiology lab.

But the key component that made a true difference in this was the application early on of the molecular methods that we had and the new instrumentation. We were very fortunate to have acquired funding through a microbiology cooperative agreement with the FDA and that placed a number of instruments in our laboratory with enough advance—a year or so advance of that outbreak that we were able to do all of the kinds of training including all of the staff members that we wanted to well in advance of this outbreak. It wasn't until we

actually had to use it in the field, real life action that we were able to assess whether the success of our undertaking.

In that case, we had isolates available from both clinical and from food matrices—in this case, cantaloupe. And by combining all of these new technologies and with multiple staff who are always available we could run this for a long period of time nonstop and were able to provide isolates, a crucial element to support our PFGE analyses and upload these to PulseNet quickly.

Really from the time that we had the cantaloupe in house to work with it was a little bit more than a week—actually about 10 days that we were able to support the epi investigation and provide a clear linkage of cantaloupe to human cases. In addition, we received re-agents from the CDC that allowed us to do MLVA, which corroborated everything that we had seen so far and identified a number of patterns and—also present in both clinical and food products.

And so it was this enhanced surveillance system, that we had, that was made possible by a large number of relatively newly trained staff, new instrumentation and the changes in the questionnaires that have been described that were in place at that time. It allowed us to rapidly identify. And so it was a coordinated effort because everyone knew their roles.

In this particular case it was, I don't know that I've ever seen it more at work more beautifully that the capabilities and the capacity of this lab were able to handle the onslaught of samples as well as our cooperation with federal partners. Everyone participated in a coordinately regulated way that made this outbreak response as successful as it was.

The last thing I want to talk about were the key elements that are crucial to our experience and that is the continuous funding stream is really a thing. We are pretty much dependent on federal level support from various federal entities but it is that funding that allows us to purchase new instrumentation that can be used across various programmatic elements that we undertake here in Colorado. As well as maintain a high capacity so that we can respond to a pretty large outbreak where we can channel a large number of samples in a high through put manner to identify sources of infection or pathogens present in food or in patient samples.

And it is together that the coordinated surveillance program with our communicable disease epidemiologists and those specialists in our environmental health program that that communication that we have with our epidemiologists, that sort of pick apart what's working and what's not. And by doing that, we are able to form guidance documents that we can share with all of the public health partners both laboratory, epi, and environmental health people within the state.

One of the key things in this particular outbreak is that we are fortunate that we are in the same city as our regional FDA laboratory and we have a positive working relationship with them so that we can actively pursue outbreaks of foodborne illness not only at the state level but as necessary with our FDA partners.

Again, these are just key elements that have worked for us and I'm sure that many state laboratories have already implemented many of these. Some may have not and at least I hope that this is something for all of us to think about. With that, I will hand it over to Melissa.

Melissa Cumming: Thank you, Dr. Maguire. I am Melissa Cumming and as Dr. Schieber indicated, I am going to talk about an experience we had in Massachusetts

involving an outbreak of listeriosis cases that were associated with post-pasteurization contamination of milk. So if you'd like to go directly to slide 27.

To begin I'd like to highlight that in Massachusetts all foodborne disease investigations are facilitated by our Working Group on Foodborne Illness and Control, affectionately referred to as WGFIC. WGFIC is a formal collaboration that was established all the way back in 1986 in an effort to respond to outbreak situations in a systematic and coordinated manner.

WGFIC is comprised of representatives from the epidemiology program, both our food and clinical laboratories, as well as our food protection or environmental program. At these regular meetings, it's also not unusual to have representatives from other agencies in attendance and involved in our outbreak situations and that ranges from individuals with the FBI to local health departments. And they would be attending these biweekly meetings.

At WGFIC meetings, normally all outbreak and foodborne illness compliant situations are reviewed and documented. Work and communication is maintained in a shared database that's accessible by all members. Members also share access to each other's case information including finalized clinical lab results and epidemiologic investigation information. In Massachusetts, we're fortunate that in the epidemiology program all of our labs and our food protection program are all in the same building. So certainly that facilitates the collaboration of the WGFIC group.

Next to slide 28. Just for some background on *Listeria* in Massachusetts and the 2007 outbreak, I'm going to cover. Here we typically see 25 to 35 confirmed cases of listeriosis each year. In 2007, the year in which this outbreak occurred we identified 33 confirmed cases. In 2007 isolates for a third of all culture-confirmed cases were never forwarded to our state lab

institute for PFGE testing. Of the 22 isolates that were forwarded to the state lab and PFGE testing was completed on four matched the outbreak strain.

This was very unusual. As other states may be familiar in a typical year it's not unusual for us to see no matching isolates within the state of Massachusetts among all of our *Listeria* cases. And interestingly, this outbreak was only the third time that pasteurized milk has been implicated in human infection with *Listeria monocytogenes*. But it does serve as an important reminder that while we know pasteurization does eliminate *Listeria* it is possible for contamination to occur after pasteurization as we see often with the soft Mexican-style cheeses.

Slide 29. Now I'd like to briefly present a timeline of the cases associated with our outbreak. In October 2007, we identified a listeriosis case and received an isolate for case number 2 with a PFGE pattern that was indistinguishable from an isolate submitted approximately 120 days earlier in June. The PFGE patterns associated with these two patients—a patient in June and a patient in October—had never been observed before in Massachusetts or in PulseNet. A review of available epidemiologic information on these two patients did not indicate a common exposure.

Then in November, we identified a third case that also had an indistinguishable PFGE pattern from cases 1 and 2. Attempts were made to interview patient number 3 but were unsuccessful. Then a week later on November 27, a fourth case was reported to us and in the course of investigating that case samples of pasteurized coffee-flavored milk produced by a local dairy were collected from that patient's home for testing along with other food and beverage samples from their home.

In early December, the state lab institute labs determined that the clinical isolates from all four of these cases had indistinguishable PFGE patterns.

Shortly thereafter evidence of *Listeria* growth was reported by our lab from the coffee-flavored milk sample that was obtained from the home of case number 4. That was an open sample obtained from case number 4's home.

Slide 30, please. In response to the findings of the *Listeria* growth in the open sample the Massachusetts Food Protection Program went out and inspected the dairy that was nearby in central Massachusetts and collected 11 additional samples of unopened flavored and unflavored milk products for testing at the state labs.

On December 21 *Listeria monocytogenes* isolate was obtained from the open milk sample taken from the home of the fourth case and was also confirmed to have a PFGE pattern that was indistinguishable from that of the isolates from the four listeriosis patients. On December 27, the lab indicated a presumptive positive result for *Listeria* in one of the unopened containers of coffee-flavored milk that was subsequently collected from the dairy.

Slide 31. As a result of these findings, the dairy agreed to a voluntary cessation of operations and a recall of all of their products on that same day. Just a day earlier before that closure and recall the Massachusetts Food Protection Program conducted a full environmental inspection of the dairy facility in cooperation with FDA and the local Board of Health in the town where the dairy was located.

This inspection was extensive and occurred over several days. More than 100 samples of milk and environmental swabs were collected at that time. A review of all procedures at the dairy facility including mandatory recording charts, a full inspection of all aspects of the facility and their sanitizing processes were reviewed.

On December 30, the lab confirmed that *Listeria monocytogenes* with PFGE patterns identical to the outbreak strain was identified from a sample of unopened coffee-flavored milk as previously stated and this was the first positive matching in an unopened milk sample.

Slide 32. Just some background on the dairy involved in the outbreak. This was a dairy located in the central part of Massachusetts. A herd of 300 cows was maintained on a farm. Raw milk was transported regularly from this farm to a processing facility located in a nearby town and of note this processing facility was quite old. It was about 50 years old at the time.

The facility produced a variety of flavored and non-flavored milk products and they were produced in both plastic and glass bottles at the same facility. Their products were available at both retail outlets at the dairy and on the farm. Their products were also sold through home delivery and at a small number of other retail sites. They provided products under their own dairy brand name as well as other custom produced brand names.

The facility was routinely inspected by the Massachusetts Department of Agricultural Resources. They also had a long history of being compliant with FDA Interstate Milk Shippers programming.

Slide 33. At this point in the outbreak, the potential existed that cases for whom no isolate was submitted for PFGE testing were potentially linked to the outbreak. Epidemiologists then investigated all 11 cases of listeriosis reported during 2007 in Massachusetts residents for whom no clinical isolates had been submitted to the state lab institute for PFGE analysis. The purpose of this was clearly to determine if any patients among these individuals had exposure to milk products produced by the implicated dairy during the six weeks preceding their illness.

Telephone interviews were conducted with these patients or their next of kin and during this retrospective investigation a fifth associated case was identified. This was a 31-year-old female who presented in September with fever and preterm labor. A follow up investigation and interview of this patient revealed that the case did in fact drink both 2% and whole milk produced by the implicated dairy throughout her entire pregnancy.

Slide 34. A summary of the morbidity and mortality associated with this outbreak highlights some of the most at risk populations associated with listeriosis. In this outbreak, there were three fatalities all over the age of 65. There was one late-term stillborn infant and in a fourth pregnancy-associated case a child was born prematurely but fortunately did have a good outcome.

Slide 35. As already mentioned after the closure of the dairy and the recall of all if its dairy products more than 100 additional environmental and product samples were collected by the Massachusetts Food Protection Program from the dairy's processing facility and adjacent retail store. In the end, one environmental swab from a floor drain in the finished product area, one skim milk sample, and seven flavored milk samples all tested positive for *Listeria monocytogenes* that matched the outbreak strain using PFGE testing.

In addition two additional environmental swabs and four additional samples of milk both flavored and non-flavored tested positive for seven distinct strains of *Listeria* including three different *Listeria* species and three strains of *Listeria monocytogenes* with PFGE patterns that differed from those of the outbreak strain. Of note, the positive environmental samples that matched the outbreak strain were taken from a shield in a bottle washer and around the drain of the bottle fill room.

Slide 36. And in conclusion without the use of molecular typing the detection of outbreak would have taken much longer to identify or potentially would not

have been identified at all. One thing this outbreak did highlight and expose was a gap in isolate submission. Although we had always requested submission of *Listeria* isolates from all hospital and commercial reference laboratories in the state they were not being routinely submitted to the state lab institute for PFGE testing.

Additionally because we know listeriosis is a "tip of the iceberg" disease, it appears that contamination can potentially occur for a prolonged period of time before enough evidence of a problem is apparent and obvious. And finally in the investigation of this outbreak several distinct strains of *Listeria* were found both in the environment of the dairy and pasteurized milk samples suggesting that post-pasteurization contamination can go undetected even when pasteurization processes are being monitored and are showing evidence of being done correctly.

Lastly to slide 37. Following the outbreak regulations in Massachusetts were instituted that required all clinical laboratories to submit all *Listeria* isolates to the state lab institute for PFGE testing and this is what occurs today. Additionally, the number of *Listeria* isolates uploaded to PulseNet and cases reported to national surveillance systems has increased fourfold from 2007 to 2011.

And finally our food laboratory capacity was bolstered and an increased emphasis system placed on food testing, which has resulted in an approximately a threefold increase in the number of food samples submitted for testing to the food laboratory at the state lab institute from approximately 100 samples prior to this outbreak to 300 and beyond following the outbreak.

And with that, I will turn it back to Dr. Schieber. Thank you very much.

Richard Schieber: Thank you all for these excellent presentations. For the question and answer period, I'd like to remind everyone that you can get in the queue to ask a question by pressing star 1. Record your name when prompted and you'll be announced into the conference by Jane, our operator, when it's your turn to ask the question.

I encourage you to take advantage of this opportunity to share the strategies you've used and the lessons you've learned, challenges that remain, and your success stories.