

**CDC Ebola Response Oral History Project**

The Reminiscences of

Frederick J. Angulo

David J. Sencer CDC Museum

Centers for Disease Control and Prevention

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Frederick J. Angulo

Interviewed by Samuel Robson  
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Interview 1 of 1

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Q: This is Sam Robson, here today with Dr. Fred Angulo. Today's date is December 8<sup>th</sup>, 2016, and we're here in the audio recording studio at CDC's [United States Centers for Disease Control and Prevention] Roybal Campus in Atlanta, Georgia. I'm interviewing Dr. Angulo as part of the CDC Ebola Response Oral History Project. Dr. Angulo, thanks so much for being here with me today. For the record, would you mind stating your full name and also your current position with CDC?

Angulo: Thank you, Sam. I'm Frederick James Angulo and I'm the associate director for science in the Division of Global Health Protection in the Center for Global Health.

Q: Thank you. If you were to give me a two-to-three-sentence, capsule description of what your part in the Ebola response involved, what would you say?

Angulo: For the first nine months, I was the lead of the Unaffected Countries Team, and then for the last six months I was the associate director for science, both times working with the International Task Force.

Q: Backing up drastically, can you tell me when and where you were born?

Angulo: I was born in Tacoma, Washington, on October 22<sup>nd</sup>, 1956.

Q: Did you grow up in Tacoma?

Angulo: No, my father was in the [US] Army and we traveled a lot, so I grew up throughout the United States and even spent time in Germany. Finally, our family settled in Marin County, where I went to high school in Novato High School, which is in northern Marin County.

Q: What was it like there?

Angulo: We had a very nice, very tight family, and it was nice to finally settle down and spend some time in one city, one town. I did enjoy living in California. Then from high school, I went to college in California at the University of San Francisco, which is where I met my wife, and we've been married for I guess the last thirty-six years.

Q: Congratulations. When you were growing up in high school, did you hear anything calling your name career-wise? Or what interested you back then?

Angulo: I knew I was interested in the sciences and biology in particular. My father is a microbiologist, so I went to college to study biology, thinking I would go into one of the medical professions—wasn't sure which one. My grandparents have a cattle ranch up in

Shingle Springs, which is near Sacramento, and I spent summers working for my grandfather. As I was working more outdoors with the cattle, I became intrigued with veterinary medicine, and in my sophomore year as an undergraduate I decided to start applying for veterinary school. In order to get an understanding of the broad field of veterinary medicine, I began working in various jobs—a veterinary emergency clinic, I worked with a veterinary researcher in San Francisco, I went to Oregon and spent the summer in Oregon working with a veterinarian, a large animal veterinarian. I got to see the different areas of veterinary medicine. Finally, I was accepted into veterinary school. I wasn't accepted on my first application upon graduating from USF, but on my second application after I had gotten a master's degree in biology, I was accepted and went to veterinary school.

Q: Just a strange question maybe, but when you look back at your time with your grandfather's cattle or the time when you spent that summer in Oregon, are there memories that stand out to you in particular of caring for the animals or being in nature or anything like that?

Angulo: My grandparents had a ranch up in Northern California, up by Lake Tahoe. It's a beautiful mountain high sierra ranch that was homesteaded by relatives. We drove the cattle up there and spent a couple months up there with the cattle, and that was just beautiful country, high sierras, beautiful mountain stream that runs down. It's called the Upper Bassi, which is the name of the ranch. We still, to this day, that ranch has now been passed down to myself and to all my cousins, and our family goes up there every

summer to camp and just relax. The Upper Bassi has become kind of a Mecca for us, or a place to come together as family each summer.

Q: That is very sweet. Can you tell me about what vet school was like?

Angulo: I enjoyed it, but really probably the first month of veterinary school, I met a professor who was doing work internationally and was doing a lot of public health work on the veterinary side, and I really became interested in the things that he was doing and began to work more closely with him. Because of his mentorship then, although I was in veterinary medicine, I learned that I wasn't as interested in the clinical side, the direct animal care. All that was interesting, but I was much more interested in the population medicine, dealing with the herds of animals, or even most interested in public health and working with how the animals relate to the humans. I ended up staying in veterinary school for a fifth year, got a master's in public health while I was in veterinary school, and then finally graduated veterinary school after five years and went into working in the public health field. It was quite a change in direction I thought, even from undergraduate, not really knowing what I wanted to do in medicine or in biology, knowing I wanted to do something in the medical field, and then ending up in veterinary medicine. But in veterinary medicine, not doing what I thought I initially was going to do because I thought I would be doing clinical veterinary medicine, and then getting interested in public health, and then finally ending up in public health. It was quite a journey finding myself finally into the public health field.

Q: Dr. Angulo, when you made that transition in vet school and started thinking about—instead of caring for individual animals, which was still interesting to you, but you're interested in the more population-based thing—were there certain diseases or certain topics that captured your imagination immediately?

Angulo: Those diseases that were transmitted from animals to humans. Interestingly, the real exotic tropical diseases were, I found, very interesting. When I eventually came to CDC, I had somewhat of an opportunity to go into that area in parasitic diseases, but I then elected to go into much more common and routine diseases that are transmitted from animals to humans, that being the foodborne diseases. Although I originally was interested in veterinary school with these exotic parasitic diseases that were transmitted from animals to humans, I ended up working in the areas of more common zoonotic diseases—diseases that come from animals to humans.

Q: You said—was it four years of vet school and then a year of a master's program, or do I have that wrong?

Angulo: That's right. Well, I had an undergraduate of four years and then I had a master's because I didn't get into veterinary school the first time. Then I went to veterinary school and got interested in public health, so I stayed and got another master's degree, my second master's degree. Then after that, then I ended up going to get a PhD in epidemiology and public health. So I spent a number of years in college. Fortunately, my wife was very supportive.

Q: [laughs] You probably learned to be an excellent student. Was it really just straight to the PhD program?

Angulo: No. When I went into undergraduate, I was on an ROTC [Reserve Officers' Training Corps] scholarship. The Army paid my way through undergraduate, so I owed the Army six years when I graduated from undergraduate. I deferred that time for veterinary school, but when I finally finished veterinary school I went in the Army for six years. While I was in the Army I was working on public health issues as a veterinarian. We were fortunate enough while I was in the Army to be stationed for two years in Belgium and two years in Italy, and while I was in Europe in both those assignments, they were full service veterinary clinics, very busy clinics with a lot of small animals—taking care of a lot of the small animals that belonged to the service members. After those six years in the army, then I got out and went to UCLA [University of California, Los Angeles] to get the PhD in public health.

Q: Were those six years kind of tending to the military service members' pets? Is that—

Angulo: Partially, and the veterinarians in the Army work in a variety of fields, one of which is in food safety. They are responsible for the quality of food that's on the base or on the post. We had some food safety component to the work, and then also there were some military animals, military dogs that I helped take care of. That was a very minor part of the job, but the majority of the work was taking care of the small animals, the

pets. These were NATO [North Atlantic Treaty Organization] bases in Europe, so they were pets belonging to not just the US military but to those from the United Kingdom and Italy, etcetera.

Q: What was your wife doing at that point?

Angulo: We had a family. She is a nurse and has always worked for a couple days each week at each of the locations that we lived in, but we were also raising our children. We have four boys, so we were busy through those years raising the children.

Q: After those six years are up, can you tell me what happens from there?

Angulo: Then we went to live in Los Angeles. My wife is from Los Angeles, so we were there close to her parents. They helped with watching the kids while we were—my wife then worked full time, a nurse at the UCLA [Medical Center] while I was a student for those three years, and then through the help of her parents we were able to juggle the kids. I was able to finish the PhD in three years, and then at that time I learned of the EIS [Epidemic Intelligence Service] program here at CDC, and so I applied and was accepted into the EIS program and came to CDC in 1993.

Q: Right out of the doctoral program?

Angulo: Yes, that's correct.

Q: What I love to ask about EIS people, and you probably get this all the time—well first of all, what was your assignment, and also, were there certain projects or outbreaks that really stay with you to this day that you remember?

Angulo: I was fortunate enough in the EIS program to be selected by, or matched with a very strong program, the program on foodborne diseases or foodborne and diarrheal diseases, and now called the Enteric Diseases Branch. While I was there, I went on four different Epi-Aids [epidemiologic assistance trips] to the field—one of which was the first large, multi-state outbreak due to *Salmonella*-contaminated tomatoes. These tomatoes were distributed from Chicago throughout the Midwest. I also worked in Gideon, Missouri, a small, rural town on a *Salmonella* outbreak due to the contaminated water. They had built a water tower and distributed un-chlorinated water, and unfortunately there was a hole in the water tower and birds were roosting in the water tower and contaminated the water. I also worked on the largest outbreak of botulism in the United States at that time. The largest outbreak in El Paso, Texas, due to an aluminum foil wrapped baked potato that had been left in the oven for a couple days before it was made into a skordalia, which is a dip. I also went to West Africa to Guinea-Bissau, and while I was in Guinea-Bissau, I worked on a very large cholera outbreak that resulted in three thousand deaths. Those were the most memorable field experiences. I had some great supervisors while I was there. Patty [Patricia M.] Griffin was my main supervisor and remained my supervisor for almost twenty years, because I stayed in that branch after I finished EIS. I worked closely Dave [David L.] Swerdlow on a couple of those

outbreaks and he was a great mentor. Of course, I was working with Rob [Robert] Tauxe who's now the division director in that division and just a tremendous mentor.

Q: Of course, I'm interested in the experience in Guinea-Bissau, this being an Ebola oral history project. Can you kind of describe Guinea-Bissau for me and how it was when you were there? Was that your first time in Africa?

Angulo: It was not my first time in Africa—first time in West Africa. The outbreak in Guinea-Bissau being in Portuguese-speaking country, I was fortunate enough to travel to Guinea-Bissau with a fellow EIS officer, Alex [Alexander] Rowe, who spoke Portuguese, and we were investigating this large cholera outbreak. The finding that we found, our most remarkable finding, was that we were able to demonstrate that families that used fresh lemons, that prepared the rice—we found rice was a vehicle for spreading cholera—rice that would be prepared at one time and then held throughout the day. You can imagine that the rice could become contaminated with cholera when multiplying people would become ill when they would eat the rice, particularly later in the day. We found that the families that put a lemon on the rice as a seasoning, that lemon served to prevent the growth of the cholera and prevented illness. We actually did a study while we were in the field of what the acidity of the lemons were that were being grown in Guinea-Bissau and found that it was quite acidic, and that in fact it made sense that it would be a factor that would prevent illness. So we gave a simple recommendation to use more lemons in the midst of all the other recommendations that we're making in terms of safe water, encourage washing of hands, etcetera. We published a quick paper that described the

impact of the lemon, the acidity, on preventing the multiplication of cholera, but also had several other papers that we published.

I would say related to the Ebola outbreak, the paper that we published—because I think we had four or five papers related to this outbreak that were published, but the one that was most related to Ebola was that we found that a major focus of transmission events for this cholera outbreak were the large funerals that would be held. These funerals would of course result in large number. The body would be held and not buried, and a large number of family members would come immediately to the village to celebrate the life of the person who had died and make a large feast. When they would make the large feast, some of the people that actually prepared the body were also preparing the food, and if the person died of cholera, then the food could become contaminated. People that attended the funeral would become infected with cholera. We partnered with a psychologist and a sociologist and we studied the funeral practices in the village areas in Guinea-Bissau and gave suggestions on how we could culturally, appropriately approach the village leaders and advise them to have funeral feasts in a safe manner where they would not become contaminated with cholera. All these features came up during the Ebola outbreak. In fact, during the Ebola outbreak, the sociologist, who lives in Finland although she still continues to go to Guinea-Bissau and do research there, we put her in contact with the Ebola response and she gave advice. The papers that we published on these funeral practices were of some value in reviewing ways to try to prevent the transmission of Ebola related to funeral practices.

Q: What was her name?

Angulo: It's a long Finnish name. First name is Erin, but then it's a long Finnish last name, sorry. [note: Joanna Einarsdóttir]

Q: We'll put it in the transcript. That is all super fascinating. Can you tell me what kinds of approaches you took with cultural sensitivity, trying to approach people about changing their funeral practices to reduce the transmission?

Angulo: I think the key was getting the village leaders to understand the risk of the transmission and then have their leadership trying to introduce soap. Hygiene practices could be done through the village leader where the village leader endorsed the practice. It wasn't novel, but it was understanding the connection of the leadership in the village so that then you could get the message, which were messages that we would all understand beforehand or would have understood beforehand, but be able to get those messages transmitted in the village.

Q: Do you know if that made any difference in transmission?

Angulo: That's a good question. We didn't have the study that showed that it was an intervention that was impactful and, yes, the cholera epidemic did eventually die out, but whether it died out because of those interventions or other factors, I'm not certain. We

did have evidence that there were less large funeral outbreaks later in the outbreak than there were earlier in the outbreak, which was encouraging.

Q: So your time in EIS is '93 to '95? Is that right?

Angulo: That's right.

Q: What happens after that? You stay with enteric, right?

Angulo: I stayed with enteric diseases. I had the same supervisor, Patty Griffin, as my supervisor both as EIS and then I remained on her staff, and she eventually became the branch chief, and I eventually became the deputy branch chief. I stayed with that branch for sixteen years. We had a number of projects that actually began during my second year of my EIS program, and they continued. One of which was starting the flagship active surveillance program for foodborne diseases in the United States—it's called FoodNet. Actually, Dave Swerdlow and I put the proposal together during my second year of EIS to the US Department of Agriculture, and they accepted it because at that time in the early 1990s there had been a very large *E. coli* O157:H7 outbreak in the Pacific Northwest related to the Jack in the Box outbreak. That actually was in the midst of an election campaign, and children died in that outbreak, and one of the campaign promises was that if Clinton was elected, that he would overhaul or strengthen the food safety inspection program in the United States, which he was elected and he did. Then the US Department of Agriculture approached us, this is in 1994, asking, as we overhaul this

meat and poultry inspection program in the United States, could we demonstrate that there is less illness? We said that we would have a hard time doing it with our current surveillance program, but we need to set up a new surveillance program that was active surveillance, which we did with ten different state health departments in the United States and created this program called FoodNet. FoodNet was able to then more closely monitor the change in foodborne illness over time, and also became a framework in which to demonstrate what the sources of the foodborne illness was and whether it was due to meats and poultry or not and whether meat and poultry illness was declining or not over time. That began, and I eventually led the FoodNet program, and we worked on that for a number of years.

Also, at the end of my second year of EIS, we began the first national antimicrobial resistance monitoring program for antibiotic resistance related to the use of antibiotics in food animals, which is a controversial issue and was particularly controversial at that time because at that time, fluoroquinolones had been approved for use in poultry in the United States, and we began to rapidly thereafter see the emergence of fluoroquinolone-resistant *Campylobacter* in the United States. We were monitoring that program through this new surveillance program called NARMS [National Antimicrobial Resistance Monitoring System], which eventually expanded to all fifty states in the country.

I worked on those two programs in particular, and increasingly, as we were working with those programs, began more and more international collaborations as other countries were interested in setting up similar foodborne disease surveillance programs or

antibiotic resistance programs—worked a lot with other countries establishing those, and eventually, began to work with the World Health Organization to set up a training program and a capacity building program to help countries to set up their surveillance programs for antibiotic resistance and also for foodborne diseases.

That led to—I went to WHO [World Health Organization] for six months to help them set some of these programs up, and we began these training courses all over the world. At first it was called the Global *Salmonella* Surveillance Program, but it eventually changed its name to Global Foodborne [Infections] Network. It was quite a successful international training collaboration with Institut Pasteur with the Danish [National] Food Institute and with WHO. As I was working with WHO in that area of foodborne disease, I also began working with WHO on setting up antibiotic resistance programs, and that became a program called AGASAR [Advisory Group for Integrated Surveillance for Antimicrobial Resistance], which also has been broadly established in several countries. Finally, we began an international collaboration to estimate the burden of foodborne illness globally. This was called FERG, or the WHO Foodborne Disease [Burden] Epidemiology Reference Group. That was a ten-year project that just concluded a couple years ago where we published the estimates of foodborne illness globally. These international collaborations increasingly put me in contact with CDC's international offices, and I began to work a lot with the CDC Kenya office, the CDC Thailand office, CDC Guatemala office, in particular with the Global Disease Detection programs. At this time, as with the beginning of the Center for Global Health here at CDC and in particular the Global Disease Detection program, I then about five years ago, six years ago, then left

the foodborne disease group and came to the Center for Global Health to work in Global Disease Detection on these international capacity-building efforts and have been in this division, now the Division of Global Health Protection, since.

Q: Since you have transitioned to CGH [Center for Global Health], has that work really continued in the same way of building the international collaborations, around building surveillance programs, or has something changed in the last five years that wasn't there before in terms of your day-to-day?

Angulo: The most remarkable thing in the last six years that I've been in the Center for Global Health has been the fact of the remarkable new resources that are available for capacity building. The first available resources were the Global Disease Detection resources, and that was great in terms of setting up what are now ten CDC country offices and Global Disease Detection regional centers in Kenya, Thailand, Guatemala, South Africa, Egypt, etcetera. Those were the first resources at CDC for broad-based infectious disease capacity building. The other programs, the international programs, whether it be vaccine-preventable diseases with a lot of resources for polio eradication or tuberculosis or malaria, they're focused on a single disease, or HIV [human immunodeficiency virus] with the PEPFAR [President's Emergency Plan For AIDS Relief] funds. Focused on a single disease, and some broader-based capacity building, but not extensively. It is focused on controlling that one disease where the funding comes from. The nice thing about Global Disease Detection is its broad-based capacity building where we're focusing on building up the systems—the laboratory system, the surveillance system, the

ability to detect and respond to any infectious disease issue. The issue was that there never were sufficient funds to have a robust program. It was quite a step forward because there were funds, and this establishment of Global Disease Detection was a consequence of the SARS [severe acute respiratory syndrome] outbreak in early 2000. When SARS demonstrated the need to have forward-based CDC staff that could respond to an emergency, that did lead to some allocation of funds from Congress for the Global Disease Detection program, and increasingly, with the understanding of the threat of pandemic influenza, there were lots of resources for influenza preparedness that didn't necessarily come to the Center for Global Health, but the Center for Global Health partnered with the Influenza Division in their programs, which were quite robust. That was a key partner for the Global Disease Detection program. But the most remarkable thing was then Ebola, and with Ebola we have Global Health Security [Agenda] funds, and those funds have led to a really ramping up of this broad-based infectious disease capacity building.

I would say another thing that is remarkable in these six years—it's actually remarkable just in my time from CDC—is the essential contribution of the Emergency Operations Center. When I first began at CDC, I was in a group, foodborne diseases, that did lots of outbreaks and lots of multi-state, large US outbreaks, and we initially coordinated those outbreaks just within our branch. With the evolution and development of the Emergency Operations Center, we began to move those outbreak investigations into the Emergency Operations Center because they had some things that could really strengthen the ability to investigate. One of the things they could do in the Emergency Operations Center is

rapidly do a phone survey of the general population, and we could find out if a certain practice that we detected among ill people was common amongst the general population. The population surveys in the EOC were just phenomenal. We could do those within a couple days, which was great. There were other things that the EOC could do more rapidly, whether it be getting people out on travel and logistics support. That was helpful domestically, but then with the Global Disease Detection resources, there came an important part of that GDD funding besides the funding that I mentioned that was going to the ten centers. They also established a Global Disease Detection Operations Center in the EOC, and this GDD Operations Center importantly had a contingency fund, and that contingency fund supported international travel for outbreak investigations for the first time. Those GDD contingency funds for international outbreak investigations, which really began in 2005, 2008, to become available, was really an important addition, and now has become a main part of the international response. Now, programs don't have to scramble to find the money to travel internationally to support an investigation. The GDD Ops Center can provide it. That was a huge advantage that I have seen of now we have a low threshold to go to the Emergency Operations Center, and also, when you do get involved on activities internationally, there are resources available to support CDC staff.

Six years ago, when I came to the Center for Global Health, among the early things I worked with was anytime there was an EOC activation for an international event, I would become involved. That was an expectation or just an understanding of responsibility for our division. I was very involved in the Haiti cholera epidemic, and in particular, Dave Swerdlow was the incident manager and I was his deputy incident manager for a number

of months in the Emergency Operations Center. When pandemic influenza occurred and Dave Swerdlow led the International Task Force for pandemic influenza, I joined Dave as his deputy to lead a team that was overseeing some of the teams that were sent to the field.

This gets into Ebola, how did I get involved in Ebola? Well, Dave Swerdlow came over to become the lead of the International Task Force, and as soon as he came over to the International Task Force, he pulled me over right away to serve with him in the International Task Force. That was a recurring thing. That's actually one of the things about the Emergency Operations Center is that when you get pulled into the Emergency Operations Center, of course you want to bring in people that you've worked with before that you know well so that you can support the response. That's how I got involved early in the Ebola response, was because of people that were in the EOC that I had worked with before.

Q: I know that Barb [Barbara J.] Marston eventually led the International Task Force. Did she succeed David Swerdlow, or how did that work?

Angulo: Ray [R.] Arthur was the first lead of the International Task Force. It wasn't really a task force, it was just when it first started. Then when it became a task force, Dave led it for a period of time, and then Barb replaced Dave.

Q: Can you describe David Swerdlow for me?

Angulo: How would I describe Dave? He's got a great sense of humor, always fun to work with, but a very excellent epidemiologist; therefore, he was a very good mentor. I mentioned that I had worked on a couple of outbreak investigations, Epi-Aid investigations while in EIS in foodborne disease with Dave, and he was very thorough on the study design. When it was over and we wrote up the reports and the manuscripts, he was a very good mentor in terms of vastly improving my scientific writing skills because of his mentorship. The thing that I had enjoyed working with Dave about, both then and in the program in field investigations or in other projects in the program, but also then when we were together in the EOC, is he is always thinking about the bigger picture. For example, when we were together in the Haiti cholera outbreak, we were there together when there was evidence that the case fatality rate—that there was a second wind of the epidemic, and that a more robust response was needed to reduce the case fatality rate. We pointed that out, that the evidence is coming in, and of course, when we shared this with Dr. [Thomas R.] Frieden, he immediately said that's right, we need a plan. We, in one day, came up with a forty-million-dollar plan to increase the resources needed to rapidly scale up—to take the clinical care to a higher level. This required a partnership with the USAID [United States Agency for International Development] to scale up the response, but we were able to put that plan together in twenty-four hours and share with USAID. Eventually, it was adopted, and we were able to rapidly scale up the resources to have a more robust response. That's the example of working with Dave, is that he has a vision and looks outside the box, if you will, and looks at the bigger picture and says, what can we do that we're not doing? I find him in that respect to be visionary.

Q: So he pulled you into the International Task Force, and that's how you became involved in the Ebola response, is that right?

Angulo: That's right. Of course, the CDC was involved in Ebola early in the summer. The EOC was activated in July I believe, and there was lots—in fact, the whole EIS class, much of the EIS class, was mobilized to go to the affected countries. I was aware of all of this, but I wasn't involved. I was a little bit nervous to get involved in Ebola because I don't have any experience with hemorrhagic fevers, or less experience with viral diseases. My background is in bacterial diseases, so I didn't know how I could get involved or should be involved. I was willing to go to West Africa, but I didn't know exactly where I would be needed. In mid-August, around August 15<sup>th</sup>, something like that, mid-August, Dave Swerdlow became, as I mentioned, the lead of the International Task Force, or came to help Ray Arthur lead the International Task Force. There was going to be an overlap, and then Ray was going to be taking some leave. Ray had been leading the international efforts because Ray Arthur leads the Global Disease Detection Operations Center, the Ops Center. The Ops Center was leading the International Task Force activities, and so as that transitioned with Dave taking it over from Ray, Dave invited me to come in.

When I came in in mid-August, I remember the first day I came in, I started trying to get oriented on what is happening. That afternoon, we got a call from the CDC assignee, the malaria assignee in Senegal, Julie [I.] Thwing, and Julie called saying, "We have an

Ebola case in Senegal.” There was an introduction out of the heavily affected countries into a neighboring country. Dave turned to me and said, “Fred, you’ve got to lead a new team, and this team is going to be for every country that’s not a heavily affected country. You need to coordinate the response in Senegal, but also start working with other countries to make sure that this doesn’t spread to any other country.” That was my immediate charge, and so I quickly mobilized two people. And fortunately, one of those people was Mary Reynolds, who’s from Viral Special Pathogens lab experience, and she was willing to lead the team. We found an EIS officer to travel to Senegal with her and a couple people from [the Division of Global Migration and] Quarantine also came because one of the issues—as soon as the case was introduced into Senegal, the immediate consequence was the Senegalese closed their international airport. That was a really dire concern because many of the humanitarian flights were flying through the Senegal airport to get to West Africa. With the airport closed, that threatened some of the supply chains. We got this team together, and they were able to travel to Senegal immediately. Next day, they were on the airplanes traveling to Senegal, and began to partner with the Ministry of Health [and Social Action] in Senegal to understand the outbreak. Fortunately, it turned out in this introduction in Senegal, it was a single student who had traveled from Guinea into Senegal and became ill, exposed seventy-five people. But fortunately, none of those seventy-five people—we came to learn none of those seventy-five people became ill, although they had contact with this. So there wasn’t a secondary transmission occurring in Senegal. The chain of transmission was broken quickly, but it was a concern obviously that it would have spread.

It was before I arrived in the International Task Force, but the huge success was the spread of Ebola into Nigeria that had occurred a month earlier. In Nigeria, we were fortunate that we had several collaborations in place. The introduction into Nigeria was a single person ill on an airplane and introduced it into Lagos, and secondary and tertiary transmission occurred in Lagos and then it also spread to Port Harcourt, a second city. When I joined the International Task Force, besides leading the response in Senegal, my team picked up the Nigerian response although it was well in its—it was quite a mature response. I led the lingering activities that were in Nigeria, and I learned a lot from that Nigeria experience because what Nigeria showed us was how vitally important it is to rapidly identify all of the controls and to monitor them and prevent secondary transmission. But in order to do that, the success story in Nigeria was that there was a Field Epidemiology Training Program, an FETP, that was very robust, in particular because of the polio resources. Polio's resources that were provided to the FETP in Nigeria led to well-trained field epidemiologists that were used to being in the field and finding cases. In some of the polio trace-backs, they found cases, even in the most difficult settings, and knew how to do contact tracing in a very robust way and to monitor the contacts. That EIS-matured program, experienced EIS program, was just phenomenal. They immediately went to the field in the Ebola outbreak and broke the chains of transmission.

The second thing was because of the polio effort, there was an emergency operations center concept and program in Nigeria, so that when Ebola was introduced, they immediately set up an emergency operations center to coordinate and make all the

decisions rapidly. These decisions, which sound simplistic, but the emergency operations center for example had the ability to immediately allocate resources, small resources. In some of our other countries' responses, paying for the taxis, which was a minimal expense, would take a week to get the necessary signatures to pay for. But here in the EOC in Nigeria, they were able to immediately allocate funds. Although they did get some of the funds from private partners, so in some instances, even going through the government was not quick enough, they got additional resources added. But nonetheless, they had a mechanism to make decisions rapidly to, how do we respond? So the FETP, the EOC, and then they had a robust laboratory program network because of the polio. All those pieces were in place mainly because of our—in large part because of CDC country office partnership with the Ministry of Health, and we had their trusted relationship with the Ministry of Health. All those programs together allowed CDC to contribute to quite a robust response in Nigeria and rapidly contain the introduction.

We learned a lot from that in our team as we were starting up this Unaffected Countries Team, we called it, in the third week of August. I remember that we were fortunate that on my first or second day, Frank Mahoney had returned from Nigeria and came to the EOC, and I sat down with him and debriefed him, and he shared all these stories about the success in Nigeria, and we learned from that, that those are the things we needed to focus on for our responses in the other countries. We began to focus our energy on controlling Senegal, but rapid concerns about well okay, if this could happen in Senegal and happened just a month earlier in Nigeria, what about Côte d'Ivoire or any immediately neighboring country? And also, any country. Like Nigeria demonstrated, it

doesn't have to be an adjacent country. Any other country that has connections, flight connections, there could be transmission. What can we do to strengthen the neighboring countries so that it does not spread out of these heavily affected countries? We began to form a lot of partners.

At this time, now the end of August and throughout the month of September and October, we were working seven days a week. We were getting four hours of sleep a night. It was all-consuming, and it was amongst the hardest I've ever worked at CDC. It was also amongst the most proud times for me personally because I immediately learned that this initial concern that I had about joining the Ebola response, I don't know anything about Ebola and I don't understand that disease, and I didn't know the incubation period, I didn't know anything about it—I immediately learned of what I could do. Really what was needed was basic field epidemiology, and that these epidemiology tenants that I knew quite well and that the things that I had done throughout my career at CDC in terms of leading field investigations, that's what was needed. I quickly became very comfortable in my role even though I was initially very concerned that I didn't know what I was doing. I remember when I first started, the first people that we trained, we would have to send them to get the fit test for the respirator. It was quite concerning, the things that we were training them on, and how we were fearful that we're sending people into harm's way. It was good to get more comfortable, if you ever get comfortable—get more comfortable with that over time.

Those first weeks were quite busy, and we were fortunate that we immediately formed a number of important partners. We were maintaining the Senegal response, and the Senegal response became quite successful in terms of the seventy-five contacts who were identified and quarantined and no additional transmission occurred. We kept the team in Senegal—for actually the next eight months, we had staff rotating through Senegal. We started saying immediately, we need to get teams in all countries ahead of time, so we began to target people, French speakers in particular, but anybody with experience, field epidemiology experience, that we could send on a rotating basis so that we could have one or two CDC staff people in each of the—we identified fifteen high-risk, unaffected countries. That became our goal of having a staff member on a thirty-day rotational status in each of the countries. That was quite a heavy lift because so many people were needed in the heavily affected countries, and so how could we get people? Not that we're competing, but how do we find people?

Among the things that happened, one of the important contributions was that amongst the EIS officers, some of them, about ten each year are international EIS officers. It was learned that international EIS officers who are not US citizens were not permitted to travel to the heavily affected countries because the State Department would be unable to evacuate the non-US citizens from the heavily affected countries. They would have to be evacuated through WHO channels in which we couldn't guarantee the speed at which they would be. So it was decided by the EIS program that the international EIS officers, non-US citizens, would not go to the heavily affected countries. We immediately said, we'll use them, send them to us. That was great. We got them, they were fantastic, they

jumped right in, and we were able to send them to the unaffected countries, so that was super. We also quickly tried to think of creative ways that we could get experienced epidemiologists to join us in these unaffected countries, and we learned of an interest from the state health departments that some of the state epidemiologists, experienced field epidemiologists in the states, were interested in deploying. Less interested in deploying to a heavily affected country, but interested in deploying. We were able through the CDC Foundation to establish a novel partnership with the Council of State and Territorial Epidemiologists, and the CDC Foundation provided resources to CSTE, and CSTE then put the call out to state epidemiologists, anybody wanted to travel to Africa to help with training to let us know, and we got a couple, a cadre of state epidemiologists. We had one cadre of four epidemiologists that came in. I remember they came in on January 2<sup>nd</sup>, and we trained them for that first week and then we sent them for the entire month of January and much of February to some of the unaffected countries. That was a great shot in the arm. We also had a partnership with the Canadians, and we got some people from Health Canada to join our team, and we also sent them to the unaffected countries.

We formed a lot of partnerships, as I mentioned, to try and accomplish the task of the Unaffected Countries Team. We scoured, looked all over CDC, to try to find people that would be available to go. Among the partnerships that we formed was with the World Health Organization. The World Health Organization, shortly after the introduction into Senegal, also recognized that they needed to do training programs and evaluations of neighboring countries to see how well prepared the neighboring countries were for the

introduction of Ebola. WHO formed this evaluation team, and we joined WHO. We went on nineteen of those evaluation teams. It's a one-week tour where we'd go in and assess all of the ability of, do they have infection control practices? Do they have a quarantine area? Can they do contact tracing? Do they have a laboratory with the ability to get specimens to a laboratory? We assisted in those WHO assessment trips, and we sent a CDC staff person on each of those trips.

Q: In what kind of ways did you help?

Angulo: They were usually a ten-person WHO team, and we would commonly lead the epidemiology team or epidemiology assessment, which would focus on the ability of the country, ministry of health, to do contact tracing. Do they know how to do contact tracing? We became very aware that there wasn't an adequately robust set of guidelines for contact tracing, so we actually wrote—we got an EIS officer who joined our team, Ashley [L.] Greiner, and she, in a week, wrote a very nice manual on contact tracing, which eventually led to publishing it into a couple papers. One was a paper that described the barriers to doing adequate contact tracing and the experience we had during the outbreak. The other one was describing the actual contact tracing approach. The new manual, it eventually became a WHO, CDC manual on contact tracing. Our team wrote that because we need it as a training material to train. That was just the way it was in this time. We would start something, identify a need, grab someone, and we'd do it and get it done, like the contact tracing manual. Ironically, you would think that in the heavily affected countries they would have had a contact tracing manual, but they were even

more overwhelmed than we were. We were overwhelmed, but we were working on training in preparation for an introduction, and we weren't having to deal with current transmission. We were thinking we had opportunity to develop some of these training materials.

By being present on these WHO assessment teams, they were very effective in some of the countries. Some of these fifteen countries we ended up sending staff to. In some of those countries, we did not have a CDC country office or did not have a history of much partnership with the ministry of health, and so these often led to introductions to the ministry of health, and they became comfortable with the idea that we would like to send a CDC staff person on a rotating basis for the next several months to help you, especially in the areas of field epidemiology. Ministries of health became comfortable with that idea. WHO was an important partner. Another important partner was USAID, the Agency for International Development. USAID helped us put together three different regional training courses—we did two in French and one in English—where we invited ministry of health staff to come in, and we gave a one-week course on contact tracing and on getting specimens to the laboratory in a timely manner and all the things that would be necessary to detect and rapidly control an introduction of Ebola. That was a great partnership with USAID.

We were juggling all these things at once while we were then also trying to get staff on these rotations. Our team blew up literally, in terms of increased in size, from mid-August from just myself to having a headquarters footprint of about ten people, twelve

people. We had to train people that we were sending to the field. We had to get them rapidly equipped to working in the EOC to get all that done and then also deploy them. At the peak, I think our team might have had seventy people in it because we had sixty people at one time in the field and the peak was probably in January. We were rapidly trying to get people to the field and therefore identify people in advance and bring them in for a one-week training before they went, and then send them for thirty days. We got people to sign for forty-five days to allow us to train them for the week and then deploy them.

In the midst of this, as we were doing all this preparation, this is now in September, we realize this was all great but what we really need is to identify a ready team. A team here at headquarters so if there were an introduction anywhere—so we are putting a single person in every country, which we succeeded in doing, but what if there was an introduction in a country? We would need a bolus of people to send to that country. We need people, and among the things that were delays, realities that we had to deal with is that even in the midst of this public health emergency, we still had to, of course, abide by the visa regulations of countries. We had to identify someone, and then most of these countries require a visa. So we had to identify them, we had to get their passport, we had to get their passport up to the embassy in Washington, DC, to get them to get a visa and get it back in time so they could travel. We wanted to try to do it within a week—identify a person, deploy them within a week by getting their visa. We worked very closely with the passport office, and we were sending couriers up every day with passports trying to rapidly get the visa. There were these things we had to work through. We even talked to

the State Department, and we in a couple instances asked for extraordinary favors to get us into a country rapidly. We were able in a couple instances to travel people and they unusually got a visa upon arrival because of this special need that we need to expedite things. We had all these issues that we had to deal with in the midst of all this. Amongst those was the realization, we need a ready team.

Before I mention the ready team, I'll tell you about the second introduction. We had the introduction in Senegal, we managed it pretty rapidly. We began to partner on the WHO assessment trips, and we sent one of the—I think it was the first WHO assessment trip, which was in September, mid-September. We sent two people. One of them was Rana Hajjeh, who was a division director in the National Center for [Immunization] and Respiratory Diseases, so a quite experienced virologist, epidemiologist. We were able to send Rana Hajjeh and an EIS officer to be a member on this WHO assessment trip to Mali. They arrived on one day, and the day they arrived in Mali, there was a case of Ebola introduced into Mali. We were fortunate in that we had—first, there was a CDC country office in Mali. It's a small office, but there is a country office. The PEPFAR activities are modest, but they have a malaria assignee there and a country director and a really excellent locally employed staff. We arrived the day of this introduction, and so this assessment team from WHO rapidly turned into a control-the-outbreak, control-the-introduction team. CDC, because we had this senior person present, assumed a leadership or an important coordinating role of this response. It was quite a robust WHO response because WHO had all the staff present, but because we had a senior staff French speaking, Arabic speaking, it was great to have Rana Hajjeh there, fortuitously. She was a

huge contribution to controlling the outbreak introduction rapidly. She insisted upon this comprehensive contact tracing and all these fundamental things. She had the authority to say, “No, you need to go find them. This person traveled in a taxi, and there were three people in the taxi that you haven’t found yet. You need to go find those three people in the taxi. It is not acceptable that they not be traced.” Her authority convinced people. They found those people. Other instances like that, and also of course with this introduction into Mali, Dr. Frieden was extremely concerned and interested. He had daily calls with us on the situation in Mali, and Rana Hajjeh was able to give a very thorough and experienced assessment of what is happening in the country. That was quite impressive, and in fact, we were able to control this introduction into Mali with no additional transmissions. It was a rapid containment, and really in the midst of all this, I think we demonstrated—because WHO was all present, they saw, wow, look at CDC, the quality of the people that we have and the ability of things to do, that also led to this really ramped up invitation from WHO to be involved in all of their assessments and to be more involved in all of the preparedness work. That was one thing that happened in mid-September.

When that happened, we then—back to my point about the ready teams—we also realized okay, now we’ve had Nigeria, Mali, Senegal with the introduction, we can anticipate other introductions and we need to have a better ability to have surge capacity. We formed the concept of a ready team, and we started rostering people here at CDC that would be willing to be on call to travel immediately to countries. We started to try to get visas in advance for them and other efforts so that we could try to have a rapid team.

As we developed this rapid team, then the most remarkable introduction besides the Nigeria introduction—the other introduction was an introduction into Mali that occurred later. I think it occurred in October, and it was a frightful introduction because it was introduced by an imam who was very well known in the region. He developed Ebola and died in the main hospital in the capital city, and his funeral was attended by thousands of people. There was lots of exposure to this imam, and in fact in the hospital, there was transmission to the healthcare providers. Several of the healthcare providers became ill and died, so there was secondary transmission in the hospital, and then family members of those hospital workers became exposed, so there was tertiary transmission. This all wasn't initially detected because it was this holy person that kind of eluded original detection and people were disbelieving that he could have Ebola. We became aware of it after there was already secondary transmission and it was quite disseminated.

Fortunately, because we had this ready team available, when we heard about it, we immediately that day had eight people on a plane the next day to Mali to join this response. That was quite fortunate because our teams—first, we had great staff, we had French speakers and experienced epidemiologists. We had Ryan [T.] Novak, an experienced epidemiologist, who was experienced in the region since he has worked on the meningitis issues in the meningitis belt in Africa and he knew the partners there. We had Leah [F.] Moriarty on that team. Leah Moriarty did Peace Corps in Mali and speaks some of the local dialects, the local languages, in addition to speaking French. It was a very robust team. To further strengthen the team, we got Pierre Rollin joined the team and was able to travel with it. We were able to get this really robust, strong, really large

team in Mali immediately, and they had the tools. They had the contact tracing manual that we had written. It was available in French. They had the paperwork, they had the tools they needed, so it was quite a strong response.

In contrast to Nigeria, there wasn't an FETP in country. There was not an EOC in country, and so the Ministry of [Public] Health [and Hygiene] in Mali was not as prepared to manage that introduction themselves as they were in Nigeria. It was fortunate that the most concerning introduction occurred later than the first two, Senegal and Mali, and that it occurred at a time when our team was ramped up and we were able to send people rapidly in all the skill sets that were needed, and that they were able to rapidly contribute to contain the outbreak, which they were able to do. They were able to identify all the contacts and to isolate the contacts and prevent additional transmission events. It was quite a successful intervention in Mali and was the highlight of the success of the work that we were doing. We demonstrated that all our preparedness activities contributed and had an important role.

That was the highlight of the work we did. It still of course continued through Christmas. We were all here for Christmas. We had staff in the field deployed in several of the countries. We celebrated a Christmas conference call. [laughter] We wished everybody a merry Christmas. The way that we were managing our teams in the field is we would talk to each team in the field at least once a week and be in constant e-mail contact, so that at the peak we had fifteen teams in the field, so we had fifteen conference calls a week. Each conference call of course is usually an hour, so it was quite a huge lift to manage all

of these teams. In addition to sending teams to each of the countries, we sent a team to the WHO regional—we sent rotations, single-person, but on several rotations, to the WHO AFRO [African Regional Office] office to facilitate the contact on all these preparedness assessment visits. We also sent two rotations to WHO Geneva because we were writing this contact tracing manual—we found that it would just be quicker if we had someone present in Geneva to help walk the manual through WHO clearance, which we ended up doing.

I would say that as the team extended, or as we felt like things were becoming under control and we were able to manage introductions and the timing was right, we began to have more discussions about, what about global health security? All this response in Ebola for preparedness and the partnerships that we're forming, but what about longer-term partnerships with these countries? We were fortunate that we had someone from the global health security team join our team, and we increasingly began to discuss with ministries of health about global health security and the possibility of transitioning the work in Ebola preparedness to broad-based infectious disease preparedness with global health security. We began working on that, and then in the midst, towards the end of the team's time in January, we began to develop budgets for proposals for each of the fifteen countries on, this is what these countries need to strengthen their emergency operations center, their laboratory capacity, their epidemiology. We began to contribute to budget deliberations. All of which went into the big budget proposal for the Global Health Security [Agenda], or the Ebola response, and ultimately did receive funding. The framework that we had begun to work on was then transitioned into the longer term

Global Health Security Agenda activities, which are continuing to this day. That was, of course, most successful in those countries of these fifteen countries—the countries that had a CDC country office. If they have a country office already present, then the country director, although that country director is funded and largely working on let's say PEPFAR activities, that country director could develop a proposal for expanding to global health security and hiring some additional local staff or even CDC staff that could lead efforts on setting up a Field Epidemiology Training Program or advancing laboratory capacity. So our team did definitely contribute to the momentum towards the global health security efforts.

A critical partner that we had here at CDC, because of the focus of our team is on field epidemiology in particular, was in partnership with the Field Epidemiology Training Program itself. In the midst of this response, we partnered with them to develop a novel training program that was called STEP. STEP is Surveillance Training for Ebola Preparedness. The STEP training, which was a one-week training course, was evolved, and the intention was to train at the district level, the epidemiologists at each district level, on how to detect and respond to Ebola. It was just basically the training that we were offering in our teams, but doing it within the FETP framework. That was great to see that launched. The first STEP training occurred in Guinea-Bissau; all the districts in Guinea-Bissau had representatives in the training, and then also the training occurred in Côte d'Ivoire and also in Mali. As the FETP program took over and developed and operationalized the STEP program, our staff in the field worked closely with the FETP staff to participate in the STEP training and then to continue the activities that the STEP

training set up. That was quite a successful partnership, and that experience setting up STEP contributed to the FETP setting up a training program that is now called FETP Front Line. The FETP Front Line training is a six-month training program for district-level epidemiologists, and that begins with the one-week training course like the STEP training and then they go back to their districts and they do projects, and then they return to report on the progress of their progresses. That Front Line training is very related to the FETP STEP program that we were engaged with, and that continues to this day with FETP Front Line now being an important component of the global health security activities. That was also a great partnership.

Our team, I think we achieved all our success. It became apparent in the end of January that there was less urgency, that we were more confident that the neighboring countries had capacity and could manage an introduction, and that we could then transition the activities that our team was doing into the global health security activity. There was a team outside the EOC that was the global health security program, so we began to transfer activities from our team to the global health security team, and eventually the Unaffected Countries Team, we stopped activities in February of 2016.

I have to say, I'm very proud of the work that our team did, and it just was a thrill to do it. The key thing, it just was so many things that CDC does well, and many of the resources that CDC has is our strength, and that strength was in particular working with EIS officers. There were a lot of EIS officers that rotated, some EIS officers returned a second and a third time to our team because our team was in existence for I think nine

months. We had some officers rotate three times through. It just was so much fun to work with all the EIS officers. I think I worked with almost half of the officers in one of the years and probably a third of the officers in the other year.

I worked with a lot of EIS officers, and just working on the capacity building efforts in the ministries of health and being able to see—because I traveled myself, I traveled to West Africa three times. I went to Ghana twice and to Côte d'Ivoire twice, and amongst the countries I went to twice, I went to Cameroon also. I had seen the difference in the probably three months between the time that I went to Ghana and three months' difference on the time I went to Côte d'Ivoire the second time, and you could just see the difference in the three months of how their capacities had increased their confidence that they could control an introduction, and their ability to—they had established laboratory supply networks where they could get specimens even from the most distant districts rapidly to their central lab to be tested for Ebola. They had a team identified and rostered and trained and drilled that could rapidly respond in their country, if there was a case identified, to develop the contact tracing. You could see the enhancement three months later. That was quite rewarding to see the progress.

Q: Regarding the EIS officers who you got to know, and kind of these foot soldiers who you were able to collect from, I'm thinking about having a CDC person in each of the different unaffected countries and the international EIS people were some of them, and then the CSTE people were some of them, and then some Health Canada people were some of them. Are there some certain individuals among them who, I don't want to say

are more important to you or anything like that, but who at this very moment come to your mind and you can kind of describe them a little bit?

Angulo: I would say that one of them was Kelsey Mirkovic, an EIS officer who just graduated in July and is now in the Division of Global HIV/AIDS and Tuberculosis. She was with us three times, and she actually went on the first deployment to Senegal when that case was introduced, and then after being out of our team for a month, came back again for another rotation. And then after being gone for a couple months, came back and did a third rotation with us. Ashley Greiner also—she is the one who wrote the contact tracing manual, and she did three rotations with us over the time. She was with our team early and helped us to develop a concept of the ready teams. She was great. She noticed and we all noticed, but she vocalized it, that there's no contact tracing manual, we need one, and she started writing it. She just had that initiative or understanding that this is needed, let's do it. She drafted it, and the next day we come to the office and she has a draft of the contact tracing guidelines. She was a great contributor. It was just like Dave Swerdlow, who I'd worked many times with, first invited me in, I had a pipeline of staff from Patty Griffin's and Rob Tauxe's Foodborne and Diarrheal Diseases group or the enteric disease groups. We had several of those epidemiologists who came over to work on rotations either here in Atlanta with me or did a rotation. It was really as people would come and do a rotation with us, we would say, okay, who do you know that could come in next? We kept bringing people in, and so we tended to get some people from the same programs. I think the other teams in the EOC had similar experiences—that they would find, once you have a conduit of people coming from a certain program—that group, the

Foodborne and Diarrheal Diseases group, the enteric disease group, was really a huge contributor to our team. It was a natural partnership because that group is so used to doing outbreak investigations domestically. When we brought them into our team and we were focused on field epidemiology and the kind of outbreak investigation-type response that we needed in these unaffected countries, it was just an easy understanding and they immediately grasped the concept even though they're focused not on viral diseases or hemorrhagic fevers, but they could immediately apply what they had been working on. It was an easy translation to bring them into our team—they hit the ground running.

Q: You mentioned something, it's probably a minor thing in the grand scope of your work, but it was interesting. You said that the State Department pulled some great favors for you. I think it was related maybe to getting visas so people could go in on the rapid response teams. Can you tell me about what those consisted of?

Angulo: It was in particular in Mali, because Mali does require a visa to enter it. When we mobilized our ready team and sent the ready team, they didn't all have visas. When I say State Department, I mean the US Embassy in-country and the ambassador in most of the countries that we worked with. We were heartily welcomed—we were always welcomed by the US Ambassador. In many instances, the ambassador was so thrilled to have a CDC person come to the country, amongst the things we would do would be talk to the US staff there about Ebola, and they found that very reassuring. The ambassador in many of the countries were very, very helpful in helping us get over some of the bureaucratic hurdles that might exist in the countries and getting—in this instance, in

Mali, he just picked up the phone and called the government and said, “This is the CDC team, we need the visas.” And it came immediately. We always enjoyed this high-level support in each of the countries we were working with. The partnership with the US embassies was always great, they were always very supportive.

Q: Completely different track here, but I’m wondering if you can think back to a time during the Ebola response when you were able to reflect back on Guinea-Bissau with the cholera.

Angulo: Yeah, I did an Epi-Aid in Guinea-Bissau in ’93 or ’94.

Q: Right. A time when you were able to reflect back on that and the lessons learned from that and make use of it in the Ebola response.

Angulo: Well, I mentioned the funeral practices experience, but I would say that the experience I had as an EIS officer, and also after EIS when I was with this group that did a lot of domestic outbreak investigations and we were constantly supervising staff in the field. That was a main experience that I had in leading this team, the Unaffected Countries Team. The heavily affected countries had large teams from CDC, and the headquarters here did not have direct contact with the teams in the field. The teams in the field reported to their team lead, but there was less little contact between the heavily affected team here in Atlanta with anybody except the overall CDC leader in the country. Or a certain program like the infection prevention and control team lead would be in

contact with the infection prevention and control team here and be a whole team of people present in the country. We were sending people to countries where they were the only person or two people, so our team had this—we knew that there was a need to constantly ensure that the people in the field knew they had a home base here and anything that we needed to help them with, we would help them, and we would contact them with necessary frequency to make sure that they didn't feel like they were just put out there without any support from home. That was certainly experience from supervising EIS officers when they would do their field investigations here domestically, just the need to constantly be in contact with them and assure them that we would support them in anything they needed when they were traveling. That experience was certainly from my domestic experience, my EIS experience, was something that carried on as we led this team, as we operated this team.

Q: Can you tell me about a time when somebody really needed something from you in the Atlanta office?

Angulo: We had a couple instances. We had one instance that was a little bit disconcerting, but we were sending a team to Equatorial Guinea, a small country, to do an assessment, and the flights didn't work out and they weren't able to travel, and they kind of got waylaid. We actually, quite unusually, ended up having to bring the team home. The team got as far as Paris but couldn't get farther and we just said, we've missed the assessment team. The mission is not so essential that we would go through Herculean efforts to try to get people—let's regroup. We actually brought the team back to Atlanta,

so that was unusual, but it was more important so that the people felt comfortable back in Atlanta rather than to go to Equatorial Guinea and feel like they weren't supported. Some of the things broke down in terms of who was going to meet us in Equatorial Guinea. This Equatorial Guinea is a country that Americans don't normally travel to, so it was quite unusual that we had an invitation, but support broke down at the end, so we brought them home. That's one example. Fortunately, we didn't have any—which was pretty remarkable—we didn't have any personal emergencies that we had to bring people home early on. Fortunately, I can't recall an instance where we had an emergent situation.

Q: That's a good thing. [laughs] Can I ask, were there ways in which this response changed your broad outlook on what doing public health means and what CDC does?

Angulo: It certainly reinforced my belief and understanding about CDC and the public good that we do and how critically important we are for public health. I would say amongst the most remarkable, I have always had tremendous respect for Dr. Frieden, but I would say that this Ebola response, he was—I just was so impressed by Dr. Frieden. He was just aware of all the issues. He would cut right to the central feature of the issue. He's wrestling with all of the issues in the heavily affected countries and he was aware of the issues that we had in the Unaffected Countries Team and was present on some of the conference calls. He just had tremendous leadership. In a couple instances with a couple countries in particular, for example in Mali, when we had the introduction, Dr. Frieden and our country team suggested it would be helpful to talk to someone in leadership in Mali to impress upon them the importance of finding all these contacts, including the

ones that were in the taxi, for example. Dr. Frieden was able to immediately call the president of Mali and talk to him, and things happened. He just was at our disposal and entirely supportive. I was really proud to be part of an agency that had that kind of leadership where he was really a champion of public health. That was very exciting to see up front. I've worked with Dr. Frieden before on some other issues, but in this instance, working so close with him, his leadership was just phenomenal. His ability to grasp all the issues. A little bit intimidating because when you have daily conference calls where he's asking you questions, it can be intimidating. But fortunately, that only happened for a short period of time during the Mali introduction where we were holding daily calls with Dr. Frieden. But anything we needed to do, he was always supporting us.

Another champion during this, I would say, reflecting on the response, another champion was the CDC Foundation and the way that they would get things done. Each of our introductions—whenever there was an introduction into a country, like for example was introduced in Mali, the Foundation immediately contacted us and said, we have resources here for you immediately. What do you need the money for? And in this instance, because we sent the whole ready team to Mali, we said we need an office space. Boom, they rented office space. They had two rental cars for us, had everything set up for us immediately using CDC Foundation resources. It was just incredible what they were able to do. That was quite—just wonderful.

Q: I was debating whether to ask you this question because I actually haven't asked it of anybody because it seems so minor and out of left field. But it seems like so much of the

job is being part of these conference calls and making yourself available to the people in the field. You mentioned you had people in fifteen countries and that's an hour conference call per week, per country. It's so much time dedicated to that. Can you tell me a little bit about how you organized a conference call? What is shared?

Angulo: We'd have conference calls just once a week with everybody, and they would tell us what they had done in the last week and what they were hoping to do. We would always give them an overview. One of the other things—and from experience, I certainly understood one of the frustrations, but the realities for these teams that we sent to the field is that they want to know what's happening in the broader response. They're out in Côte d'Ivoire or they're out in Guinea—sorry, in Gambia, teams in Gambia, and what's happening in the heavily affected countries or what's happening in our team and what is likely to happen? We would always give them the thumbnail sketch of, this is where we currently are. This is what we're focusing on, this is what we want you to do, these are your priorities. Focus on these areas. Then we would talk about how are they doing in terms of trying to accomplish setting up a training course, or if they were doing an assessment of the laboratory shipping capacity of the country. Have they gone to the laboratory to confirm that there's Ebola reagents and testing capacity in the country? We would always have a set of things that we always wanted to be checking on, and we would ask them to follow up. In their thirty days they're there, these are the things that we would want to accomplish. Every team that came home, too—when someone would rotate back thirty days later, we always would have a debrief where we'd invite the whole team, not only the headquarters staff, but the whole team, and the person would present to

us, what did they experience while they were in the field? We always had a debrief from them about their experience. They would tell us everything from how we could make the deployment better, what hotels should people stay in. Some of these countries that we're sending people to, ATMs [automated teller machines] are not dependable. Should they be traveling with US dollars, or should they use the local currency? All these practical things that would come up. Guinea-Bissau is a good example. Guinea-Bissau is difficult to get to, and you have to fly into Senegal, and then in Senegal, get a Guinea-Bissau visa in Senegal—we can't get it anywhere else—and then travel. It was complicated to get there, and then also, once you're in Guinea-Bissau, the banks are not dependable, so you have to bring the money in. There's all these things that we would inform the next people on the debrief, but they would tell us what they had accomplished on the priority list and we would then set up the priorities for the next team. We always strove to have an overlap, so that the next person that was deploying would be present at the debrief from the person who was returning. We would give everybody a one-week orientation before we deployed them, and then during that one-week they would have the debrief from the last team. We tried to do that.

It was a combination of the weekly conference calls, the training before they went, and then the debrief when they returned that all led to—I think this is one of the things that several people remarked to me: in their team, the whole team generally, people knew our mission, they knew what we were trying to do, and they knew what they were accomplishing as a team. They weren't these individual people that we deployed, but they all saw how they were contributing to a greater team. That reflected itself by so

many people came back and rotated through a second and third time because they enjoyed working with our team. They wanted to work on Ebola. This was a team where it was very clear what we were doing. It was very clear that we had the tools to contribute to improving the capacity of the countries we were working with, and so people felt there was a good camaraderie and esprit de corps on our team because we were so aware of what our mission was. I think that might have been lost on some of the other teams. Some of the EOC teams were enormous, and people were less clear on what they were doing to the greater mission, etcetera. Our team was small enough that we were able to maintain that focus, purpose.

Q: Can I ask, was there anything that looking back you wish had been different about the response? Anything about CDC's approach to it that maybe systematically could have been changed and you think maybe would have resulted in a better outcome?

Angulo: That's a good question. I don't know—within the heavily affected countries with our team, I felt that we did as best as we could. We didn't get things done as quickly as we had hoped to do because finding staff was a huge, huge effort. Then once you find someone, then deploying them, etcetera. Always the hardest thing is finding the people to go, and we exhausted the staff. Finding people that spoke French, they were so precious if we could find a French speaker. In retrospect, if there was perhaps—I think that some of the things that we learned led to establishment of new systems here at CDC. At CDC, there's now a Global Rapid Response Team that's created and rostered, so that there will be some staff already pre-volunteered to rotate in an emergency immediately. Those are

some of the things that I think we could have done better in this response. I think we've learned from it. Overall, I'm really proud of what CDC accomplished in this response. I'm very proud of the team that I was fortunate enough to work with. But the overall success of the entire response was quite amazing. I'm very proud of CDC.

Q: Is there anything that you'd like to talk about that we haven't covered so far?

Angulo: No. Sam, I appreciate the opportunity to talk about the team. There is a nice collection that describes the overall CDC effort in the supplement that was published in the *MMWR [Morbidity and Mortality Weekly Report]*, and our team has a nice chapter. It's nice because at the end of that, it has the name of everybody who rotated through our team. It is listed and acknowledged. I was very fortunate to have so many great people that worked with us during these nine months that we were active. It was quite an honor to have worked with such a group.

Q: Well, just out of curiosity, do you have plans to return to the ranch soon out west?

Angulo: I do. Every summer we go back up, so we'll be going in August.

Q: Thank you so much for being here, Dr. Angulo.

Angulo: Thank you Sam, I appreciate it. Thank you for the opportunity.

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