
Preparing for Emerging and Unknown Threats

Q&A

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Francisco Diez-Gonzalez (University of Minnesota): About reducing promiscuity—that seems really challenging.

Robert Buchanan: If it were easy I would have done it already. Let's at least find out what's fostering promiscuity. I think we are doing a number of things during normal processing of food that actually stimulates it. In the case of *E. coli*, certain antibiotics activate its SOS repair system, and then you scramble everything.

Richard Isaacson: Shaun Kennedy¹, director of the National Center for Food Protection and Defense here at the University of Minnesota, will now take Bob Buchanan's place as a panel member.

Steven Slack (Ohio State University): Jackie, you have been a thought-leader on food production and protection. How should we raise these issues in a way that will awaken consciousness so that the public relates to them in the same way as they relate to public-health issues?

Jacqueline Fletcher: It's difficult to raise awareness because we have such plentiful food that is healthy and safe in this country. It takes a little bit of shaking for people to wake up to what the potential is, and the 2011 outbreak in Germany may be one of the things that can do that. I don't mean to make light of that terrible event, but if we use incidents like that to illustrate what the impacts can be and the fact that it can happen here, then those kinds of things can help. But, we can't sit back and wait for disasters. We also have to approach the public in other ways, and we don't generally do that that well. I'm referring to elementary-school level as well as all the way up, with educational programs. Certainly in

¹Pages 191–207.

our universities we can increase awareness by creating possibilities for students to interact across disciplines. It's a challenge, and I don't think we can ever let up.

Isaacson: Are there any lessons from the animal side that speak to this? Jeff?

Jeffrey Bender: Back in 2001 when I was dealing with anthrax and animal-related agro-terrorism issues, one of the things that I quickly had to learn about—and was not well versed in—was the plant world. As Jackie mentioned, we've had some significant events in the plant world and I don't know if we have highlighted them well. A lot of us have taken for granted the cassava issue, for example. We need to get on the bully pulpit and talk about these and economic impacts associated with them, as well as related direct impacts on people. Sprouts are one issue, but clearly we have significant issues regarding leafy greens. In the past ten years we've had a lot of issues regarding fruits in general. With those stimuli, we've come a long way, but we can do a better job.

Isaacson: When *E. coli* first hit the fan, it was clearly a beef problem and particularly a ground-beef problem. I think the statistics now show that there is at least an equal number of plant contaminations as there are beef contaminations.

Dan Gustafson (Food and Agriculture Organization): A question for Shaun. Bob Buchanan mentioned technology as part of a prevention strategy—technology to suppress horizontal transfer of genes in *E. coli*. What kinds of technologies?

Shaun Kennedy (University of Minnesota): What Bob was referring to is that we don't understand the horizontal transfer of bacterial genes to the point where we can stop it. Gaining a better understanding of that process is the first step.

Bender: I don't know that you can stop *E. coli* from transmitting genes, but, on the flip side of that, what wasn't mentioned was the concept of co-selection. We don't know what the co-selection factors are, so, for example, if one looks at antibiotic-resistance determinants in *E. coli*, salmonella and other enteric organisms, you see things that cluster together, that are co-transferred. They are not necessarily related to specific resistances such as to heavy metals or quaternary ammonia compounds used as disinfectants. We don't know what virulence factors might be co-selected for simultaneously. But, if we could start understanding co-selection factors—I don't know that we could intervene—there's a possibility of figuring out ways of reducing virulence with new strategies.

Allan Eaglesham (National Agricultural Biotechnology Council): Jeff, with the lack of a link between CWD² and CJD³ in the three gentlemen who died after eating venison, how surprising is it that one of those men died of a prion disease, and what did the other two die of?

²Chronic wasting disease.

³Creutzfeldt-Jakob disease.

Bender: The CDC⁴ sent out investigators who were aware of these individuals who had neurologic degenerative disease and, basically, tried to characterize them. Fewer than 7% of individuals who die are autopsied, so, going back to the records, they tried to identify the actual diseases. Even physicians make mistakes in their diagnoses. In going back to these and pulling the case reports and any pathology, they found that one of them did, indeed, have Creutzfeldt-Jakob disease. One of the others had Ménière's disease and I can't recall the third, but they were unrelated diseases. So, initial suspicion, because these three individuals had actually hunted at the same camp—although they didn't know each other—raised a lot of public concern. There have been investigations of other hunters showing some CJD, but no substantial link has emerged. Now, there's interesting science behind prion diseases: can you induce the prion to infect human tissue? If you force the prion to adapt, you can actually do that. So, it cannot be said that this can absolutely never cause disease, but, at the current stage of our understanding of CWD, we have no evidence that it does cause this disease. Those three cases were unrelated. Only one was a prion disease.

Karin Wittenberg (University of Manitoba): One of the problems that we encounter in our communication with the public is the fact that messages from the producers, processors, distributors and retailers aren't always consistent, and then, on top of that, you have the various government layers. Traceability hasn't been mentioned at all at this conference. What is your sense of the value of that tool and whether it may present better messaging to the public.

Kennedy: Traceability technologies have improved. However, it's a challenge in that the interoperability of traceability systems is very limited. If one company has one food supplier and another has another, by sharing information they may be able to rapidly move upward and backward. In the peanut outbreak that has been mentioned a couple of times, several of the affected companies do have traceability systems, yet it took them as much as four months to figure out where some of their products were being contaminated. The systems in place have gotten better, but until we have a common platform for information sharing it's not really a full solution. To your point though, that's how to restore consumer confidence. As soon as you tell consumers exactly what is and what is not contaminated, you gain their trust again.

Bender: Gene Hugoson⁵ touched on this. There is a desperate need for clarity in how we do this better. How do we evaluate that system? The jalapeño pepper case provided a clear example of the complexity involved. Historically, here in Minnesota, we have utilized this technology and it has been very helpful. I look back at the Schwan's ice cream salmonella case. That was a good example of determining where the product was; that outbreak looked like it was regional. It looked like the focus was a restaurant versus a national outbreak. Looking at traceability gave us the strength to crack the case. We had epidemiological

⁴Centers for Disease Control and Prevention.

⁵Pages 227–232.

evidence and no microbiologic evidence at that time, but we felt comfortable using those data to craft the appropriate risk communication.

Francisco Diez-Gonzalez (University of Minnesota): A question for Jeff, about the spread of influenza. We are fortunate that the 2009 pandemic wasn't as infectious as in 1918. What did we learn to help prepare us for the big one in relationship to what Bob said about anticipating threats. A major pandemic will impact every aspect of human activity.

Bender: That's a big question with a few possible answers. What did we learn from the H1N1 pandemic? One is that we were right in saying that this could happen—that reassortment is possible, that new strains can form with potential for pandemics. We expect it every 30 to 50 years. We have the technology to watch the emergence of new strains and we are starting to understand what we don't know. The second issue is preparedness. If you remember, there was a lot of panic and there were missteps in communication. A clear example is the issue of vaccines. We didn't have enough time to prepare the vaccine and, when it was produced, availability was delayed. There was public concern about the vaccine's effectiveness and confusion as to whether it induced the disease, and whether it contained thimerosal and was associated with autism. So, improved diagnostics are needed as is transparent risk communication especially regarding vaccination. Also needed is more-rapid vaccine production, part of which is appropriate monitoring of how strains vary over time. H1N1 comprises a number of clades with divergences within those clades. Within H1N1 there's resistance to some of the antivirals. And further to what Jackie was saying, we can't forget about this. We've already seen cuts in funding for influenza research because the thinking is that we've just had a pandemic and won't have another for a while.

Bill McCutchen (Texas A&M University): What are the prospects for increasing outbreaks of foodborne illness, including regulatory implications for the use of radiation especially for leafy greens, fruits and vegetables, as well as meat products?

Kennedy: The first step in successfully getting irradiation adopted by the public is to change the Delaney clause so that irradiation is no longer defined as an ingredient and doesn't have to be mentioned on the front label and can be treated as electronic pasteurization. Having to put the radura saying "irradiation" on the front is the reason consumers are not adopting it. If consumers knew that many of their spices have been irradiated—because they are exempted from the Delaney clause—you would have the same problem. Without radiation or gas treatments you would end up with all sorts of "extra value" in your spice. With that change in labeling, I don't think it would be hard to move forward because of benefits in protecting public health.

Bender: It's a tool that we need to continue to pursue, but, unfortunately, I don't think we'll see that change in our lifetime. We need to focus on the fact that we do need terminal pasteurization-type procedures and, clearly, irradiation is one. We have a technology that

works and we have a public-perception problem precluding acceptance. Also, we need to continue to push for other technologies. We have high-pressure technologies for controlling microorganisms on products. Instead of focusing on one bug we have technologies, like cooking, that kill many. We need to continue to try to educate and also look for alternatives, including policy approaches to working with the public.

Kennedy: The marketing campaign should be relatively easy: eat the same foods the astronauts eat.

McCutchen: You're exactly right. Texas A&M has been preparing the food for NASA for a long time. That is what they eat. We eat it as well.

Isaacson: What challenges are there with fresh fruits and vegetables that are different from meat?

Kennedy: Well, irradiation has been tested on a number of fresh fruits and vegetables like strawberries, to extend the shelf-life. Really the only problem with it is on foods that have a high fat content—you end up with rancidity.

Fletcher: It would probably help with post-harvest plant diseases as well.

Michael Kahn (Washington State University): Yesterday, the focus was on food availability and food security and today it's been much more on food safety as a component of food security. One of the things that we've been seeing is how much investment there has been in the food-safety area—anti-terrorism and contamination of food—and yet the number of people who died of *E. coli* in Germany, for example, was relatively small. The magnitude of the food-availability question is huge and I'm wondering if there are opportunities for investment in food safety to have more impact on, and inform the question of, food availability?

Fletcher: That they are linked to me is obvious. A previous speaker mentioned One Health, which is focused primarily on human pathogens and animal pathogens. I'm a member of One Health as are other plant pathologists, and that is an area where those elements come together. Did I understand your question correctly—are we missing the boat by spending so much on food safety when food security may be the larger issue?

Kahn: That's a component, but at this point my question is: are things being developed? It's a microeconomic-macroeconomic kind of difference. Food safety is a collection of anecdotes about particular diseases at the present time in relatively small numbers of people and yet we were informed yesterday that we are looking at another two and a half billion people by 2050. That's a lot of people, and if we don't meet crop-production targets, many will be starving, which is a public-health problem, not a disease problem directly. It will lead to enormous disease problems. But, by investing in rapid scanning for diseases,

food-preservation technologies and so forth, are we investing in these anti-terrorism things in a way that allows us to make the transition—to blend the technologies—to a macro situation that can lead to significant increases in food production, enhanced food distribution and food preservation? This conference to me is in two parts. We talked about huge problems yesterday. But the problems discussed today, albeit serious, affect relatively small numbers of people. I don't quite see where the two discussions for long-term food security are coming together. I think this is something that really needs to be thought about because people aren't getting excited about the prospect of two and a half billion more people—and we don't have food to feed them—in the next 35 to 40 years.

Fletcher: The two are definitely connected and we are doing things now about terrorism and food safety that can translate. Where that is possible we should make sure that the opportunity isn't lost. It can happen through One Health, programs that the State Department has and even AAAS, but your larger question is a philosophical one that is difficult to answer.

Kennedy: One way to look at it is—whether or not it is right—food safety hits rich countries directly. Food security does not hit rich countries directly yet. So, until there is some actual pain for rich countries it takes altruism and politicians are not necessarily known for altruism. And the second thing is that the foodborne illness problem in the United States, you could say, is relatively small. It's estimated at 3,000 deaths. Internationally, especially in the developing world, it is fairly significant: 2 billion cases of foodborne illness a year with 1 million deaths. So we still have a problem with food safety and unsafe food may be worse than no food at all depending on what it's contaminated with. There are some cases where, in animal health, there's been a direct link to food security. Investments have been made by DARPA⁶ in Central Asia to build animal diagnostic labs to help prevent highly pathogenic avian influenza outbreaks. That has a direct benefit on food security in Central Asia, but the motivation for DARPA is that those countries have nuclear weapons and if they lose a protein source there is the potential for public unrest leading to government overthrow, and someone else gets control of the nukes.

Tony Shelton (Cornell University): This is a question for Dr. Fletcher. I am interested in the historical perspective of NIMMFAB⁷. It seemed to develop because of a particular coming together of various forces—9/11, maybe the foresight of American Pathological Society—but as you talked about it and the need for it, and thinking about getting future funding, has the university or the federal government made any longer-term commitments to making sure it will continue? And then are there other scientific societies who could also learn about the model based on your experience in developing it?

Fletcher: I don't have any funding beyond contracts and grants. The only secure funding really is the faculty positions. All of my faculty, except me, are assistant professors and

⁶Defense Advanced Research Projects Agency.

⁷National Institute for Microbial Forensics & Food and Agricultural Biosecurity.

don't have tenure yet, so that's not even totally secure—but they are good so they will get it. There is definitely interest on the part of various agencies in what we are doing, but they have not offered avenues for a permanent situation.

Shelton: What about the private sector—food companies, Grocery Manufacturers Association—have you approached them for funding?

Fletcher: No. Maybe we should. I have been trying to get high visibility at a number of different types of venues speaking at various programs, moving into new areas. I'd love to talk to you about how one might go about that because we have to be creative. Some of our initial sources of funding, as I pointed out, have fallen by the wayside because of the economy. I've seen institutes at universities come and go. There are surges of needs, and to keep NIMMFAB operational and make it viable for the long term, we must be flexible. Each of the scientists in my group at NIMMFAB has a home department and several of them are in my department, Entomology and Plant Pathology. Each has a scientific area that should survive on its own if NIMMFAB should cease to exist. I am hopeful that NIMMFAB's contributions will continue to be important and needed.

Carol Ishimaru (University of Minnesota): Thinking about sustainability and food security, one of the things that comes to mind for me is the vast quantity of food that is imported every day through our ports and the relatively miniscule amount of food that is inspected. How can we improve our ability to detect pests and pathogens? Are there technologies or regulations that could be used to decrease risk?

Fletcher: Those containers are the size of large trucks and they just open the doors and look in. Do they see insects crawling around? New methods of sampling the interiors are being developed—assaying for volatiles, for example—and basic research along those lines is necessary. We simply can't afford to hire the number of people required for full inspection without delaying the transit of fresh produce.

Kennedy: At road ports of entry, from Mexico for example, if they identify a truck for inspection, they have between five and ten minutes to conduct that inspection before they have to release the truck. We don't have the technology to effectively sample a truck full of watermelons in five or ten minutes and find out if anything has been sprayed on them. However, there are some basic technologies. You can look at what is being done to detect bombs and nuclear weapons at ports of entry to see what is needed. Every container that comes into a US seaport now goes through a specialized radiation detector. It's just run through so it doesn't interrupt commerce. I don't know how we would get to the point where we could do that for biological materials and chemical contaminants, but that's how we may end up, not interrupting trade.

Bender: One important aspect is working with exporting countries and actually engaging producers to understand risks. Another thing is risk assessment of particular pathogens of

concern, particular products of concern, particular countries of concern and characterizing them and picking out which parts you want to look at. These are all things that are actually included in the Food Modernization Safety Act. Also important is the issue of “shopping”: if I am rejected at one port can I gain entry at another? We need the infrastructure to be able to say, “You were rejected at Port A, therefore we are not going to let you enter Port B.” We need to support the Food Modernization Act because that will actually help do that. Credit is due the Department of Homeland Security for identifying the products of concern, the countries of concern, and the pathogens of concern and prioritizing them in terms of risk assessment.

Liangliang Gao (University of Minnesota): What can be done to encourage funding from the private sector? And what will be the job prospects over the next five to ten years in food security and public health?

Fletcher: I talked about education and training and the fact that our graduate students who had interned at the FBI both ended up going to the FBI or to the defense community in some aspect. There definitely are these types of jobs, but the challenge is that students have to work at finding them. That’s one of the goals of my program. For example, the ARS lab at Fort Detrick is looking to hire people from our program because it’s unusual to have the combination that we offer. It’s knowing where things are needed and then preparing students to move into those areas.

Kennedy: To your first question, it’s important for us to look for a diversified portfolio of funding support. The private sector is an important part of that, which is actually something we are doing because we can’t count on a single source for steady funding, such as the government. Regarding where the jobs are, one of my friends calls the Food Safety Modernization Act, the “Food System Employment Act,” because a number of inspectors and third-party auditors will be required for full implementation. In year one, an additional 4,000 FDA food inspectors will be needed. So, if you are in food that might be a place to look.

Bender: I liked Dr. Fletcher’s slide showing the cross-training at the FBI. I wouldn’t have thought that plant pathology would be of interest to the FBI, but that’s a phenomenal networking and cross-training opportunity and it’s the kind of thinking you need as a graduate student. You never know where you will end up and I encourage you to think along those lines.

Stephen McCurry (Grains for Health Foundation): A follow-up comment to Shaun’s response to the question about food supply versus food safety. I don’t dispute your answer at all that wealthier countries are more concerned about safety. However if, say, China were to request repayment of the money lent to the United States in bushels of wheat rather than in dollars, that might suddenly get our attention.

Kennedy: Those kinds of things actually do come up as far as the role of China is concerned. China is the reason the corn market is tight. And China has made an intentional effort to become a dominant player in the global dairy industry. So they are going to impact us even more.

Isaacson: I didn't know how much question and answer we would have. I had prepared a list of my own questions, which we didn't get to. It's really been wonderful—a thoughtful set of questions, very stimulating and engaging. I want to thank the audience. I also want the audience to thank the panel for their excellent presentations.