

CAREERS

TURNING POINT Biophysicist explains how going overseas enriched his career **p.859**

IRELAND Biomedical institute set to recruit for diagnostic research **p.859**

NATUREJOBS For the latest career listings and advice www.naturejobs.com



PUBLIC HEALTH

Food-safety sentinels

Disease outbreaks in recent years have revealed the vulnerability of food supplies. But they offer opportunities for those interested in waging war on microbes.

BY LAURA CASSIDAY

In the summer of 2009, a particularly nasty strain of the bacterium *Escherichia coli*, known as O157:H7, infected at least 74 people across 32 US states. They had painful abdominal cramps and diarrhoea, and about half of those affected were ill enough to need hospitalization. Initial attempts to trace the outbreak to a particular food product left epidemiologist Karen Neil perplexed.

“Normally, *E. coli* O157 outbreaks are associated with ground beef or leafy greens like

spinach or lettuce,” says Neil, who works at the US Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia. But according to questionnaires filled out by the patients, not everyone had eaten the usual suspects in the days before their illness. So Neil conducted in-depth interviews with five patients, and revealed a common factor: all had eaten the same brand of refrigerated cookie dough. “This was the first time that raw cookie dough was associated with an *E. coli* O157 outbreak,” says Neil.

Such detective work is common for those charged with safeguarding the food supply

from biological and chemical contaminants. At each step along the chain from farm to table, researchers are needed to quickly detect and respond to problems when they arise. Scientists such as Neil work on the front lines of outbreak response, whereas others focus on prevention or detection strategies or on understanding how food-borne pathogens make people sick. Employers seek expertise in areas ranging from public health and epidemiology to microbiology and behavioural sciences. Although federal funding for food-safety research in the United States has remained mostly flat since a spike after the terrorist attacks on 11 September 2001, the breadth of the field means that there is a consistent demand for researchers in government, academia and industry.

GOOD GROWTH

As food imports from around the globe increase, more personnel will be needed to ensure their safety — and government scientists are often the first line of defence. Inspectors employed by the US Department of Agriculture (USDA), the Food and Drug Administration (FDA) or private companies visit factories, slaughterhouses, restaurants and ports. There they examine sanitary conditions and manufacturing processes, ensure proper food labelling and collect samples for laboratory testing. The USDA, for example, employs more than 7,500 food inspectors nationwide, with entry-level positions requiring a bachelor's degree or one year of job-related experience in the food industry. The FDA's Center for Food Safety and Applied Nutrition (CFSAN) in College Park, Maryland, shares monitoring duties with the USDA. The CDC works with both agencies, as well as with state governments, to investigate outbreaks of infectious disease.

Detecting and identifying food-borne pathogens is a slow process. Inspectors must swab a food sample onto a Petri dish and culture it for at least six hours before laboratory analysis. According to Steven Musser, director of the Office of Regulatory Science at the CFSAN, his office has a high demand for scientists with experience in developing tools to detect food contaminants, especially portable devices that work more quickly. “It's impossible to screen all of the material,” he says. “But the more tools we can put in the hands of inspectors in the field, the more products we can look at. We're looking to hire bioinformaticians who know how to handle very large data sets, because right now we can generate data much faster than we ▶

WWW.JUPITERIMAGES.COM

► can analyse them.”

Researchers also need tools to trace outbreaks to their source quickly. In the United States, physicians report suspected food-borne illnesses to state public-health departments, where scientists culture microorganisms from patients' stool samples and analyse pathogen DNA with pulsed-field gel electrophoresis. They report genetic signatures of detected pathogens

to a CDC database that links the PulseNet national network of public-health labs and is used to identify clusters of outbreaks that may be linked to a common source.

Closely related strains of some microorganisms, such as *Salmonella*, can't be differentiated using pulsed-field gel electrophoresis. So the CFSAN Office of Regulatory Science employs about 130 scientists who work closely with biotech companies to develop techniques for fingerprinting food-borne pathogens, including whole-genome sequencing, proteomic analysis and mass spectrometry. “Data analysis is one of the big bottlenecks of this work,” says Musser.

Also in demand are researchers with expertise in analytical instrument development, food microbiology and mass spectrometry. Musser says that the number of new research positions available in 2011 will depend on the level of FDA funding in the federal budget. “We typically don't start the hiring process until Congress passes the budget in the springtime or summertime,” he says.

PUBLIC CONCERN

Food-safety research at the FDA will get a boost if Congress and President Barack Obama approve the Food Safety Modernization Bill, which the US House of Representatives passed in 2009. The Senate passed a similar bill on 30 November 2010. If lawmakers can work out discrepancies, the legislation could be signed into law later this year. The Senate version of the bill calls for increased surveillance and testing of foods by the FDA and includes provisions for at least 4,000 new field staff at the CFSAN and the FDA Center for Veterinary Medicine in Rockville, Maryland, in 2011, with further yearly increases until 2014. The bill also appropriates US\$825 million for food-safety work at these centres in the first fiscal year.

In general, funding for food-safety research waxes and wanes with public concern over disease outbreaks. In the 1990s, ‘mad cow disease’ galvanized food-safety research in Europe. At the same time, US federal funding for food safety increased by more than 60%, spurred



“Right now we can generate data much faster than we can analyse them.”

Steven Musser

by a deadly 1993 outbreak of *E. coli* at the fast-food restaurant chain Jack in the Box. With the terrorist attacks of 11 September 2001, funding priorities shifted to food security. More recently, much-publicized outbreaks of *Salmonella* in peanut products and eggs seem to have refocused public attention on food safety, as reflected by the pending legislation.

But government support is not enough. Collaborations among government, academia and industry are essential to keep food safe. In Europe, scientists at universities in the Netherlands collaborate with industry researchers through the Top Institute of Food and Nutrition based in Wageningen, a public-private partnership funded by the Dutch government that fosters industrially relevant innovations in food quality and safety. In January 2011, the Top Institute will announce vacancies for graduate students and postdocs in 20 new research projects at member institutes, says Marcel Zwietering, a professor of food microbiology at Wageningen University, a participant in the partnership that has an internationally renowned programme in food-safety research.

Basic-science researchers often interact with industry and government. Michael Peck, programme leader at the Institute of Food Research in Norwich, UK, says that much of his time is spent working with industry and food-safety regulators to apply his research findings on the physiology and molecular biology of *Clostridium botulinum*, the food-borne pathogen responsible for botulism.

Similarly, researchers at the University of Georgia Center for Food Safety in Griffin collaborate closely with scientists at the nearby CDC. “After my lab developed the first test for detecting *E. coli* O157 in food, the CDC began sending us food samples associated with outbreaks,” says Michael Doyle, director of the University of Georgia centre. “Now that some of the state health departments have gotten good at detecting harmful microbes in food, they usually only send us samples in which the organisms are really hard to isolate.” Frequent collaborations with other sectors mean that people skills and the ability to work well in a team are valuable assets for those in the food-safety field, notes Neil.

Food-safety researchers in industry have another motivation: company profits. A food recall can cost a company tens of millions of dollars in lost profits and liability lawsuits and

even force them out of business, as demonstrated by the 2008–09 *Salmonella* outbreak at the now-defunct Peanut Corporation of America. “Safety will always be an important thing for food companies to guarantee, because one big problem can ruin 100 or more years of existence of a brand,” says Zwietering.

DODGING DISASTER

To avoid such scenarios, industry scientists conduct routine testing of products, perform environmental monitoring at factories, and work to develop more efficient detection methodologies. Technicians may not need even a bachelor's degree for entry, whereas team leaders typically have PhDs in areas such as food science, chemistry, microbiology or chemical engineering. “Many of our former students are now in food-safety positions with major food companies,” says Shaun Kennedy, director of the National Center for Food Protection and Defense at the University of Minnesota in St Paul. Zwietering notes that in the Netherlands, although the number of students interested in food and agriculture has dropped, the demand from industry remains unchanged.

Food companies typically have more resources than universities for training researchers in specific skills, and provide ample opportunities for career advancement. Scott Hood, senior manager for microbiology and thermal processing at General Mills in Minneapolis, Minnesota, says that at a large global food company such as his, it is common to spend a couple of years in the lab, then maybe a year or two at a plant seeing the daily challenges of the production environment, before coming back to headquarters to work on food safety and quality at the corporate level.

But when every food-industry executive's worst nightmare — a suspected outbreak of food poisoning — does occur, scientists from all sectors work together. The company's food scientists work overtime with government agencies to trace the source of the outbreak to a specific plant and production run.

Like many food-safety researchers, Neil savours the opportunity to make an impact. “It's a very important and exciting field to be in right now,” she says. Before joining the staff at the CDC in June 2010, Neil was a postdoctoral fellow in the CDC's Epidemic Intelligence Service, a two-year training programme for health professionals interested in applied epidemiology. She conducted field investigations in Rhode Island, Missouri and Uganda.

“Sometimes you don't know in the morning that you'll be leaving for an outbreak investigation that afternoon,” she says, “which makes the job even more interesting.” ■

Laura Cassidy is a freelance writer based in Hudson, Colorado.



“State health departments have gotten good at detecting harmful microbes in food.”

Michael Doyle