Julie Spencer:

So I just had this moment in that math class with Helen, who's just an award-winning professor. She's really an incredible teacher. And I just had this moment where I could just see the power of mathematics to help relieve suffering from diseases. And I just decided that's the direction I wanted to go.

Announcer:

This is ORISE Featurecast, a special edition of Further Together, the ORAU podcast. Join Michael Holtz for conversations with ORISE experts on STEM workforce development, scientific and technical reviews, and the evaluation of radiation exposure and environmental contamination. You'll also hear from ORISE research program participants and their mentors as they talk about their experiences and how they are helping shape the future of science. Welcome to the ORISE Featurecast.

Michael Holtz:

Welcome to another episode of the ORISE Featurecast. As always, I'm your host, Michael Holtz, in the communications and marketing department at ORISE and ORAU. And I'm excited today to be talking about the Intelligence Community Postdoctoral Research Fellowship Program. And I'm excited to have one of the fellows, Julie Spencer, with us on the program. Dr. Julie Spencer, welcome to the ORISE Featurecast.

Julie Spencer:

Thank you, Michael. It's nice to be here.

Michael Holtz:

So tell us a little bit about who you are and what you can about the Intelligence Community Postdoctoral Research Fellowship Program.

Julie Spencer:

Well, you already said my name, so I guess I don't need to say that. I'm a computational biologist. And I had been working as a grad student as an intern here at Los Alamos National Lab and this opportunity came up. In the posting of the research topics available for the IC Postdoc Fellowship, I just found the perfect match for me and my background and for the skills I was interested in acquiring. So it had to do with the drivers of infectious disease, which is what I've been studying. So I just thought, okay, I'll go ahead and apply and see what happens. And I was very surprised to be awarded the fellowship.

Michael Holtz:

Really? Well, I'm glad you were, because I'm glad we get to have this conversation. I wanted to just talk briefly about what the fellowship is. So the folks who are listening understand the Intelligence Community Postdoctoral Research Fellowship Program was established in 2000 to support unclassified basic research in areas of interest to the intelligence community. This is a program funded by the Office of the Director of National Intelligence and the program annually supports several post-doctoral fellows from across the United States, accredited colleges, universities, and US government laboratories across the country.

And in collaboration with research advisors, postdocs develop and submit technical research proposals that align with research opportunities proposed by the intelligence community. Topics include a wide range of things, Julie, including what you talked about related to infectious diseases. Talk about your background and how you got to the point of being interested in infectious diseases. Is it something you have always had an interest in? Was it something that, while you were pursuing your education, you sort of fell into, or was it long before that?

Julie Spencer:

Thank you for asking that question in that way. That helps me be a little concise, because I was going to ask, do you want the short answer or the long answer? So yeah, I was in my PhD program at the University of New Mexico and what I started initially studying was the evolution of bacteria and specifically drug-resistant mycobacterium tuberculosis, which is the bacterium that causes tuberculosis. So I was really interested in the mutations that take place that enable this bacterium to be resistant to the drugs that are used in TB treatment because it's a pretty serious problem worldwide still. We don't notice it that much in the United States because there is not that much TB in the United States, but it still is an ongoing problem and could potentially be a problem here depending... I don't want to be too alarmist or anything like that, but diseases are what I study.

So I started out studying that and then my primary PhD advisor actually was hired away from University of New Mexico and there was an applied mathematician and epidemiologist on my committee, Helen Wearing. And I said, will you be my new advisor? And I think the reason I was interested in working with her is that I had taken an applied calculus class with her and she had showed us this phase plane diagram that showed just the cycling of the spread of disease. So a lot of diseases are seasonal and they will just peak and then go down to a valley and peak again and go down into a valley. And there's a way of looking at that where you can see that pattern establishes an equilibrium where it's not really increasing overall and it's not really going away. It's just kind of in equilibrium, like the waves of an ocean.

And so she showed us how the system of ordinary differential equations can describe that process. And then also, how you just tweak one of the parameters a tiny little bit, like the incubation period or the infectious period or the rate of transmission from person to person. And you can actually make the disease go away for... This is mathematical modeling, where you can actually play with what will happen to a disease with millions of people.

[inaudible 00:07:11] is just an award-winning professor. She's really an incredible teacher. And I just had this moment where I could just see the power of mathematics to help relieve suffering from diseases. And I just decided that's the direction I wanted to go.

Michael Holtz:

That's really cool. And of course, we've seen a lot of that... I would be remiss not to talk about the obvious...

Julie Spencer:

We have a recent example.

Michael Holtz:

Exactly. That's still sort of going on. Obviously your work comes into play. It's very current, of the moment, as they say, and continue. So can you talk a little bit about the research work that you're doing now?

Julie Spencer:

It's hard to know where to start because I'm working on several different projects simultaneously and that's been one of the wonderful things about the IC Postdoctoral Research Fellowship is that I've been here at Los Alamos National Laboratory in A1, which is the information systems and modeling group. So we collaborate with a lot of different divisions all across the lab. And there are a lot of multidisciplinary teams that are solving different problems. So one of the really unexpected, amazing things is that I've been able to collaborate with a lot of different teams on a lot of different projects.

Michael Holtz:

That's really cool.

Julie Spencer:

So that's why I'm having trouble trying to figure out where to start. One of the things that I've been working on is just trying to forecast dengue in Brazil and I've been working with a relatively simple statistical model is just linear regression, where we have this algorithm in R, which is a programming language, to find the optimal coefficients that will make the best possible equation to forecast based on the data that we input.

I've been experimenting with a lot of different data streams and here at the information and systems and modeling, we call it data fusion, where we're synchronizing a bunch of different data streams, maybe satellite data on vegetation or climate data or case count data... Definitely case count data from the history of the case counts and then at different spatial and temporal resolutions. So for Brazil, for dengue, what I've been working on is the weekly resolution and at the state level.

And so it's just been this long process of trial and error to try to find the best combination, to try to predict dengue outbreaks in Brazil. And just for a little bit of background, dengue causes 400 million new infections every year. It's a really, really major... That's an estimate, but it's a really major tropical disease that causes a lot of suffering and economic loss.

Michael Holtz:

So that's a big deal, especially in somewhere like Brazil, where you've got a lot of tropical landscape, right?

Julie Spencer:

Most of Brazil is tropical. A little bit in the Southern part is more in the higher elevations, is more temperate. So dengue is famously difficult to forecast. And one of the reasons for that is that it doesn't... It isn't transmitted from human being to human being like COVID-19, for example. It is transmitted by mosquitoes. So in order for dengue to spread, a mosquito has to bite an infected person. And then the virus has to travel through the system of the mosquito to get to the salivary glands. And that takes a few days. And then the mosquito has to still be alive after that process is completed, which is highly temperature dependent, but I'll get to that. And then if the virus has traveled to the mosquito's salivary glands, and then the mosquito is still alive and then it bites another human, that's where it gets transmitted to the next human and spreads.

Michael Holtz:

There are a lot of factors in that, in that transmission, but it sounds like that's what you're looking at.

Julie Spencer:

So there's a lot of mosquito biology involved and it is kind of fun and interesting because I'm a biologist and I've ended up working with a lot of applied mathematicians and I'm not primarily a mathematician, but that's the wonderful thing about multidisciplinary teams, is that on a team you can have a biologist, a mathematician, a statistician, a computer scientist who can help with automating the code. I mean, I can write research code, but I am not a computer scientist. So I really appreciate the help from the computer scientist.

I feel that what I bring to this project is careful consideration of the mosquito biology, because that's my background and I can do basic systems of ordinary differential equations and I can derive R-naught, and I can do a sensitivity analysis, but compared to a real applied mathematician, my skills are pretty basic in that area.

Where we feel like we've been able to make progress is that we're looking carefully at how the mosquito's life is affected by changes in temperature. And it is pretty complex because what we've found is that as the temperature gets a little bit warmer, the virus moves through the mosquito's body faster. However, when the temperature gets to a certain level, and then this is for a species Aedes aegypti, which is the primary mosquito species that spreads dengue. There are other mosquitoes that do it, but we're looking at Aedes aegypti.

So when you get to about 30 degrees Celsius, the mosquito's lifespan starts decreasing substantially. So then you start closing the window of transmission because there's a shorter and shorter period of time where the virus has reached the mosquito's salivary glands and the mosquito is still alive. And then you get up hotter, 35 C, and the mosquitoes just all die and you have no dengue.

Michael Holtz:

So it's almost feels like there's a race of the factors, right? Is it hot?

Julie Spencer:

Some of the ways that mosquitoes are affected by temperature are actually contradictory. And so we're trying to capture that. And a lot of other really good research has been done on this. For example, Erin Mordecai has really been a pioneer in this field. And so it's been just fascinating reading that. I guess that's part of the job, reading all the work that people have done and then trying to improve on it a little bit.

Michael Holtz:

Right. So Julie, let me ask you, has science always been an interest to you? Like as a kid? Did you dream of working in the sciences, of being a scientist?

Julie Spencer:

Yeah. So when I was about 10, someone gave me a chemistry set and about the same time, my parents bought a... I'm afraid this is going to date me a little bit. My parents bought a World Book encyclopedia.

Michael Holtz:

Oh yeah.

Julie Spencer:

That just kind of opened up a whole world to me. I would just sit there and read it. I wanted to know what everything was made of. I wanted to know how everything worked and I always entered the science fair and my school and that kind of stuff. So the memory I have about that chemistry set is that there was a list of experiments and I just started going through the list of experiments and doing them. And I came to this one where it said, okay, fill a beaker about half full of water. And then there was this little chunk of pure sodium.

And I'm not sure if you're familiar with what pure sodium does when you throw it in water. But the instructions were to throw the chunk of pure sodium into the beaker of water. And I had no idea what was going to happen. So I threw it in there and it just lit on fire and started skating around the surface of the water. And then there was this poof and I just was kind of... As a 10 year old, I was pretty impressed and it was a very memorable occasion. And I thought, hey science is pretty cool. I think a lot of scientists have something like that.

Michael Holtz:

Sure. Yeah. There's sort of an X factor moment of this is what I'm going to do.

Julie Spencer:

Yeah.

Michael Holtz:

I love it. I've had recent conversation with other scientists who use data and they talk about the multidisciplinary team and our sort of vision, the cartoon vision of the scientist having the Eureka moment in the lab by themselves, doesn't really happen much anymore because you have to work with, as you said, the mathematicians and the data scientists and the engineers and all of that. So just, I guess, talk about that again, just in terms of how important it is to be part of that multidisciplinary team. And as you said, you're on a number of projects because you're not just focused on one thing because of that sort of multidisciplinary focus.

Julie Spencer:

I feel like I'm kind of on a soap box about the multidisciplinary team thing, because it's just been the most wonderful thing about working here. That's why I plan to have a career at Los Alamos National Lab now. It has been particularly interesting having statisticians on every team because ideally you would always have a statistician on a team because they help with the experimental design and make it so your results are actually meaningful.

I think what happens a lot, especially with biologists, is that you collect data from the field or you collect data from the literature or something like that. And then you have an idea, you have a hypothesis, you're testing your hypothesis, but if you don't have really advanced training in statistics, you might not be too clear on exactly how you're testing that hypothesis and how robust your results will be and how they'll stand up.

And so if you have a statistician from the very beginning, they will say, that particular test doesn't really apply to this type of data. And they just know that on the tops of their heads. And then you don't have to wait until later, until you've done a whole year of work. And then you say to the statistician, oh, can you help me brush up the stats so I can write a paper on this? And they're like, actually, you're going to have to do this all over again.

That's just one example. I've had this wonderful computer scientist on my team, who's actually a student. Her name is Martha Barnard, and she's a post-bacc. She actually just finished a year as a post-bacc intern at Los Alamos Lab. She is so good at programming in R. So I will write this very rough code to accomplish this task and run this algorithm to do this forecasting. And then I will send it to her and then I will have written about a hundred lines of code and she'll send it back to me and it'll be 20 lines of code. I'm sure everyone's had that experience or I don't know if they have or not. She's so just so cheerful and helpful about it and she teaches me how to do it. So then next time I can do it that way. So that's pretty awesome collaboration.

Michael Holtz:

For sure.

Julie Spencer:

Martha is a rockstar and she's now gotten an NSF fellowship to go get a PhD at the University of Minnesota in biostatistics.

Michael Holtz:

Very cool. So there's collaboration and mutual learning and all of that. So it sounds really like an amazing experience all the way around. Not to give you a leading question, but would you recommend the Intelligence Community Postdoctoral Research Fellowship to other people?

Julie Spencer:

Yeah, so I kind of feel like this fellowship isn't as well known as it should be. And I am just really enthusiastic, I don't know what the word is, really, but salesperson for this fellowship.

So I have had the most amazing two years. It's been absolutely incredible because there's a travel allowance. And so I got to go to New Orleans to the American Geophysical Union and met some of the foremost mosquito-born virus, researchers in the country and have ongoing collaborations with them. I got to go to Columbus, Ohio to this amazing climate resilience conference sponsored by the Department of Energy. And I met collaborators there.

And then more recently I got to go to Canada, to Kelowna, Canada, to a pandemic preparedness workshop with some of the foremost infectious disease specialists in the world. There were only 20 people there from 10 different countries and Odo Diekmann was there who invented the concept of R-naught, from the Netherlands, just as one example. But I looked at the list of presenters and I recognized 15 out of 20 of the names just from papers that I had read. And I got to go collaborate and brainstorm with these people as an equal.I think my conspiracy, or what's is it called? Imposter syndrome? I think that's permanently cured.

Michael Holtz:

That's good to know.

Julie Spencer:

So yeah, I just had to plug the travel and presenting at conferences and I've had the opportunity to present because of this fellowship. I've had the opportunity to present my research and network at 10 different conferences and workshops.

Michael Holtz:

That's amazing.

Julie Spencer:

I hadn't really expected that, either, that there would be just all this really fun travel and networking and ongoing collaborations. This fellowship provides you the opportunity to focus on a project. Whereas I think a lot of postdoc opportunities probably have so many other responsibilities that it's hard to focus on your project. There's a kind of freedom in having that salary and that support and the travel funding.

I don't want to forget to mention that the mentorship has been just really priceless. So Anthony Nguy-Robertson and Erik Scully have been my ORISE mentors. Oak Ridge Institute of Science and Education. And then Carrie Manore has been my onsite Los Alamos National Lab mentor. The quality of the mentorship is just outstanding. They've been so generous with their time and their advice and telling me about invisible ropes and things like that I would not have known about. And with those, without those mentors, I don't think I would've done anything.

Michael Holtz:

Wow. That's amazing. In terms of paying it forward from a mentorship perspective, do you look forward to the opportunity to mentor others?

Julie Spencer:

Yeah. So that's the perfect next question, because I know this is just going to sound over the top, but I am so grateful for the quality of the mentoring that I'm actually on fire to pass that torch and be an amazing mentor myself because no one pays anyone to be that good of a mentor. That's not really in the job description, but it's part of the culture. And I do think it's an important culture for training the next generation of scientists.

Michael Holtz:

Awesome. Julie, is there anything I haven't asked you that you want to make sure and say about either your experience or about the fellowship itself?

Julie Spencer:

I don't know. I think we've pretty much covered it. I just think that part of what's really nice about the design of this fellowship is that you get to work with a mentor at a national lab or a university or another institution. And so you're just not in a vacuum working on your research problem. You're working with just amazingly amazing people. And I guess I want to quote one of my mentors, Sara Del Valle, in saying, people first, mission always. So I know it's might be a little cheesy, but that's become my personal motto.

Michael Holtz:

Awesome. I love it. Well, we will leave it there and recommend that folks take a look at the IC Postdoctoral Research Fellowship program and apply. Put themselves out there for this amazing experience. Dr. Julie Spencer. Thank you so much for spending some time with me today and talking about your experience as a fellow.

Julie Spencer:

It's been a pleasure to talk with you. Thank you so much.

Michael Holtz:

Thank you and have a great day.

Julie Spencer:

You too.

Announcer:

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