

## Just Forensic Anthropology and Forensic Pathology Portfolio

**Introduction** [00:00:05] Now, this is recording, RTI International Center for Forensic Sciences presents Just Science.

**Voiceover** [00:00:19] Welcome to Just Science, a podcast for justice professionals and anyone interested in learning more about forensic science, innovative technology, current research, and actionable strategies to improve the criminal justice system. In episode three of our 2021 NIJ R&D and beyond mini season Just Science sat down with Danielle McLeod-Henning, a physical scientist and program manager and the Office of Investigative and Forensic Sciences at NIJ, to discuss forensic anthropology and forensic pathology. Danielle McLeod-Henning has been the physical scientist in charge of the forensic anthropology, pathology and medicolegal death investigation portfolio since 2009. In that time, she has dedicated her efforts to bridging the gap between research and application. Listen along as she talks about technology translation, creating research connections outside of forensic science and the NIJ research portfolio in this episode of Just Science. This season is funded by the National Institute of Justice's Forensic Technology Center of Excellence. Here is your host, Molly Dix.

**Molly Dix** [00:01:32] Hello and welcome to Just Science. I'm Molly Dix with the Forensic Technology Center of Excellence, a program of the National Institute of Justice. Today, I'm happy to be hosting Danielle McLeod-Henning, a physical scientist who oversees NIJ's R&D portfolio that includes forensic anthropology, forensic pathology and medicolegal death investigation. Danielle, welcome to the podcast.

**Danielle McLeod-Henning** [00:01:56] Thank you, Molly. It's my pleasure.

**Molly Dix** [00:01:58] So Danielle and I have worked together for a long time, but this is an exciting day to actually get to sit down and have some real conversations. So today, my hope, Danielle, is that we can dive into two areas of interest. One for me is how NIJ and you via your portfolio helped bring technologies that have been developed in other areas beyond forensics and bring them into law enforcement and forensic applications. And the other I know this from the history of working with you is your role in funding research that helps to bring science to those cases that are hard for law enforcement and society to deal with. And I think they've been called the ugly cases. So that said, I think let's back up and let's just kind of do a little introduction for our listeners in terms of your personal path, kind of where you are today as a program manager and maybe some of the themes that you're most passionate about.

**Danielle McLeod-Henning** [00:02:50] Thank you, Molly. I've been at NIJ since 2006, but I've been in my current role as the physical scientist for our forensic anthropology, forensic pathology, related MDI disciplines, and crime scene investigation since 2009. I studied anthropology in undergrad with a focus on biological anthropology or rather than choosing an academic route after undergrad, I sought a more applied route and studied forensic science and grad school. So some of the themes that my portfolio covers very diverse field of related MDI disciplines with some common themes, such as human identification, cause and manner of death determination, and other factors that support medicolegal investigations. Some of the studies that we explore are looking into more accurate methods for post-mortem interval determination or time since death, novel concepts for human identification, such as geolocation using isotope analysis, and looking into finite element modeling, exploring the biomechanics of head trauma in the hopes of differentiating between intentional and accidental trauma.

**Molly Dix** [00:04:02] Fantastic. And right there in your introduction, I hear finite element analysis, which is the traditional engineering discipline which I studied in undergrad and bringing that towards those ugly cases where you're looking at trauma and so forth. So perfect lead-in to kind of still staying at the top level. When you think about NIJ, the time you've been there, are there certain elements in terms of technology direction, areas of need, maybe even variations in terms of who the stakeholders are that you're aiming towards bringing benefit? Are there trends or changes that you've found interesting or maybe even that you're seeing for the future?

**Danielle McLeod-Henning** [00:04:42] Yeah, so forensics being such a niche field, it's been really interesting. Certainly in the past few years, we've done a lot of outreach to other communities to try and adopt technologies that are rather established in other fields. But to look at it from a forensic science perspective and to see how we can adopt that, to address forensic science challenges. So one example certainly is using advanced imaging. And when I talk about advanced imaging, it can be for multiple applications, particularly in my portfolio used for post-mortem examination, such as a virtual autopsy using CT and MRI as a triage tool or even as a supplemental tool for the post-mortem examination. Other areas of imaging that we have looked into at NIJ and funded research and development in is hyperspectral imaging and looking into LiDAR and other sort of imaging technologies for crime scene applications such as crime scene documentation, crime scene reconstruction, and also detection and identification of evidence at the scene. So we have looked into a number of fields within all the forensic sciences, but those are some examples within my portfolio that we have kind of adopted and supported technologies from other fields so that they can address a forensic science need and challenge.

**Molly Dix** [00:06:17] What I'd love to do is even add a little more color there in terms of some of the ones that I found interesting. So you mentioned that advanced imaging and when you think about CT and MRI, you think about the medical, it feels a little closer to forensics. But that that move towards hyperspectral is really intriguing with that technology coming out of JPL and NASA in the 1970s. And our team at RTI does a lot of work with NASA. So this is where I kind of geek out with you. And so that concept that you funded a mineralogist at Miami University, which I think I want to highlight this for all those listeners who are not in forensic science, but whose technologies can bring that kind of basis. And I think if I remember right, that was really aimed at taking his technology that he was using for minerals towards helping trying humans and remains. You want to add any color for our listeners in that specific case?

**Danielle McLeod-Henning** [00:07:14] Molly, that is a perfect example of looking into other sort of academic lines of research in completely separate field geology, mineralogy, not something that you typically think of when you think of forensic science. And so this particular PI saw a forensic science application with what he was studying when looking at mineral deposits. And so instead he was looking into the hyperspectral imaging from a geological perspective, but then thought, hey, this could potentially have forensic significance if we are trying to essentially remove the geography of the area to try and use for either search and rescue or to find unidentified remains, even looking for a potential suspect. And he wanted to adapt this technology, not only just the imaging portion of it, but then using that imaging technology on a drone to cover large areas.

**Molly Dix** [00:08:21] Are there ways either in the past or even thinking towards the future that you are actively or you kind of hope might happen in terms of pulling in those researchers that aren't forensic scientists, but have those technologies that are enabling?

**Danielle McLeod-Henning** [00:08:38] Yes. So we currently funded, in addition to the geologists that we just mentioned, I have funded in my portfolio biomechanical engineers, microbiologists, computer scientists, imaging experts just to try and, again, adopt within forensic science applications that are established in other fields. And it's really exciting to be able to look at the opportunities and just what is already out there and what these experts are already doing and how that can be applicable for a couple of samples that I wanted to bring up, particularly, as I've mentioned before, biomechanical engineers looking at finite element modeling of the skull to try and determine fracture mechanics and forces applied that when you look at an infant that fell out of the crib and what are the forces applied to cause a specific trauma versus some sort of intentional trauma that was imparted on that child. And so being able to use engineering to try and differentiate the two or at least have a quantitative basis to say, well, the forces applied or the forces necessary to cause these particular injuries do or do not line up with the history of what was actually said about the incident. Another area that we are looking at and that we have funded is looking into the microbiome. So not only the microbiome of the decedent, but also looking at the microbiome of the environment around the decedent, including the entomological communities and how each may interplay with each other to form a consistent time core. So this goes back to that question of post-mortem interval or time since death, which is one of the most important questions at a death scene is when did this person die? So NIJ is invested in research that's looking at novel techniques for post-mortem interval determination that may be applicable across the geographies and the environments and looking into the microbiome of the decedent is one of those particular areas.

**Molly Dix** [00:10:59] Interesting. And so that's one of those kind of areas that's so hard where a child comes into the E.R. and there's a situation where you almost can be involved in helping relieve stress for a family that's already been through a lot to say, to help say, this was an accident or this was not potentially. And I know you've also funded research towards genetic testing in sudden death investigations, and I feel like that fits in that same kind of space. You want to share a little bit about that?

**Danielle McLeod-Henning** [00:11:31] Absolutely. So although a death may end up natural, a thorough investigation is still necessary to rule out foul play and sudden and suspicious death, particularly in infants and children. Cause and manner of death in sudden fatal events involving infants and children and the ability to be able to determine natural, accidental, and intentional continues to be a high priority need of the community. So we have funded studies looking into genetic markers that may lead to a sudden fatal event. And this is what we coined the term molecular autopsy. So we have funded studies with the New York City Office of the Chief Medical Examiner, as well as Harris County, to look into potential genetic markers that may lead to a sudden fatal event so we can really help to rule out any sort of intentional death and really help to address those undetermined deaths.

**Molly Dix** [00:12:32] This is great. So you follow technology, you recognize those opportunities to take a technology that's matured beyond forensic science and bring it towards forensic science. You're aware of the needs of the forensic community, law enforcement, E.R. doctors, medicolegal death investigators, everybody who's, who's in this world. And so the finite element modeling is kind of that exact overlap, right, it's both. But some are more towards the technology and some are more towards the user needs. When

you think about your portfolio, you think about solicitations, maybe even how you review the grants that are proposed and select them. Is there anything towards the ratio within the portfolio or priority within the portfolio? Is there anything kind of about that overlap or where technology versus need that, I don't know, is a guiding principle for you?

**Danielle McLeod-Henning** [00:13:28] As the research, development and evaluation agency of the US Department of Justice, NIJ uses science to address the needs of our practitioner community and our state and local stakeholders. So that is really our first priority when it comes to making our funding decisions. We look at our entire portfolio to see what the body of knowledge is that we currently have, and that doesn't mean that we don't want to continue in those investments, because the beauty of R&D is that you never know what's going to happen in the future and you want to be able to have replicability and reproducibility within our research and development portfolio. So we look at a number of factors, of course, and needs, addressing needs of the community being one of the most important. We also have subject matter experts that we bring in from the field to aggressively review these proposals based on a number of criteria. So we use a lot of factors when we're making our funding decisions, but we really want to ultimately make sure that we are addressing the needs of our stakeholder community.

**Molly Dix** [00:14:39] I'm so glad that we were able to get that stated overtly. I'm hoping that there's folks listening who are going to propose and that they hear that because if you are a technologist and this is my soapbox as somebody who's done tech transition and tech transfer for my career, if you are that technologist like the professor who is really about hyperspectral imaging and minerals, if you can think about coming into your proposal, having talked to potential end users or even combining and pairing and creating that ecosystem of technology, researchers, users, I just think that's obviously the best case. And that's not always easy to do. But at least you've said it out loud. The need comes first, and that's just great. I'm glad we were able to get that out there.

**Danielle McLeod-Henning** [00:15:33] And I just I want to point out from what you just said, that we, we purposefully keep our forensic science R&D solicitation very open and broad because we don't want to pigeonhole ourselves and we don't know what's out there in regards to technology applications for forensic science and what could be out there in other academic fields that could address a forensic science need that could potentially be paradigm shifting. So we absolutely want to keep everything broad so that we make sure that we are doing the best for our stakeholders and getting top notch application proposals from a variety of disciplines and fields.

**Molly Dix** [00:16:18] Great. So here's a hard one. But I think it's interesting. If you could solve one problem in the world of criminal justice today, what would it be?

**Danielle McLeod-Henning** [00:16:28] That is a challenging one, obviously, because there are so many things that I'm very passionate about and I think are very important. And so I don't want one answer to diminish the importance of something else. So if you give me latitude, I may give two examples. One of them would be post-mortem interval determination. There have been decades of research spanning back to the early 80s with Dr. Bass's forensic anthropological research facility at the University of Tennessee looking at this very question of time since death. And still to this day, that is one of the top priorities in my portfolio and one of the portfolio areas that I get the most applications to and we are looking towards novel techniques. It's no longer, you know, putting some pigs in a field type of situation. Now we are looking at other biomarkers, metabolomics, proteomics. We are looking into the microbiome, but it's one of those things - are we ever going to find the

golden ticket? And who knows? Most likely not just because of the natural progression of decomposition from fresh to bloat to skeletonization. But who knows, maybe there is some sort of biomarker within the bone marrow of a long bone that may give us some sort of consistent and accurate and reliable time course to accurately measure time since death. Another example is, of course, the cases of sudden unexpected infant deaths. That will always be a top priority always, and something that the community, of course, is extremely passionate about - being able to distinguish intentional from natural and accidental. There are a lot of players involved, particularly from very personal levels, a lot of, um, a lot of emotions that are involved in those particular cases, a lot of passion involved in those particular cases. Who knows, perhaps future molecular analyses, studies into the microbiome, again, may help to address some of those undetermined cases. And so the more and more undetermined cases that we can rule out that were either caused by either some sort of natural cause, the more and more we can hone in on accidental versus intentional. And then with our biomechanical engineering project, even hone in more, if something was actually intentional.

**Molly Dix** [00:19:17] Two fantastic examples. And again, touching on that, that area of cases, that is just so hard. So that's two, and they're critically important, but there's so many. And so how do you or how does NIJ identify and disseminate practitioner needs that ultimately inform solicitations and grant selection?

**Danielle McLeod-Henning** [00:19:39] So we have, annually, we bring together about 50 forensic science practitioners from the field, representative of all the forensic science disciplines that we fund. And that committee is called our Forensic Science Research and Development Technology Working Group, or what we call our forensic science R&D-TWG, if you will, and every year we bring together those forensic science practitioners to help us identify operational needs or challenges that they are encountering in their day to day work life. And these are, again, challenges that might be better, faster, cheaper technologies to do this. It might be more research studies into that. So, again, it covers all forensic science disciplines. We have what we call our sub-TWGs or sub technology working groups that each of the four research and development physical scientists at NIJ manage. So the particular one that I manage is within the medicolegal death investigation and crime scene investigation realm. So I have forensic science practitioners, I have crime scene investigators, I have forensic anthropologists, forensic pathologists, and medicolegal death investigators, as well as forensic odontologists that I bring together to help me to identify what are those challenges that you are encountering in this field. So then I can use that when we are evaluating proposals to see if those proposals can actually address those needs. And as you are very familiar with the R&D process, it is not something that happens in a day or a year or even two years. It is a long process to get from concept to potential methodology development and validation and deploy to the field or to the lab. So it's not something that's going to happen overnight for sure. But as we continue to make these investments, we continue to see technologies and methods come to fruition every year. And that's exciting.

**Molly Dix** [00:21:59] That's great. So these, these TWGs or technical working groups are your connection to the community to really revisit and refine the needs and challenges. Are there resources that you would recommend grantees, especially those not in the forensic science community, use to kind of dive in on those needs and challenges?

**Danielle McLeod-Henning** [00:22:22] Yes, so our TWG needs are all posted on the Web. We call those out specifically in our forensic science research and development solicitations so that those that are, that are interested but aren't necessarily as familiar with

the challenges in the forensic science community can then look at those TWG needs and be like, oh, I think my research could really help to address that particular need. I can see that leap. I think I'm going to apply this here, so yes, we post those needs to the NIJ Web site. Another, another source of looking into research needs for the forensic science community is the National Institute of Standards and Technology, their Organization of Scientific Area Committees, or OSAC. They also post research needs for each of their subcommittees under the OSAC.

**Molly Dix** [00:23:23] Perfect. So the listeners that are out there that are not already tied to this, there's great resources there, as Danielle has highlighted. I kind of want to flip it now. So we've talked about the needs and the fact that solicitations are out there. People can go look at the historical solicitations. They can go look at the OSACs and your TWGs and really understand the needs. But innovation is all the way from that need to the idea of how to solve it. The R&D investments in working to solve it, and like you said, R&D, you never know what the future's going to bring, what's going to work, what's not going to work, how things are going to go. But you do have a portfolio and a history of funded grantees. And so the FTCoE one of the things we're very involved in, is trying to make those connections towards those investments that have been made towards users, industry, commercialization. And so one of the things I wanted to make sure we touched on for the listeners is the fact that to highlight grantees and to help drive those connections and collaborations, that NIJ has traditionally hosted the Forensic Science R&D symposium, and obviously the FTCoE is involved in that. And so this symposium historically annually is held with the American Academy of Forensic Sciences. This year, that symposium was held virtually, and it led to one of the most attended symposiums on record, which is really exciting. And I think this next kind of conversation is really beyond just this one event. But the benefits of that virtual Vs. the benefits of the in-person then kind of pros and cons, I'm just intrigued for you as a program manager, kind of how did this impact your world, the fact that it was virtual this year?

**Danielle McLeod-Henning** [00:25:11] Molly, I will say it is really exciting to know the interest and the enthusiasm is there, even when participating from one's own home. And we are able to back that up with numbers. With over six hundred attendees at this year's virtual R&D symposium. With the technology tools at our fingertips, it's great to have the option to host such incredible dissemination events even while we're in the middle of the pandemic. And I want to give major kudos to you and the rest of the Forensic Technology Center of Excellence for your incredible marketing and for facilitating a seamless event. One significant benefit of the virtual symposium was the ability to host multiple tracks and sessions by disciplines, which we have not had that luxury in the past because we would have one day in person and that would be to cover all of the forensic science disciplines. But between the poster session and the forensic anthropology forensic pathology track, I will say just in my own case, each of my MDI related presenters that submitted an abstract was able to showcase their NIJ funded research. Again, this is not something that we have been able to accommodate in the past, so that is just one major benefit of it. Another, I would say, was certainly the live Q&A session was by far the most active that I've ever experienced. And I have been moderating this meeting since 2009. It was really great. Many of the questions were quite focused on research design, which, of course is hard to get into the specifics of in a 20 minute time frame. But it just demonstrated the engagement and the interest from the audience to really want to delve into each research project. And like I said, the Q&A session this year, it was just really explosive and really exciting. There were questions coming in constantly. And I will say from, from my own personal feeling that maybe people feel much more comfortable not having to stand up in front of two hundred people and ask the question on a microphone, which I'm certainly one

of those people where I've had questions in the past, and so maybe I would try to catch the PI after they come down from the podium, to pull them aside to ask my questions. Because I feel, you know, personally I felt very uncomfortable standing up in front of hundreds of people to ask my question, particularly wondering, was that something that I missed, was it already answered, or is this something that's implied? So I feel like people don't have that hesitation. And because of that, it was a really interactive and a really fun Q&A session.

**Molly Dix** [00:27:59] Yeah, I'm like you. I agree that standing up and waiting in line down the aisle for the microphone is too much. And I think it's going to be interesting to consider how we take the benefits that we've seen. And yet we all know that the person has a huge amount of value too. So, yeah, it'll be fun to figure out what the hybrid future looks like. One that I want to, I want to try to get to, as we've talked about this natural intersection between technology and the needs. And so one of the things we're passionate about is the innovation ecosystem and making sure that collaboration is occurring. When you think about your portfolio, would you potentially be able to describe what an ideal collaboration between researchers and practitioners might look like for you?

**Danielle McLeod-Henning** [00:28:50] Yes. So one partnership that that comes to my mind immediately is certainly the intersection between researchers, whether they're neurologists, whether they're biomechanical engineers, whether they're a whole host of other particular disciplines or fields - the intersection of that academic research side with the forensic pathology medical examiner side. So having that intersection, if it's medical research, a lot of it is done on living individuals. Not a lot of it is done on dead people and what happens to a person after they die or why they died. A lot of it is research into how to prevent people from dying, such as cancer research or obviously the research that's going on now for Covid-19 and what was done for the vaccination development. A lot of research is done to prevent death, but not a lot of research is looking into - okay, this person died ... why? And how? And trying to build that intersection between the academic research side and the medicolegal death investigation, medical examiner or coroner, forensic pathologist side. That is a really great partnership. One example I would say is the University of New Mexico Office of the Medical Investigator is basically the ideal situation because the office of the medical investigator is housed within the University of New Mexico. And so it's kind of the best of both worlds. And it's also one of the major reasons why our forensic pathology portfolio, a lot of the awards have gone to University of New Mexico OMI only because there aren't a lot of applicants that we receive in that area just because most forensic pathologists can't do research. They're doing so much casework that they don't have the ability to do research. And so because OMI has that tie with the university, they have a research side as well.

**Molly Dix** [00:31:11] Perfect. So getting on my soapbox, I'll just say to all of you who are thinking about proposing, do remember kind of that idea to impact pathway, think about who you are, what you're good at, what you're not good at, who is in the innovation ecosystem in terms of federal, university, corporate, foundations might be interested, have resources, needs. Try to, try to build the story. And there are resources on the Forensic Technology Center of Excellence about that transition path. There's some guidance documents that can help you think about it. OK, one last question. Anything you want to share about what's next for your portfolio?

**Danielle McLeod-Henning** [00:31:52] And, you know, the beauty of R&D is that the possibilities are endless. And so who knows what the future may bring? Like I said earlier, in regards to PMI, are we going to find that golden ticket? In regard to imaging

technologies, now, you know, we have MRI and CT, we have hyperspectral. We have ALS - who knows in the future what imaging technologies that perhaps we adopt from other fields transition into forensic science will be able to tell us. You know, maybe it's going to be an imaging technology that finds blood at the scene and is able to give a positive identification for blood versus some other either body fluid or perhaps one project that we have funded looked into the difference between blood spatter and blowfly feces, which can sometimes mimic what blood spatter looks like at the scene. And so maybe there will be some sort of technology that will come down that will be able to look at these particular things and be able to give you not just a presumptive answer, but a confirmatory answer. So, again, you know, the possibilities are really endless and it's exciting. We have funded a number of studies in microbiome that are looking, like I said, from both the medicolegal death investigation perspective with time since death, but also looking at the microbiome of different soils for trace evidence and other sort of forensic applications. But later on down the road, maybe microbiome will be looked at. And we have had some preliminary studies in this area looking at microbiome for cause and even manner of death determination. So it's exciting. There's so much opportunity and again, the possibilities are endless. So it's exciting to see what the future holds.

**Molly Dix** [00:33:57] It is exciting. And so I would just love to remind anybody listening who thinks that you have research and development ideas to consider the solicitations that come out of NIJ. And also, if you are an existing grantee and you're struggling on that path towards impact, don't be shy. Please reach out to the Forensic Technology Center of Excellence. So that's all the time we have for today. I'd like to thank you, Danielle, for sitting down with Just Science and discussing your R&D portfolio and your wishes and hopes for the future. So thank you.

**Danielle McLeod-Henning** [00:34:31] Thank you very much, Molly. This was an absolute pleasure. It was fun to talk about science.

**Molly Dix** [00:34:36] I totally agree. I'd also like to thank you, our listeners, for tuning in today. If you enjoyed today's conversation, be sure to like and follow Just Science on your podcast platform of choice. I'm Molly Dix and this has been another episode of Just Science.

**Voiceover** [00:34:52] Next week, Just Science sits down with Tracey Johnson, a physical scientist and program manager in the Office of Investigative and Forensic Sciences at NIJ, to discuss the NIJ biology and DNA research portfolio. Opinions or points of views expressed in this podcast represent a consensus of the authors and do not necessarily represent the official position or policies of its funding.