Just DNA Results in Rapid Time

Voiceover [00:00:01] RTI International's Justice Practice Area presents Justice Science.

Introduction [00:00:08] 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 two of our Unidentified Human Remains season, Just Science sat down with Neal Parsons, a Research Forensic Scientist at RTI International, to discuss how rapid DNA analysis has become an important method for identifying unknown human remains, especially in cases of mass fatality. Rapid DNA analysis is a fully automated process of developing DNA profiles without the need for a DNA laboratory or human interpretation. Due to its quick turnaround time, rapid DNA technology has become a valuable tool that is used by law enforcement agencies, accredited crime laboratories, coroner's offices, and the military. Listen along as Neal discusses the capabilities of rapid DNA analysis, cases in which rapid analysis was used, and the importance of incorporating novel technologies within the field of forensic science. This episode is funded by the National Institute of Justice's Forensic Technology Center of Excellence. Some content in this podcast may be considered sensitive and may evoke emotional responses or may not be appropriate for younger audiences. Here's your host, Jaclynn McKay.

Jaclynn McKay [00:01:17] Hello and welcome to Just Science. I'm your host, Jaclynn McKay, with the Forensic Technology Center of Excellence, a program of the National Institute of Justice. Today we will be discussing rapid DNA and its application to the identification of unknown remains. Here to guide us in our discussion is Neal Parsons. Welcome, Neal. Thank you so much for talking with us today.

Neal Parsons [00:01:40] Thank you, Jaclynn, I appreciate it. Thanks for having me here.

Jaclynn McKay [00:01:43] Of course. I think a good starting point for today's discussion is talking about what rapid DNA analysis actually is. Neal, would you mind describing to our listeners what this process is?

Neal Parsons [00:01:56] Sure. So the FBI's definition of rapid DNA is the fully automated process of developing a CODIS core loci STR profile from a reference sample buccal swab. So with that said, rapid DNA is not limited to processing buccal swabs, and it has been demonstrated to successfully generate accurate DNA profiles from a wide variety of sample types, however, profiles generated from sample types other than buccal swabs are not currently eligible for CODIS upload.

Jaclynn McKay [00:02:25] Does rapid DNA involve short tandem repeats, or STRs, like in traditional DNA testing, or single nucleotide polymorphisms, also known as SNPs, like forensic genetic genealogy?

Neal Parsons [00:02:38] So rapid DNA uses STRs and is consistent with the traditional STR typing process carried out in a forensic laboratory. The only difference is it's a completely automated system and it's performed within a single instrument versus multiple instruments in the traditional laboratory. The rapid process uses almost an identical workflow; however, it's miniaturized to some extent. This workflow is extraction, amplification, separation, detection of those fragments and then allele calling. What the difference is, it is done without human intervention, and that is a big differentiator. All the

rapid DNA platforms currently on the market target the 20 CODIS core loci. They also target several additional markers that aid in kinship calculations.

Jaclynn McKay [00:03:27] Neal, you walked us through the workflow of rapid DNA analysis, but I didn't hear you mention a quantification step and I know that this is used in traditional DNA testing in a laboratory. So does rapid DNA analysis actually use a quantification step?

Neal Parsons [00:03:45] So the current rapid DNA platforms do not perform quantification, which is one of the reasons the FBI has restricted current CODIS eligibility to reference buccal swabs.

Jaclynn McKay [00:03:55] What are some ideal sample types for rapid DNA analysis?

Neal Parsons [00:03:59] So as mentioned previously, buccal swabs are the ideal sample type. The development of rapid DNA systems was initially based on booking station requirements and implementation where a buccal swab would be collected at the time of arrestee booking, much like fingerprinting that's done when a person is arrested. However, rapid DNA is capable of processing many different sample types, including blood, muscle, organ tissue, bone, saliva, semen and dare I say it, I might get some nasty emails saying this, but even touch DNA in certain scenarios. Now, let's be clear, I'm not saying these sample types are eligible for CODIS upload or should be used in every situation, but there is value in knowing that these systems have that capability, and I don't believe that should be dismissed. Ultimately, the successful generation of full and usable partial STR profiles through rapid DNA depends on many variables that impact sample quality, such as sample amount, degradation of the sample, the potential for multiple contributors, etc. The competent collection of a DNA sample by a trained practitioner is critical to the process.

Jaclynn McKay [00:05:06] With the various different sample types that could actually be used, what kind of applications does rapid DNA analysis have?

Neal Parsons [00:05:14] So there is a multitude of applications for rapid DNA. Number one, right, is the booking stations. This is what it was originally developed for, for processing arrestees at the time of arrest. Investigative leads in law enforcement, investigations would typically need to rely on a local DNA index system, but that is one way that law enforcement is using it on a daily basis. Sexual assault casework, we've seen this in Kentucky, and they are doing it with rapid DNA to expedite this process, however, they're also confirming the results using traditional laboratory methods. It's used in military sensitive site exploitation for intelligence operations. It's been used at the border for the confirmation of familial relatedness for undocumented migrants. And finally, it's used to identify unidentified human remains, in particular, mass casualty events.

Jaclynn McKay [00:06:09] Neal, could you tell me a little bit more about how rapid DNA is used to identify unidentified human remains?

Neal Parsons [00:06:15] Rapid DNA has proven to be highly effective and efficient solution for the identification of unidentified human remains, especially in mass casualty events. If you'd like, I can go through a couple events that I supported.

Jaclynn McKay [00:06:28] Absolutely, we'd love to hear about them.

Neal Parsons [00:06:30] Well, the first mass casualty event in which rapid DNA was used to identify human remains was the 2018 campfire. And this fire was, and still is the deadliest wildfire in California's history. The fire killed 85 people that we know of. There's potentially still more unaccounted for and it burned over 150,000 acres. But the intensity of this fire was so immense and great that it melted cars and it turned houses into ash and it made victim recovery very, very challenging. As you can imagine, the human remains were severely burned, integrated, which complicated the identification process. Typical identification methods such as fingerprints, dental records, they were initially used to identify the victims and were capable of identifying 22 of the recovered remains, but the rest were so degraded, DNA analysis was the only option left, and knowing that, they had to come up with a different solution. So the Butte County Sheriff's Office and the Sacramento County Coroner's Office elected to employ rapid DNA. And I know this wasn't an easy decision. There was pushback from state agencies and significant logistical barriers to implementing this in a reasonable amount of time. And not to mention that nothing like this had ever been done before. There was no standard operating procedure for this. But when the first samples came back with full profiles, this complex and massively coordinated effort became very focused and it was driven forward fairly quickly. So for every set of remains, sample selection was paramount. If there was a blood clot in the heart, that was selected first. The next best option was any muscle or organ tissue that could be recovered. And finally, when none of those sample types were available, the charred bone fragments were the last option. So in addition to the victim samples, you have to have familial reference samples to match it to. And so this effort was coordinated nationally through press briefings by the Butte County Sheriff's Office and resulted in 225 familial references being collected. And of these, 219 were processed through rapid DNA analysis. The whole effort only lasted a couple of weeks. So within the first couple of weeks of that first STR profile being generated, this DVI effort identified 58 victims of the 62 remaining human remains. And in my opinion, the effort demonstrated what is possible and provides a template for when disaster strikes again.

Jaclynn McKay [00:09:03] Thank you for that example, Neal. I think that really demonstrates how amazing this process is and what work can be done with it. If you have any more examples you want to share with our listeners, we're all ears.

Neal Parsons [00:09:17] Yeah, sure. So one other event that I'm directly aware of is the Calabasas helicopter crash, which happened on January 26th in 2020. Now that helicopter went down just outside of Orange County, California, and nine passengers perished during that crash. The Santa Barbara Sheriff's Corner Bureau actually deployed a rapid DNA instrument and sent it down to the Los Angeles County Medical Examiners Coroner's office. The process was to identify the remaining victims. So they originally identified four of the victims through fingerprints and the remaining five victims required DNA analysis. I believe that the process had started on the 28th, and by the morning of the 29th, the five other victims have been identified. It highlights another example of how powerful rapid DNA could be for a quick turnaround time, and we know that this is not only good for resources, but it's also really important to give families closure and I think we were able to do that in a very short amount of time.

Jaclynn McKay [00:10:33] Neal, you spoke about how law enforcement agencies, as well as medical examiners offices, have used the rapid DNA system. So what agencies have access to it?

Neal Parsons [00:10:44] So rapid DNA is used by federal, state, and local law enforcement agencies, accredited crime laboratories, coroner’s offices, and the military.

The use of rapid DNA for investigative leads is one of the most common ways it is being employed. It is not strictly used by accredited crime laboratories. Again, for DVI situations that doesn't have to be done through an accredited laboratory. It wasn't done for the Campfire, it wasn't done for the Calabasas helicopter crash, it wasn't done for the Conception boat fire. So there's plenty of uses for rapid DNA outside of the accredited laboratory.

Jaclynn McKay [00:11:26] Thank you for that clarification. So I know in accredited laboratories there are guidelines on what qualifications one needs in order to be a DNA analysts and with the capability of law enforcement agencies to be able to use these systems, are there any additional training or specific qualifications that they must have in order to operate the system?

Neal Parsons [00:11:49] That's a really great question. You know, accredited laboratories, they require their DNA analysts, their bench analysts, to go through rigorous training on how to collect samples, how to do triage of samples. I believe that law enforcement officers that are using rapid DNA technology need to have adequate training in collecting samples in the field or triage samples if they are bringing them back to process the samples at a later time.

Jaclynn McKay [00:12:18] I know you mentioned that some of the sample types that are used for rapid DNA are not CODIS eligible and you also mentioned the need to compare DNA samples from unknown samples to familial reference samples. Are all profiles obtained through rapid DNA search and DNA databases, or does it just depend on the application of the samples being tested?

Neal Parsons [00:12:48] Yeah. Without a database to match to, you know, DNA can only be used for 1 to 1 comparisons, which is fairly limited, so a database is critical. For rapid DNA profiles to be eligible for CODIS upload, it needs to be sourced from a buccal swab, collected and processed at an approved booking station, or an accredited DNA laboratory. However, local DNA index systems, or LDIS, is what they're known as their acronym, are DNA database is used by some law enforcement agencies. A LDIS enables rapid DNA profiles generated from crime scene samples to be essentially queried against a data set of locally obtained profiles for investigative purposes. You could also define the database used for disaster victim profiles, for example, like in the Campfire, a LDIS as well.

Jaclynn McKay [00:13:41] Neal, you gave us some very powerful examples of how rapid DNA helped identify victims and bring closure to families, but are there any drawbacks to using rapid DNA?

Neal Parsons [00:13:53] There is always a drawback to any new technology, so there are a few with rapid DNA, and one is the CODIS eligibility is currently limited to buccal swabs processed in an approved booking station or an accredited laboratory. The cost per sample is more expensive than traditional laboratory DNA analysis. There's the high throughput processing of samples would require many instruments. Typically, rapid DNA systems can either do five samples, four samples, or one sample currently. So the platforms are limited to at most five samples at a time. So samples are typically also consumed through the rapid DNA process, which can be problematic if a confirmatory test needs to be performed. And finally, samples that contain mixtures, which is quite common in crime scene samples, would require a trained DNA analysts to interpret the data. So those are a few of the primary drawbacks to using rapid DNA.

Jaclynn McKay [00:14:49] Thank you for breaking all of that down. In thinking about the future and steps moving forward, what is the future vision for rapid DNA?

Neal Parsons [00:15:00] I personally believe the future of rapid DNA is for it to stop being considered a novel technology and finally be accepted for what it is, and that's a valuable tool that augments the capabilities of forensic science. I also believe that we'll see more law enforcement agencies establishing and sharing LDIS databases, specifically for investigative use, using rapid DNA.

Jaclynn McKay [00:15:23] If a law enforcement agency wanted to get involved with rapid DNA analysis, what resources and guidance is available for them?

Neal Parsons [00:15:31] So first and foremost, I would advise that agency to head to the FBI rapid DNA website and get acquainted with the rules and regulations of rapid DNA use. Second, I would connect with other law enforcement agencies, perhaps within their state or an entity that is well known for using rapid DNA, and get their perspective, pick their brain, understand how they're using it, how it works well, and see if it fits into your requirements and needs. And third, research the two current platforms that are out there and determine which one is best fit for your operations and sample throughput.

Jaclynn McKay [00:16:12] I think that's great advice for anyone who is looking to get involved with rapid DNA. Any final thoughts you'd like to leave our listeners with?

Neal Parsons [00:16:20] I think as new technologies and capabilities emerge within the forensic sciences. It's extremely important that forensic scientists question the validity of that technology. But I also think it is just as important to not dismiss its potential, especially when it's based on entrenched perceptions and methodologies.

Jaclynn McKay [00:16:40] Thank you so much for that insight, Neal. I've really appreciated our discussion and thank you so much for your time.

Neal Parsons [00:16:47] Absolutely. Thank you, Jaclynn. I appreciate you having me here.

Jaclynn McKay [00:16:49] If you enjoyed today's episode, be sure to like and follow Just Science on your platform of choice. For more information on today's topic and resources in the forensics field, visit ForensicCOE.org. I'm Jaclynn McKay and this has been another episode of Just Science.

Introduction [00:17:08] Next week, Just Science down with Dustin Driscoll and Mark Pooley to discuss human identification efforts related to missing and murdered indigenous persons. Opinions are 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.