

# New advances make DNA even more powerful as a crime-fighting tool

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**With recent changes and innovations around the use of DNA in forensics, law enforcement has a more powerful tool than ever to solve and prevent crime. Local DNA databases and Rapid DNA technology, combined with arrestee DNA collection, are putting more bad guys in jail—and clearing innocent suspects faster.**



*During 2012, several vendors rolled out Rapid DNA instruments that are capable of producing an STR profile from a sample in less than 90 minutes. At the October 2012 International Association of Chiefs of Police (IACP) Conference in San Diego, California, attendees had the opportunity to demo one instrument, the RapidHIT200, that was introduced by IntegenX Inc.*

**B**IOLOGICAL EVIDENCE would not be nearly as useful without DNA databases. In some cases, officers may have both the offender and the crime scene evidence to directly compare the DNA match; in this situation, no database is needed. But that is rare. In general, DNA profiles from crime scenes must be uploaded into a database and the database must be searched. If the offender's profile is already in the database, there will be a match when the evidence is searched. If there is no match, then the profile sits in the database and waits for another piece of evidence with the same profile or the actual offender's profile to be uploaded and matched.

In the United States, the most well-known DNA database system is CODIS, or the Combined DNA Index System, managed by the FBI. CODIS includes DNA profiles uploaded from federal, state, and local forensic laboratories that have been certified or accredited as meeting certain standards for quality control and operating procedures. The criteria for uploading a DNA profile to CODIS are quite stringent and often require lengthy review periods. In some studies of this process, DNA profiles generated from crime scenes were still awaiting upload to CODIS more than a year later due to these review requirements (Inspector General, 2004).

Demand to add profiles has only increased: In 2009, the end-of-year backlog of profiles waiting to be uploaded to CODIS had reached nearly 1 million. As a result, the National Institute of Justice (NIJ) launched the DNA Backlog Reduction Program, a funding initiative to help accelerate these uploads. In the period between 2004 and 2010, NIJ funding for this program totaled nearly \$395 million.

While this program is certainly helping, it is still true that any delays in uploading DNA profiles to CODIS postpone the ability of law enforcement agencies to get hits, preventing them from closing cases and prosecuting suspects.

For police departments which are adding DNA evidence to their prop-

## The latest technology breakthrough in forensic DNA testing is the development of platforms that can produce a DNA profile compatible with standard databases from evidence or a sample in less than 90 minutes—compared to a typical turnaround time of 30 to 90 days.

erty crime investigations, another challenge in using CODIS is that it contains very few profiles from similar, local crimes, since DNA analysis has mostly been restricted to violent crimes. Because of this, a new trend of local databases is emerging. Police in some jurisdictions are building their own DNA databases, sometimes with the help of private companies. These databases tend to be jurisdiction-specific, which helps with property crime in particular, as offenders tend to work the same area over and over. They also are not burdened with the CODIS review requirements, so DNA profiles can be uploaded quickly and matches can be found much faster. While these databases are less likely than CODIS to link crimes committed in distant states, proponents say that having local, focused resources is helping police get criminals off the street faster.

### Case Study: Bensalem

Bensalem, Pennsylvania is a community just north of Philadelphia. There, local law enforcement officials have partnered with DNA:SI Labs, accredited as a private provider of DNA analysis and databases. The company is able to guarantee Bensalem police a three-week turnaround time on the evidence or samples submitted—which is something that most government-funded crime labs are unable to do (Asplen, 2012).

The local database project in Bensalem has been working for non-violent crimes precisely because the offenders in property crimes tend to repeat their crimes in a small geo-

graphic region. The faster Bensalem police can get burglars and other offenders off the streets, the more crimes they are able to prevent. In its first two years of use, the database generated more than 55 hits on cases for local law enforcement. By contrast, they saw fewer than 12 hits from the national CODIS database in that same time period (Asplen).

According to Fred Harran, director of public safety in the Bensalem Township Police Department, the CODIS delay can be so long that “many times these criminals are already in jail for other crimes by the time you’re getting your DNA results back on the crime that you submitted for.” He said that faster turnaround times will do more than help lock up criminals; it could help prevent more victimization by those offenders.

Making the most of DNA advances, from local databases to Rapid DNA technology, has given Harran and his team success in crime-fighting.

“Criminals are starting to get the idea that if you’re coming to these towns that have these [DNA] initiatives, that you’re going to get caught,” Harran said. “This is going to be the future of law enforcement.”

### Arrestee DNA Samples

Another important factor in improving DNA databases is adding more offender profiles so that more matches are found for unsolved crimes. U.S. federal law permits collection of DNA samples from persons arrested or detained under federal authority (42 U.S.C. § 14135a). Many states have moved to the model of arrestee DNA collection for certain offenses in the same way that police currently gather someone's name, Social Security number, photo-graphs, and fingerprints during the booking process. While law enforcement officials contend that this is a proven, expedient way of catching criminals, organizations such as the American Civil Liberties Union (ACLU) argue that DNA collection should take place after conviction, not on arrest.

In studies of the impact of this timing, a number of jurisdictions have determined that many crimes could

have been prevented if DNA collection occurred at arrest instead of at conviction. In 2005, the City of Chicago reported to its state legislature that a study of just eight offenders who were arrested but then released for lack of evidence found that those offenders went on to commit 60 violent crimes—including 22 murders and 30 rapes—after being released. The study determined that those 60 crimes could have been prevented if DNA samples had been collected upon arrest. Allowing arrestee DNA collection would have matched the arrested-but-not-convicted offenders to prior crimes for which DNA samples had been recovered and entered in a database awaiting a match (Chicago Study, [DNAResource.com](http://DNAResource.com)).

In Maryland, a targeted study of three offenders demonstrated that 20 crimes could have been prevented if DNA samples had been collected upon arrest. These three offenders were arrested but released. If their DNA

**One of the trends in local law enforcement is the development of their own DNA databases. These new databases tend to be jurisdiction-specific... a feature that helps fight property crime since offenders tend to work the same area over and over.**

had been entered into a database at the time of arrest, officers would have been able to link them to past crimes and the offenders likely would have gone to prison.

Instead, in the time between their release and eventual prosecution, the offenders committed 20 more crimes, including murder, rape, burglary, and assault (Maryland Study on Preventable Crimes).

Across six states, case studies of

19 offenders found that 168 crimes could have been prevented by collecting DNA at the time of arrest instead of at conviction.

### Challenges in DNA Forensics

Despite the effectiveness of using biological evidence in crime investigations, there are still challenges to implementing DNA forensics at a broader scale. Time and capacity are two of the most serious challenges: between CODIS upload requirements and the volume of samples submitted, many crime labs have more DNA evidence than capacity to test it. In its report on the DNA Field Test, the Urban Institute noted that “crime laboratories are severely constrained in their ability to process biological evidence in volume.” It is not unusual for government crime labs (whether organized at state, county, or local levels) to have backlogs of several months to more than a year in the processing of DNA evidence.

As a result, the idea of adding DNA analysis to property crime

## Rapid DNA: An Overview

In the March/April 2007 issue of *Evidence Technology Magazine*, an article by Heather R. Fisher Sargent, MFS—“DNA in the Real World”—attempted to provide a realistic timeline for DNA analysis. This timeline started with screening evidence and ended with technical and administrative reviews. The total estimated time in 2007 was 54 hours and 15 minutes.

Now, there’s Rapid DNA.

According to an FBI fact sheet on the CODIS Program and the National DNA Index System, the term Rapid DNA “describes the fully automated (hands free) process of developing a CODIS Core STR profile from a reference sample buccal swab.” The goal of this automated process is to create field-deployable instruments capable of producing a CODIS-compatible DNA profile within two hours. In 2010, the FBI created a Rapid DNA Program Office dedicated to encouraging the development and integration of Rapid DNA technology for use by law enforcement.

During the latter part of 2011 and throughout 2012, manufacturers have pushed out new Rapid DNA solutions at an impressive pace. In a poster presentation at the October 2012 International Symposium on Human Identification, Erica L.R. Butts and Peter M. Vallone, both with the National Institute of Standards and Technology, provided a succinct overview of Rapid DNA typing. The poster, “Rapid DNA Testing Approaches for Reference Samples,” clarifies that there are actually three ways to achieve “Rapid DNA” results:

1) **Rapid DNA Services**—These private lab-based services offer a quick turnaround (less than two hours) in order to produce investigative leads. In the case of the Rapid DNA Service offered by Bode Technology, for example, law enforcement agencies send the forensic samples overnight to the Bode laboratory and are promised results by 11 a.m. the next day.

2) **Rapid DNA Techniques**—Using the latest available DNA kits, STR genotype results can be attained in less than two hours using standard laboratory equipment and protocols. In September 2012, for example, Life Technologies Corporation announced its GlobalFiler and GlobalFiler Express kits, promising the ability to process 48 samples in less than two hours.

3) **Rapid DNA Instruments**—These usually compact instruments are designed to be truly hands-free, allowing a simple “swab in, profile out” solution in less than 90 minutes. The eventual goal is for these instruments to be deployed into the field for immediate identification and investigative leads at the scene. Different versions of this technology have recently been introduced by the University of Arizona, IntegenX, ZyGem/Lockheed Martin, and GE Healthcare Life Sciences/Network Biosystems. Further, in November 2012, NEC announced that it is working on a suitcase-sized instrument with a “swab in, profile out” time of just 25 minutes. The company aims to launch the device commercially in 2014.

—Kristi Mayo

You can download a PDF of the “Rapid DNA Testing Approaches for Reference Samples” poster here:

[http://www.cstl.nist.gov/strbase/pub\\_pres/Butts-ISHI2012-Rapid-DNA.pdf](http://www.cstl.nist.gov/strbase/pub_pres/Butts-ISHI2012-Rapid-DNA.pdf)

investigations raises concerns about overwhelming an already strained lab system. Jurisdictions like Bensalem have decided to work with private labs that can process the samples faster, even if their databases are outside of the CODIS system.

### Rapid DNA Testing

The latest technology breakthrough in forensic DNA testing is the development of platforms that can produce a DNA profile compatible with standard databases from evidence or a sample in less than 90 minutes—compared to a typical turnaround time of 30 to 90 days. In the U.S., federal agencies or groups including the Department of Homeland Security, Department of Justice, Department of Defense, FBI, and U.S. Army have committed funding to make Rapid DNA possible. The first commercial Rapid DNA technologies were launched in 2012 and are already being used by agencies in law enforcement.

**The expansion of sample collection will be important as Rapid DNA allows for powerful applications of DNA testing. It could be used to eliminate suspects from an investigation, directing police manpower toward more fruitful avenues.**

Faster DNA analysis will be used for a number of fields, such as: familial relationship verification in citizenship and immigration; law enforcement investigations; and human-remains identification in mass disasters.

Along with the possibility of Rapid DNA results comes the likelihood that samples could be collected by trained police officers in addition to crime scene technicians. In the

Bensalem partnership with DNA:SI, officials noted that police officers are trained to collect DNA samples and that this has caused no detrimental effect on downstream analysis of the samples (Asplen). After concluding the DNA Field Test, the Urban Institute analysts reported that DNA collected by police officers or detectives was just as likely to yield useful profiles as DNA collected by crime scene technicians.

The expansion of sample collection will be important as Rapid DNA allows for more powerful applications of DNA testing. For example, this technology could be used to quickly eliminate suspects from an investigation, directing police manpower toward more fruitful avenues.

Profiles of arrested offenders could enable police to link criminals to other unsolved cases where DNA evidence had been saved in a database. During a burglary spree, law enforcement agents could determine quickly

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whether the crimes were isolated incidents or part of a pattern by the same offenders. This would help them put a stop to the crimes faster than if each of the crimes had to be investigated independently.

### Case Study: Palm Bay

Law enforcement officials in Palm Bay, a city of more than 100,000 people in east central Florida, have been early adopters of many advances in DNA analysis. In 2007, Palm Bay contracted with a private lab to build its own local DNA database (Blackledge, 2012). Since then, police in Palm Bay have been using DNA testing as an investigational tool for non-violent crimes, which represented 80 percent of the reported crimes in the city. During the first four years of this program, Palm Bay's crime rate fell by 25 percent, with a 40 percent decrease in burglaries, and the case clearance rate rose from 19 percent to 35 percent. This is compared to a national case clearance average of only 13 percent.

In 2011, the Palm Bay Police Department performed a three-day field trial of a Rapid DNA prototype instrument developed by IntegenX Inc., called the RapidHIT system. The technology—based on established DNA analysis processes using PCR and capillary electrophoresis—analyzed five samples simultaneously in less than 90 minutes. During the course of the trial, participants analyzed more than 36 DNA samples, including samples that had been stored for up to four years at the police department, and generated full, database-compatible profiles from all of them. The Palm Bay team also installed the instrument in a mobile crime van and used it on-site at a mock crime scene. Members of the crime scene unit analyzed several samples, producing partial profiles that yielded a match in the database. An analysis of the field trial noted that the time elapsed from the arrival of the crime scene technicians to the correct identification of the suspect from the DNA match was less than five hours (Blackledge).

Based on those results, Doug Muldoon, police chief of the Palm

**“We were able to train every police officer in 15 minutes on how to collect the DNA samples, so it’s a simple process,” said Police Chief Muldoon. “It’s actually allowing us to have an impact on crime in our community.”**

Bay Police Department, decided to add this technology to his department's set of tools—in part because of its ease of use.

“We were able to train every police officer in 15 minutes on how to collect the DNA samples, so it’s a simple process,” he said. “It’s actually allowing us to have an impact on crime in our community.” He noted that in times of tightening budgets, putting money toward technology to help fewer officers do more work is necessary.

### Get Ready for Rapid DNA

Rapid DNA analysis is a technology that promises to fundamentally change the way investigations are conducted by enabling law enforcement personnel to quickly and definitively identify suspects while they are still in custody. The technology has the potential to help create safer communities through its many applications, from policing to homeland security and defense. With the introduction of the first commercial Rapid DNA systems in 2012, a new standard will emerge in the usage of DNA profiles as an actionable biometric. 

### References

Asplen, C. and McVey, W., “Taking Control: Less Taxpayer Funding, But More DNA Testing,” *Forensic Magazine*. Posted April 10, 2012, <http://www.forensicmag.com/article/taking-control-less-taxpayer-funding-more-dna-testing>

Blackledge, J., Swiger, R., Muldoon, D., “Intelligence-Led Policing Using DNA,” *FBI National Academy Associate*, May/June 2012.

“Chicago’s Study on Preventable Crimes,” from [DNAResource.com](http://DNAResource.com)

Home Office Forensic Science & Pathology Unit, *DNA Expansion Programme 2000-2005: Reporting Achievement, 2005*.

“Maryland Study on Preventable Crimes,” Sources: Maryland Criminal Justice Information System, Baltimore County Police Department, Maryland State Police.

<http://dnasaves.org/files/MarylandDNAarrestestudy.pdf>

National Institute of Justice, “DNA in ‘Minor’ Crimes Yields Major Benefits in Public Safety,” In Short: Toward Criminal Justice Solutions, November 2004, NCJ 207203.

Office of the Inspector General, U.S. Department of Justice. “The No Suspect Casework DNA Backlog Reduction Program.” November 2004.

Roman, J., Reid, S., et al, *The DNA Field Experiment: Cost-Effectiveness Analysis of the Use of DNA in the Investigation of High-Volume Crimes*, April 2008.

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