

October 14, 2025

CODIS in Action: Capabilities, Challenges, and Casework Strategies

Amanda Overman
Forensic Scientist Supervisor/CODIS State Administrator
North Carolina State Crime Laboratory



Disclaimer

This project was supported by Grant No. 15PBJA-22-GK-01556-JAGT awarded by the Bureau of Justice Assistance. The Bureau of Justice Assistance is a component of the U.S. Department of Justice's Office of Justice Programs, which also includes the Bureau of Justice Statistics, the National Institute of Justice, the Office of Juvenile Justice and Delinquency Prevention, the Office for Victims of Crime, and the SMART Office. Points of view or opinions in this document are those of the author and do not necessarily represent the official position or policies of the U.S. Department of Justice.

Amanda Overman



Amanda Overman has been with the North Carolina State Crime Laboratory (NCSCCL) for over 20 years. Her first experience in forensics was as an intern in the Molecular Genetics Section of the crime laboratory. After graduating from the University of North Carolina Chapel Hill with a BS in Clinical Laboratory Science, she was hired by the laboratory as a DNA Database Analyst. Amanda processed Convicted Offender samples for entry into the Combined DNA Index System (CODIS) in this role. She then pursued a position in the casework section. She completed Basic Law Enforcement Training (BLET) and the State Bureau of Investigation (SBI) Academy and was a sworn SBI Agent for over 10 years. As a Casework DNA Analyst, Amanda served search warrants, processed crime scenes, performed DNA analysis in a wide variety of cases, and testified to the results in court when needed. Amanda has served as a Supervisor and the CODIS State Administrator for North Carolina during her tenure with the laboratory. Amanda feels fortunate to have been a part of the evolution of DNA analysis over her career and is grateful to serve her community in this role.

Topics for Today

- Explanation of CODIS
- Types of DNA Found in CODIS
- Searching in CODIS
- CODIS Hit Notifications
- Importance of Closing the Loop
- Limitations of CODIS for Cold Cases
- Leveraging CODIS Advancements





Explanation of CODIS

- Combined DNA Index System

- CODIS is a DNA database that allows DNA profiles from evidence samples to be compared to known and unknown DNA profiles to generate possible investigative information in the case
- CODIS was established as the result of the Federal DNA Identification Act of 1994



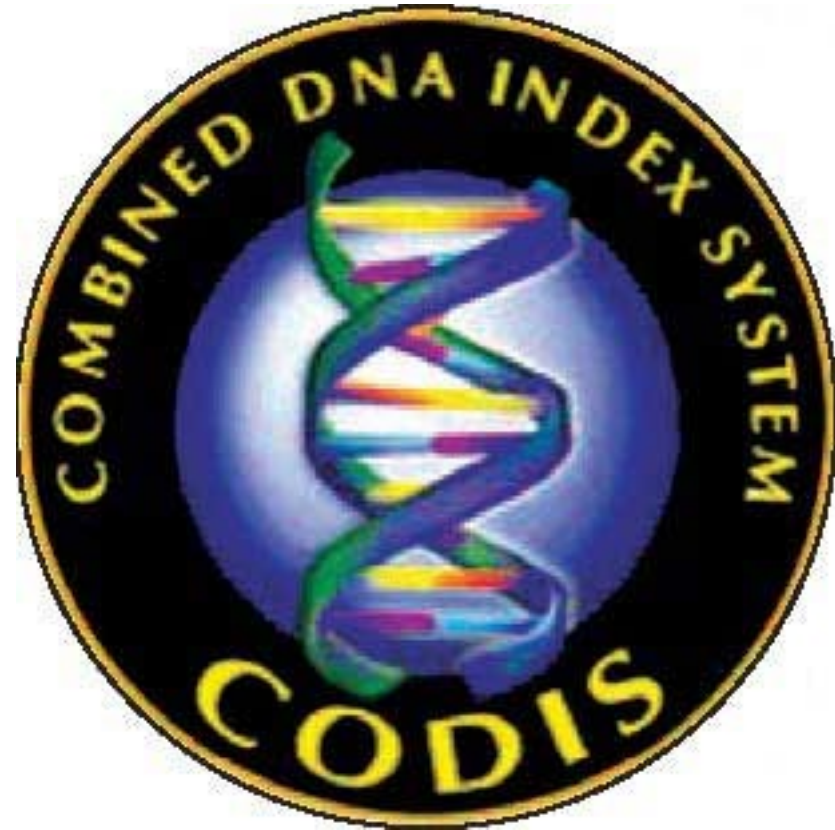
- CODIS is a network of computer DNA databases as well as the software used to administer them
- Currently, over 200 laboratories from across the U.S. participate in CODIS
 - This includes all 50 states, the District of Colombia, the federal government, the Department of Defense (DoD), and Puerto Rico
- As of April 2025, there are over **25 million** DNA profiles routinely searched in the national database
- North Carolina's state database is comprised of over **420 thousand** DNA profiles



<http://www.bbc.com/news/science-environment-13626583>

Why is CODIS Helpful?

- Serial crimes
- Sharing information
- Investigative leads



<https://forensicsources.org/wp-content/uploads/2019/07/DNA-Outsourcing-and-CODIS.pdf>

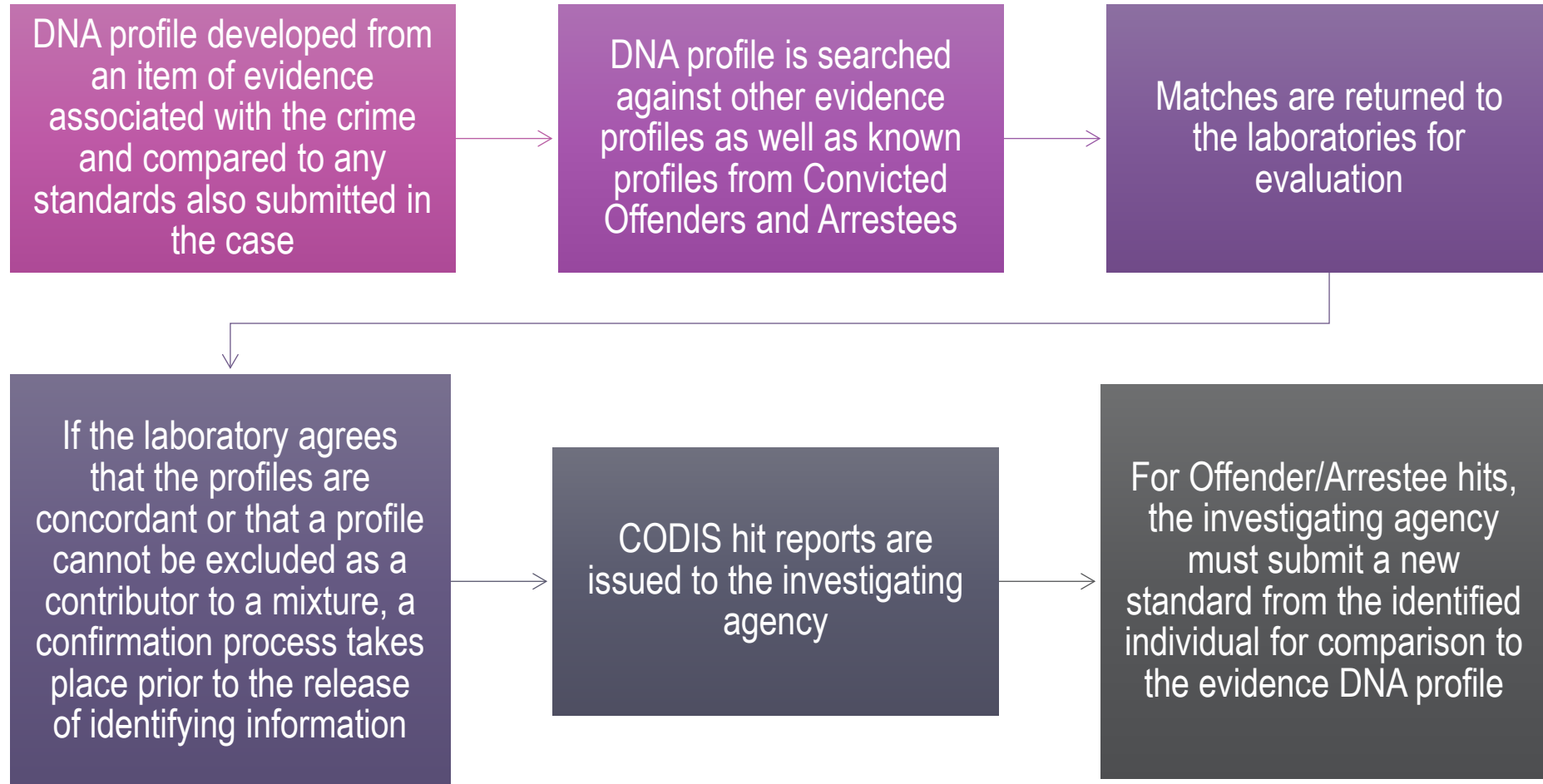
CODIS Eligibility

- Short Tandem Repeat (STR) [most common], Y-Chromosome (Y-STR), and Mitochondrial DNA (mtDNA) profiles
- Quality requirements for the DNA profile
- Forensic DNA profiles with documentation of how they are related to a crime and that are attributable to a putative perpetrator
 - The laboratory relies on case information provided by the investigating agency for this determination
 - Follow up with the agency to obtain additional information is often required

CODIS Eligibility *(continued)*

- Arrestee and Convicted Offender samples based on state laws¹
 - Arrestee profiles are expunged if the participating laboratory receives a certified copy of a final court order documenting the charge has been dismissed, resulted in an acquittal, or no charges have been brought within the applicable time period
 - Convicted Offender profiles are expunged if the participating laboratory receives a certified copy of a final court order documenting the conviction has been overturned
- Samples **not** allowed
 - Victim
 - Except for missing persons or unidentified human remains
 - Elimination
 - Person of Interest
 - Suspect
 - Allowed at the State/Local level

The Journey of a DNA Profile Through CODIS



Requirements for Data

- DNA data must be generated by an accredited laboratory
- DNA data must be generated in accordance with the Federal Bureau of Investigation (FBI) Director's Quality Assurance Standards
- The laboratory must be audited to evaluate compliance with the FBI Director's Quality Standards
- No personal identifiers may be stored in the CODIS software
- DNA data is confidential – access is restricted to criminal justice agencies for law enforcement identification purposes

Laboratory Requirements for CODIS Access

- Laboratories must comply with the FBI Director's Quality Assurance Standards
- Laboratories must be accredited by a nonprofit professional association that is nationally recognized within the forensic science community
- Laboratories must undergo an external audit every two years to demonstrate compliance with the FBI Director's Quality Assurance Standards
- Laboratories must be federal, state, or local criminal justice agencies
- Laboratories must have a Memorandum of Understanding (MOU) in place with the FBI documenting their agreement to abide by the DNA Identification Act requirements in addition to record-keeping and other operational procedures related to uploading DNA data, expungements, CODIS users, audits, etc.
- Laboratories may not use the CODIS software in any manner unless specifically authorized to do so by the FBI

Use of Private Vendor Laboratories (Outsourcing)

- If the CODIS laboratory (state or local laboratory) has a MOU in place with the private vendor laboratory, the CODIS laboratory may review and upload data generated by the private laboratory to CODIS
 - No MOU = CODIS laboratory cannot do anything with the data generated by the private laboratory
 - Check with the CODIS laboratory prior to sending evidence to the private laboratory
 - No private vendor laboratories have direct access to CODIS

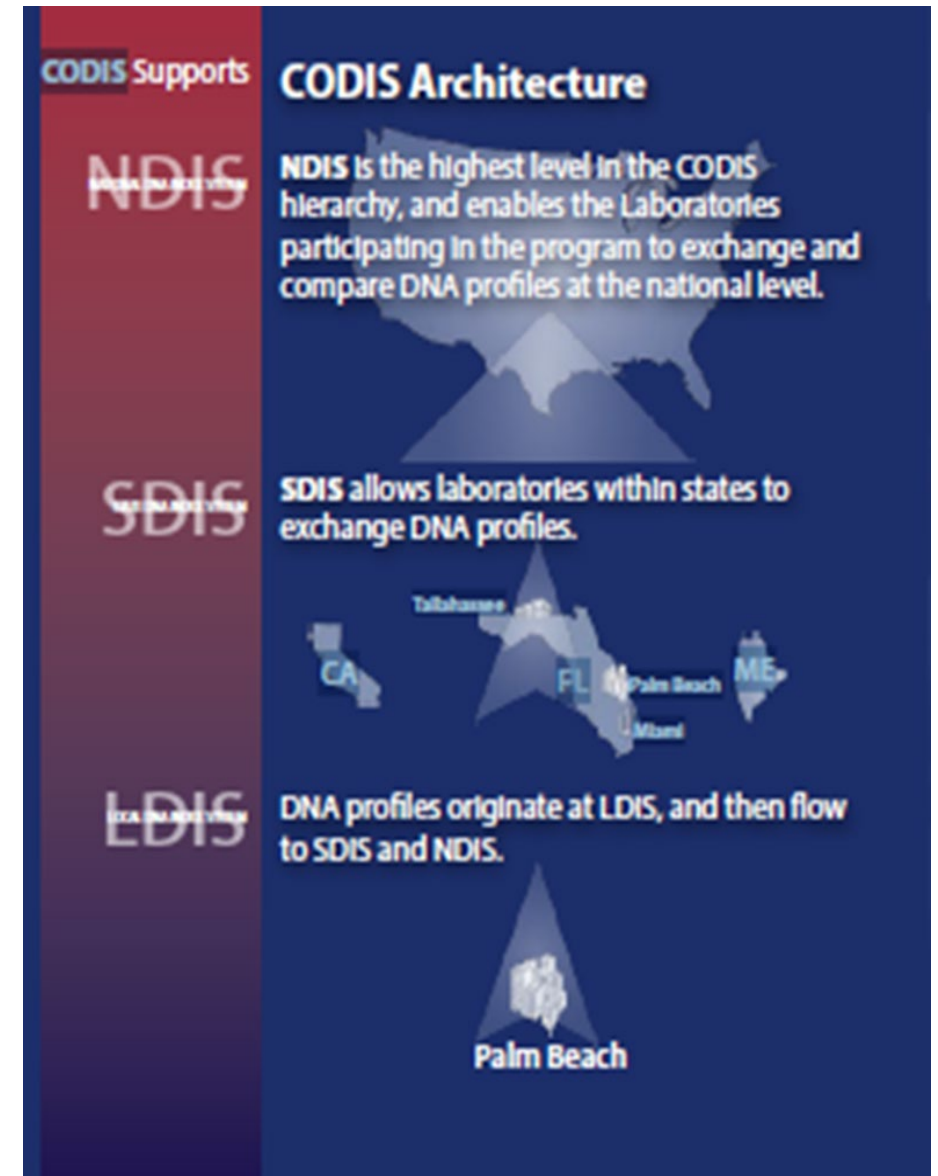
Use of Private Vendor Laboratories (Outsourcing) *(continued)*

- Considerations

- Private laboratories will test anything you request even if the evidence has no probative value in your case and/or any profile developed cannot be entered into CODIS
- It is important for contracts with private laboratories to clearly spell out expectations of what is provided for testing results – otherwise, there will be additional charges for anything extra that is requested
- Reach out to your state and local laboratories to see if they can perform this testing free of charge or provide guidance on evidence submission/contracts as well as which private vendor laboratories they have an MOU with

Levels of CODIS

- National DNA Index System (NDIS)
 - Maintained by the FBI
- State DNA Index System (SDIS)
 - North Carolina State Crime Laboratory (NCSCL) Raleigh*
- Local DNA Index System (LDIS)
 - Western Regional Laboratory*
 - Charlotte-Mecklenburg Police Department Laboratory*



Levels of CODIS *(continued)*

- Local and state databases may have different eligibility requirements than NDIS
 - Profiles that are less complete
 - More complex mixtures
 - Profiles that are not eligible at NDIS based on case information or sample type
 - These decisions are at the discretion of each CODIS laboratory



Offender/Arrestee samples¹ come in at the State level

CODIS Indexes (Source of DNA)



https://www.huffingtonpost.com/john-maki/changing-direction-a-road_b_5910948.html

**Convicted
Offender/Arrestee¹**



<https://npublicsafety.com/2016/05/first-responders-can-help-preserve-crime-scene-evidence>

Forensic

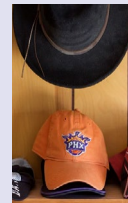


1062-half.jpg (840x525) (windows.net)

**Relatives of
Missing Persons**



razor and toothbrush - Bing
images



4486119722_52014c0240_z.jpg
(640x427) (staticlickr.com)

**Missing Persons
(reference sample)**



PoliceDNA-cmnw-020517-ph01 (704x500) (concordmonitor.com)

**Unidentified
Human Remains**

CODIS Indexes – Specimen Categories

Unknowns

- Forensic
- Unidentified Human Remains

Knowns

- Convicted Offender¹
- Arrestee¹
- Relatives of Missing Persons
- Missing Persons



Types of DNA Found in CODIS

Types of DNA

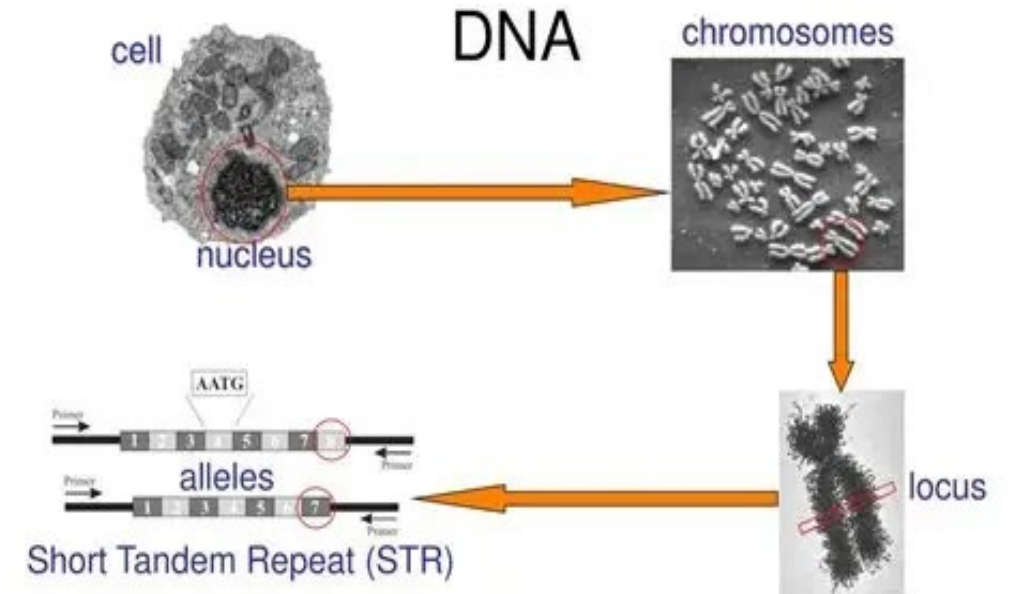
- Traditional DNA is nuclear DNA or STRs
- Two additional types of DNA can be accepted into CODIS:
 - mtDNA
 - Y-STRs



https://as2.ftcdn.net/v2/jpg/05/61/86/77/1000_F_561867731_U16ZbpW7baFbHCn35UEXisNQBJToBCvq.jpg

STRs – Nuclear DNA

- Short Tandem Repeats (STRs) – short segments of DNA that are repeated a certain number of times based on the individual
- Main type of DNA searched in CODIS
- Inherited from each of your parents – $\frac{1}{2}$ from mom and $\frac{1}{2}$ from dad
- Used for identification purposes
 - Unique DNA
 - No two people have the same STR DNA profile except identical twins



<https://tse3.mm.bing.net/th?id/OIP.ZXgc6s64roeOhlgnH7HK6AHaFi?r=0&rs=1&pid=ImgDetMain&o=7&rm=3>

mtDNA

- Maternally inherited DNA
- Found within the mitochondria of cells
- Multiple copies present in the cell
- Used for limited or degraded biological material
 - Unidentified human remains
 - **Searched in Missing Persons categories only**
- Maternal relatives have the same mtDNA (exception is mutations)
 - Less discriminatory



<https://ascensionglossary.com/images/5/59/Mitochondria.jpg>

Y-STRs

- Paternally inherited DNA
- Targets 23 areas of male specific DNA on the Y-chromosome
- Used when female DNA overshadows male DNA in a sexual assault sample or as an additional technology for missing persons or familial searching to narrow down possible matches
 - Searched in Missing Persons categories only
- Paternal male relatives have the same Y-STR profile (exception is mutations)
 - Less discriminatory



<https://scitechdaily.com/images/Y-Chromosome-1.jpg>



Searching in CODIS

CODIS Levels – Searching

- Samples are searched at the level where they are entered
 - Only those samples at NDIS are searched against the full database
- LDIS and SDIS can set their search parameters
 - Many laboratories use the same search parameters used by NDIS
 - The FBI allows for flexibility due to variations in size of local and state databases
- NDIS search parameters are set by the FBI

CODIS Indexes – Searching

- Two main search types: Forensic and Missing Persons
 - All indices are not searched against each other
- Forensic Searching
 - Forensic (evidence) profiles searched against Forensic, Convicted Offenders¹, Arrestees¹, Unidentified Human Remains (unknown), Missing Persons (known)
- Missing Persons Searching
 - Unidentified Human Remains searched against Missing Persons (known), Relatives of Missing Persons, Convicted Offenders¹, Arrestees¹, Unidentified Human Remains (unknown), Forensic

¹ State legislation dictates what convictions and arrests qualify for DNA collection for CODIS.

Minimum Allele Requirement – Searching

- CODIS requires testing of 20 STR core loci (areas of DNA) – 13 of those are searched
 - Standard testing so that profiles from different laboratories can be compared against each other
- Forensic profiles must have a minimum of 8 loci tested and a match rarity of at least ***1 in 10 million***
 - Match rarity is a calculation performed by the CODIS software that evaluates how common or rare that combination of genetic information is in the population
 - The more information that is missing from a profile = the more likely a match will not be returned

Stringency – Searching

The goal of searching is to set criteria to prevent adventitious matches while allowing true matches to occur.

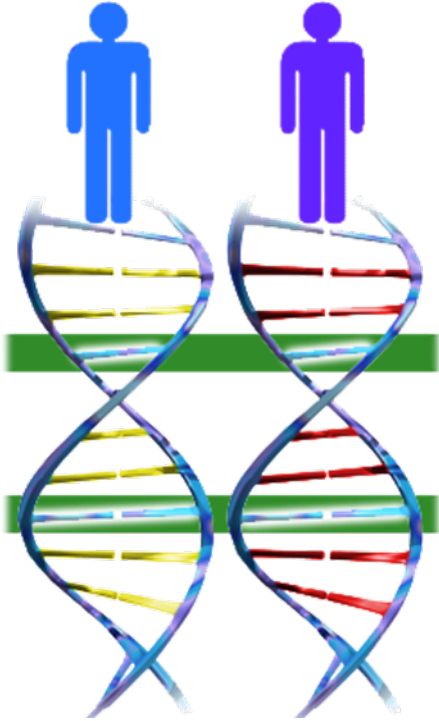
High Stringency

- Requires all alleles to match between the two DNA profiles
- Used for complete profiles being searched against complete profiles (i.e., single source, full forensic profiles against Convicted Offender/Arrestee profiles¹)
- 1 mismatch is allowed to account for typos

Moderate Stringency

- All alleles present must match, but the two DNA profiles can contain a different number of alleles
- Used for partial (missing info) and mixture (multiple contributors) profiles being searched (i.e., forensic partials, mixtures being searched against Convicted Offender/Arrestee profiles¹)

CODIS Hits



<http://projects.nfstc.org/fse/12/12-01.html>

- Searches performed at SDIS and NDIS daily
- Evaluation of matches by the Forensic Biology Section Casework CODIS Administrator (or designee)
- Matches occur between samples within the North Carolina State DNA Database (in-state matches) and between North Carolina samples and samples throughout the country (out-of-state matches)
- Once the match is evaluated, the hit confirmation process is initiated by the CODIS Administrator
 - A CODIS hit is a match that has been confirmed and aides in an investigation
- The Forensic Biology Section issues a Notification of CODIS Hit to the investigating agency requesting the submission of a standard from the identified individual

CODIS Hits *(continued)*

- The real strength of CODIS lies in solving non-suspect cases
 - Convicted Offender/Arrestee¹ Hit (most common)
 - Forensic Hit (Case-to-Case)
- Most hits in North Carolina occur to Sexual Assaults and Property Crimes
 - We also keep stats for the crime categories of Armed Robberies, Assaults, Homicides, among others
 - As you can see from the graph, the other crime types receive significantly less hits than Sexual Assaults and Property Crimes

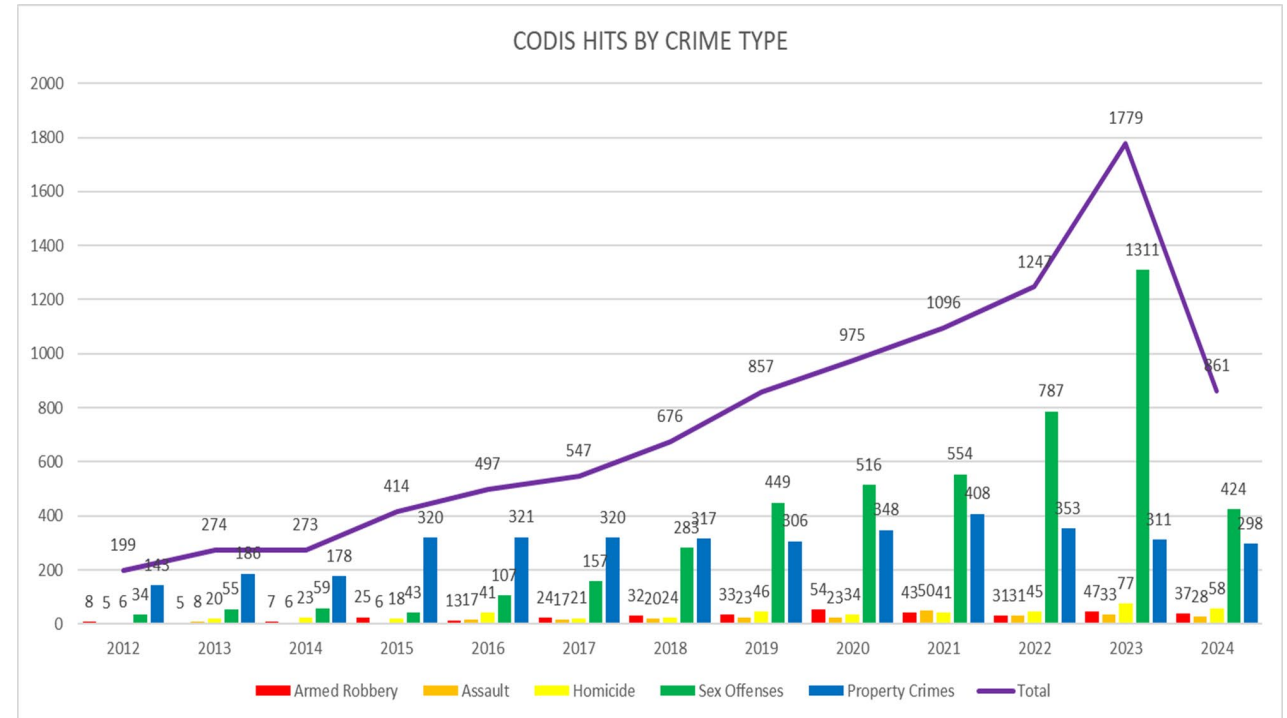


Chart created by Amanda Overman

¹ State legislation dictates what convictions and arrests qualify for DNA collection for CODIS.

Missing Persons Searches

- Since DNA is passed from parents to their children, DNA from parents and close relatives can help identify unidentified human remains
- DNA profiles from relatives of the missing person are entered into CODIS solely for the purpose of comparison to unidentified human remains
- mtDNA and Y-STR DNA can assist in these cases since the DNA remains the same from one generation to the next in family lines

Familial Searching

- Not performed at the National level
 - Not performed in all states
 - Requires additional technologies/validations – states voluntarily choose to perform these complex searches
- A deliberate search of the state database for the purpose of identifying an individual in the database (Convicted Offender/Arrestee¹) who may be a close biological relative to the unknown individual's DNA profile from the evidence
- Parent-child and sibling relationships detected
- Not detecting an exact match which can lead to many leads
 - Y-STR testing is used to narrow down potential matches for males since it is passed along the paternal line
 - Very few laboratories perform mtDNA testing so it is rarely used to narrow down possibilities related to female candidates



CODIS Hit Notifications

CODIS Hit Notification Reports

- The CODIS laboratory that entered the evidence profile will issue a report to the investigating agency that serves as an investigative lead
- In North Carolina, reports are released to the investigating agency through Forensic Advantage (FA) which is our Laboratory Information Management System (LIMS)
 - For out-of-state hits, the CODIS Administrator of that state receives an email with the report attached
- Two types of Notification Reports
 - Offender/Arrestee Hit Notification Reports
 - Forensic Hit Notification Reports

Convicted Offender/Arrestee Hits¹

- Hit between an evidence DNA profile and the known DNA profile from a Convicted Offender or Arrestee
- Report provides personally identifiable information for the Convicted Offender or Arrestee such as name, date of birth, state identification number, FBI number, and social security number
- The report may give the investigating agency probable cause to collect an additional standard for testing from any individual identified in the CODIS hit
- The agency is responsible for letting the laboratory know if the hit is to a consensual partner (sexual assaults) or to an individual whose DNA profile would be expected for a reason other than the crime so that those profiles may be removed from CODIS

Forensic Hits

- Hit between an unsolved case and another solved or unsolved case
- Case-to-Case Hit
- One hit can link multiple investigations that may not be associated through other means
- This important investigative information is shared with investigators in each linked case to facilitate communication and collaboration
- If the hit is to a solved case with a suspect standard submitted, the laboratory may issue a report with that comparison

CODIS Hit Tracker

- To manage hits, laboratories should have a system in place to track CODIS hits and issue reports
- In North Carolina, the laboratory has a tracking system that was designed by our IT
 - Hit can be tracked throughout the confirmation process
 - Reviews are documented in the system
 - Reports are issued from the software
- Commercial software is available
 - CHOP (CODIS Hit Outcome Project)
 - FSHOP (Forensic Science Hit Outcome Program)
 - Peregrine and Monday.com
 - PLIMS (Property and Laboratory Information Management System)



Importance of Closing the Loop

Submission of Suspect Standards

- DNA database samples from Convicted Offenders and Arrestees¹ are not considered evidence and do not have a chain of custody associated with them which is why a new standard (cheek swab) must be submitted and tested for comparison
- The final comparison must be made to issue a report with a statistical weight as to whether the suspect can be included as a contributor to the DNA profile from the evidence

Collaboration in Case-to-Case Hits

- It is important for investigating agencies to communicate after receiving Case-to-Case Hit Notifications
- One agency's solved case may be another agency's unsolved case
- Even if both cases are unsolved, agencies may be able to collaborate and share information that could lead to the case being solved outside of CODIS

CODIS Hit Follow Up

- The NCSCCL has recently initiated a project to follow up on actions that occur in cases after the CODIS Hit Notification is issued
- Law Enforcement Agency (LEA) CODIS Hit Portal
 - LEA can view their active CODIS hits – hits that have a request for new standard submission
 - LEA can submit case updates to the laboratory – the case is being investigated or is closed/reason
 - LEA can update arrest or conviction information as the result of a CODIS hit as required by legislation
 - Designated individuals from each agency are responsible for providing this information



Limitations of CODIS for Cold Cases

Data Quality

- A minimum amount of data is needed for database searching
- NCSCCL requires a minimum of 8 original core loci for upload and searching
 - CODIS was established with 13 original core loci – areas that are standardized and the same across laboratories
 - CODIS expanded to 20 core loci in 2017 – more areas for complex profiles, some loci in common with required loci in other countries
 - The DNA present in partial profiles also must be a minimally unique combination of DNA information
- Meeting minimum loci requirements can be challenging with older samples found in cold cases
- A profile may only meet qualifications to be searched at the State level – beneficial to have the full power of CODIS which may be achieved through testing with new technology

Data Complexity

- CODIS searching is no longer a simple comparison
- Sensitivity has increased with technological advances = detection of lower-level contributors = complex mixtures
 - Software provides the most reasonable explanation for contributors to the mixture – not the only explanation though
- Translation of complex mixtures to a set of data that can be searched in a database is challenging at times
 - A profile with multiple possibilities being searched in a database designed to search only one possibility

Searching Parameters

- The challenge is to have search parameters in place that restrict a profile from matching the entire database but having enough flexibility that you don't miss matches
- It is always better to submit a profile for direct comparison even if you believe there is a profile for that individual in CODIS
 - It is possible that a profile would be included as a contributor when there is a direct comparison, but a hit would not be obtained in a database search
 - This is based on the data present/searched and is not expected to happen often, but it is possible

Eligibility Determination

- For CODIS entry, the DNA profile must have a direct link to the crime and the sample must be attributed to the putative perpetrator
- For cold cases, this is not always an easy determination
 - Missing information – reports, notes, recollection
 - Postconviction testing – handling of evidence in court and storage after trial (chain of custody issues)
 - Multiple rounds of previous testing – increases the risk of contamination and decreases the amount of sample available

Eligibility Policy Changes

- NCSCL/NDIS submission requirements have changed over time
 - There was a brief time when the NCSCL required the submission of suspect standards for testing in any case
- Prior to the 2010s, NDIS would not accept a profile from a sexual assault case in which the victim had a consensual partner unless that partner's profile was submitted, tested, and compared to the evidence
 - There was a time when the NCSCL would not test these beyond body fluid analysis (e.g., blood, semen, saliva), cases may have not been accepted at all, or DNA was developed but not uploaded
- NDIS relaxed this requirement due to legislative changes across the country related to sexual assault evidence as well as the realization that there were instances where this requirement was unrealistic
 - Victim did not know the identity/contact information for her consent partner
 - Consensual partner not available for extended periods of time

Offender/Arrestee Profile¹ Entry

- Offender/Arrestee must be in the database
 - For cold cases, the offender may have committed his most serious crimes prior to DNA collection laws going into effect – genealogy is bringing this to light in many cases
 - 1994 – North Carolina started collecting Offender samples for a limited number of offenses
 - 2003 – DNA collection for all felony convictions
 - 2011 – DNA collection for Arrestees for a limited number of offenses, Arrestee profiles are expunged under certain circumstances
 - Lawfully owed samples
- If the suspect may have a Convicted Offender/Arrestee DNA sample in another state, the State CODIS Administrator can reach out to the State Administrators and confirm that information

Vendor Laboratories

- Vendor laboratories do not have direct access to CODIS
- An MOU between the CODIS laboratory and the vendor laboratory must be in place **PRIOR** to testing for the CODIS laboratory to accept the DNA data for review and upload to CODIS
- There are limitations to what the CODIS laboratory can do with evidence once it has been processed by a vendor laboratory
- Vendor laboratory interpretation may differ from that of the NCSCCL, creating challenges for direct comparisons to standards



Leveraging CODIS Advancements

Forensic Targeted

- Some forensic partial or mixture profiles that don't qualify for traditional CODIS entry based on the quality of the profile may qualify for a special search at NDIS
- There are different search parameters for these profiles
- In North Carolina, we regularly search profiles that only meet state searching requirements to determine if they may qualify for this type of national search
 - Searching at NDIS is best

DNA Index of Special Concern (DISC)

- Laboratories have the option of searching forensic DNA profiles from homicides, rape/sexual assaults, kidnappings, and terrorism cases against DNA profiles generated by Rapid DNA instruments in the booking station upon arrest
 - Requires additional documentation by the laboratory
 - Additional reporting requirements
- This will allow the most serious offenders to be detained when they have potentially committed additional crimes
- DISC profiles are searched against the entire NDIS database within 24 hours

Keyboard Searches (Not Routine)

- If the profile does not result in a hit, the State CODIS Administrator can request a voluntary manual keyboard search of SDIS databases from the State Administrators
- If there are exigent circumstances such as offense escalation and imminent danger to the community, a manual search may be performed of the SDIS database prior to the scheduled auto search for that day
 - Keyboard searches are not meant to circumvent eligibility requirements
 - Few cases meet the exigent circumstance requirements for this search
- **Emergency Upload and Search Request (EUSR)** – allows a laboratory to immediately search NDIS when public safety requires such immediacy and cannot wait for the routine upload and search of NDIS
 - Not intended to be a routine occurrence
 - Eligibility requirements are still in place
 - Few cases meet the exigent circumstance requirements for this search

Mixture Capabilities

- Due to increased sensitivity in DNA testing, there is a greater likelihood that DNA from multiple individuals may now be detected on an item of evidence
- Probabilistic Genotyping Software allows laboratories to deduce contributors to these mixtures in addition to providing statistical weights to inclusions
- Often contributors cannot be completely resolved
- The CODIS software allows for searching of mixtures of up to two contributors
- States/Local laboratories are successfully searching more complex mixtures at the lower levels of CODIS

Re-interpretation Changes

- The Quality Assurance Standards for Forensic DNA Testing Laboratories provides the standards for laboratories to re-evaluate previously generated DNA profiles
- This may allow upload of profiles that were previously not entered into CODIS
- If re-interpretation is not possible, additional testing with new technologies is another option that may allow for the upload of profiles that were previously not entered into CODIS

https://www.swgdam.org/files/ugd/4344b0_c2c9d0c7652f4977a57649ce500466aa.pdf



**Thank you for your time and
attention! Please feel free to
contact me with any questions!**

Contact Information

Amanda Overman

Forensic Scientist Supervisor/CODIS State Administrator

North Carolina State Crime Laboratory

(919) 582-8882

aoverman@ncdoj.gov



forensicstta@rti.org



[@ForensicsTTA](#)



[Forensics TTA](#)



www.forensicstta.org