Familial DNA Searching: Current Approaches

FINAL REPORT

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Forensic Technology Center of Excellence

The Forensic Technology Center of Excellence (FTCoE) is a collaborative partnership of RTI International and its FEPAC [Forensic Science Education Programs Accreditation Commission]–accredited academic partners: Duquesne University, Virginia Commonwealth University, and the University of North Texas Health Science Center. In addition to supporting the National Institute of Justice's (NIJ's) research and development (R&D) programs, the FTCoE provides testing, evaluation, technology transition assistance, and other services for use by crime laboratories, forensic service providers, law enforcement, and other criminal justice agencies whose mission is to combat crime. NIJ funds the FTCoE to transition forensic science and technology to practice (Award Number 2011-DN-BX-K564).

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The information shared in this report represents the opinions of the individual practitioners and researchers who participated in the webinar series, and not the opinions of their agencies, the FTCoE, or the NIJ. For more information or questions about this report, visit www.forensiccoe.org, email jerimiller@rti.org or call 919-485-5685.

EXECUTIVE SUMMARY

Familial searching (FS) is an additional search of a DNA profile in a law enforcement DNA database that is conducted after a routine search does not identify any profile matches. FS involves a two-phase process, conducted to develop investigative leads for the purpose of potentially identifying close biological relatives of the source of an unknown forensic profile obtained from crime scene evidence. FS is based on the concept that first-order relatives—such as a sibling or parent/offspring—often will have more alleles of their DNA profiles in common than those of unrelated individuals.

Although FS is not explicitly authorized by statute at the national level, a number of states currently utilize FS under implicit authorization outlined in their state database laws. Because there is a lack of clear guidance on and documentation of the policies and practices currently employed to ensure proper utilization of FS, the goal of this project was to create a document that educates legal professionals, policy makers, law enforcement officials, and forensic laboratory practitioners on the issues, approaches, and positions involved with FS as applied to criminal investigations.

To accomplish this task, the Forensic Technology Center of Excellence (FTCoE) at RTI International, in partnership with the University of North Texas Health Sciences Center's Institute of Applied Genetics, facilitated a webinar series—*Familial DNA Searching: Understanding the Current State of Affairs*—to engage stakeholders ranging from those who participate fully in FS, those who use FS occasionally, and those who do not utilize FS at all. The purpose of the webinar series was to discuss the various FS policies and practices, including technical considerations, legal challenges, comparison with other types of DNA searches, and implementation ramifications.

This document describes the use of the literature; the experience of individuals; and a webinar series model to collect highly divergent information and engage open discussion across multiple stakeholders to obtain the current landscape of viewpoints for a challenging topic. This work provides an assessment of FS policies and addresses concerns raised from FS opponents that may be used as a guide to the derivation of policy should an agency choose to conduct FS.

1. INTRODUCTION

1.1 Project Background

Familial searching (FS) is an additional search of a DNA profile in a law enforcement DNA database that is conducted after a routine search fails to identify any profile matches.[1,2,3,4] The FS process attempts to provide investigative leads to agencies engaged in the pursuit of justice by identifying a close biological relative of the source of the unknown forensic profile obtained from crime scene evidence. FS is based on the concept that first-order relatives, such as a sibling or parent/offspring, often will have more alleles of their DNA profiles in common than those of unrelated individuals.

FS involves a two-phase process. The first phase of FS produces a candidate list from the DNA database ranked by likelihood ratio estimates supporting the specified relationship (i.e., parent–offspring and full sibling) compared with the alternate hypothesis of being unrelated. The second phase of the process typically uses additional genetic testing, such as analysis with lineage markers, usually Y-STRs, to confirm or refute the specified relatedness.

Although FS is not explicitly authorized by statute at the federal level, some states currently utilize FS under the implicit authorization outlines in their state database laws. In many instances, FS has successfully identified the source of biological evidence, and these situations are often quickly reported (**Appendix A** presents news reports listings from the literature review). However, even with the rate of success of FS approximating the percent hit rate of direct searches in the CODIS, a number of agencies have not implemented an FS policy. One explanation for this lack of implementation is an absence of clear guidance and documentation of the policies and practices currently employed to ensure proper FS utilization, despite previously federally funded resources designed to provide direction concerning FS policy, including an educational resource (http://projects.nfstc.org/fse/13/13-0.html) and a discussion panel (http://www.nij.gov/events/nij_conference/2011/Pages/panels.aspx).

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[1] Maguire C.N., McCallum L.A., Storey C., Whitaker J.P. (2014). Familial searching: A specialist forensic DNA profiling service utilizing the National DNA Database to identify unknown offenders via their relatives. The UK experience, *Forensic Sci. Int. Genet.*, 8, 1-9.

[2] U.S. Dept. of Justice, Global Justice Information Sharing Initiative (2012). *An introduction to familial DNA searching for state, local, and tribal justice agencies: Issues for consideration.* https://www.ncjrs.gov/app/publications/abstract.aspx?ID=260650

[3] Pope S., Clayton T., Whitaker J., Lowe J., Puch-Solis R. (2009). More for the same? Enhancing the investigative potential of forensic DNA databases (REF 0415), *Forensic Sci. Int. Genet. Suppl. Series, 2*, 458-459.

[4] Colorado Bureau of Investigation, DNA Familial Search Policy, *CBI Policy Statement*, (October 22, 2009). http://www.denverda.org/DNA_Documents/Familial_DNA/CBI%20DNA%20Familial%20Search%20Policy%20Oct%202009%20-%20Signed.pdf

To address this issue, the Forensic Technology Center of Excellence at RTI International (FTCoE, Award: 2011-DN-BX-K564), in a cooperative agreement with the National Institute of Justice (NIJ), presented a four-part *Familial DNA Searching: Understanding the Current State of Affairs* webinar series to elucidate the landscape of policies and procedures addressing FS in the U.S. justice system. The goal of this project was to create a document designed to educate legal professionals, policy makers, law enforcement, and forensic laboratory practitioners of state and local agencies on the current issues, approaches, and positions involved with FS as applied to criminal investigations.

In addition to this final report, the entire webinar series has been archived and is available on the FTCoE website at www.forensiccoe.org. The decision of whether and how to employ FS varies from state to state; therefore, the series was designed to discuss various policies and practices associated with FS, including technical considerations, legal challenges, comparison with other types of DNA searches, and implementation ramifications. The derived policies are formulated around decisions that balance privacy concerns against public safety. Proponents of FS advocate the process as an important tool for justice that has significant crime-solving capability, and hence, case resolution. Opponents, however, cite concerns regarding issues of privacy and view FS as a violation of the Fourth Amendment. Should an agency decide to proceed with an FS policy, this report provides the groundwork for the formation of the policy, as well as procedures that address the current barriers to implementation.

1.2 Approach

The intent of the webinar series was to elucidate the current landscape of policies and procedures—beyond literature and media sources—addressing FS and then to present that information to inform the forensic science practitioner audience about the practices, policies, and limitations of FS. To achieve this goal, the project team decided it would be best to bring together representatives who do not support FS, who fully support FS, and who support FS in a limited fashion to participate in the webinar(s).

Some agencies chose not to participate in this effort, stating they had nothing to contribute to the discussions. Although the project team was composed of various subject matter experts who possess a range of opinions and experiences about FS use and policy, representation from the declining agencies might have provided greater insight. For example, agencies that do not have a FS policy could have (1) discussed how they define FS; (2) described whether specific factors play a role in their decision to not pursue or implement FS, such as lack of direction on how to develop technical policies; limited resources; data interpretation challenges; or authorization concerns; and (3) provided insight into why

some states that do not employ FS have instead used DNA dragnets—an alternate search strategy that can be considerably more expensive, has a low success rate, and has privacy implications, as indicated in the 2004 report by Samuel Walker (http://samuelwalker.net/wp-content/uploads/2010/06/dnareport.pdf) not addressed as they are by FS.

> ***"These webinars were very helpful. Throughout our validation process, we were in contact with some of the states currently performing familial search. These webinars were great because you had all of those individuals commenting on and discussing the topic in one place."***
>
> **Familial DNA Searching webinar participant**

In summary, although some webinar panelists were legal representatives who opposed FS, the majority of panelists involved in the webinar series represented agencies that conduct FS; therefore, this report captures the viewpoint of the majority. In hindsight, the diversity in viewpoints and experiences contributed to the success of the project because the majority of attendees viewed the program as an opportunity to learn more about FS in general, as well as to learn about agencies that were considering implementation of a FS policy. Thus, the webinar series provided information, resources, and contacts that were beneficial to the majority of the attendees and to the production of this report. Currently, nine U.S. states have implemented a FS policy; however, roughly half of those states accepted invitations to participate in the discussions as panelists. The majority of states that declined to participate as panelists did have representatives participate as attendees across the entire webinar series.

States Currently Conducting Familial DNA Searching

- California
- Colorado (Denver)
- Florida
- Michigan
- Texas
- Utah,
- Virginia
- Wisconsin
- Wyoming

The webinar series was constructed to obtain high engagement from the online participants and to provide as much information as possible on practices and policies of FS for the production of this report. The project team emphasized the engagement of policy and decision makers, technical leaders, and legal representatives. To facilitate participation, the webinar presentations and discussions intentionally allowed time for attendee questions. As the average attendance for each webinar was more than 100 individuals, one web host and one of the lead presenters monitored the active Chat pod for questions. The presenters answered many questions directly through the Chat pod, whereas questions directed to specific individuals, such as a presenter or panelist, were highlighted by the web host and brought to the attention of that individual. Finally, to keep the discussion from straying off topic, questions designed to maintain the direction of the discussion were provided to the panelists

several days before each live event. Panelists were encouraged to address any concerns or questions about the content of the upcoming discussion with either of the lead presenters. Lastly, surveys were made available to all web participants to obtain data metrics regarding the impact of the webinars. These metrics allowed the project team to assess the quality and impact of discussion content and to gain information on the structure of the web audience. The results of these assessments are presented in tables throughout this report.

Advertisement and promotion for the webinar series was conducted through multiple venues, including promotion by RTI, NIJ, the National Law Enforcement Corrections and Technology Center, and the American Academy of Forensic Sciences, as well as through the FTCoE electronic newsletter (12,000 subscribers), *Forensic Magazine* (http://www.forensicmag.com/search/site/familial%20dna), and the International Homicide Investigators Association (https://www.ihia.org/articles/topic/familial-dna-searching-webinars). In addition, the lead presenters *a priori* reached out to multiple agencies and practitioners, specifically from the law enforcement and legal communities.

To achieve the project objectives within the scope of the four-part webinar series, the project team generated the following tasks:

- **Task 1 – Assess the Current State of Familial DNA Searches for Criminal Investigations**. In order to assess the current state of FS, the project team conducted a comprehensive literature review and derived specific topics from these documents for discussion during the four webinars and for this final report. The team ensured that these topics aligned with the project goals and provided sufficient information, and then framed the discussion so that the webinar content would be engaging and substantial in depth and scope and would provide key resources for which the attendees could refer to as needed.
- **Task 2 – Derive Panelists for Discussion.** The panelists for each webinar were chosen based on their knowledge of the subject matter for that webinar, and every effort was made to include stakeholders with a variety of perspectives and experiences. There was no set limit on the number of panelists; rather, the project team focused on creating a dynamic discussion group that could bring forward as many experiences and perspectives as possible.
- **Task 3 – Host, Webcast, and Archive the Individual Webcast Series.** The webinar series consisted of one webinar per month for a 4-month block and began in May 2014. Each webinar was constructed around a 2-hour time slot, with a combination of presentation and discussion to maximize engagement. Archived versions of the broadcast webinars were made available before the series was completed. The intent of the memorialization was to allow individuals to access any webinar session that they may have missed. Thus, the information was readily available to ensure that attendees' knowledge would be current for subsequent webinars.
- **Task 4 –Provide Final Report.** The webinar discussions were captured and documented into this final report, which can serve as a resource document to provide a landscape of the current policies and approaches of FS.

1.3 Project Team

Project Team

Dr. Bruce Budowle – UNTHSC
Mr. Rockne Harmon – former prosecutor (retired)
Dr. Angie Ambers – UNTHSC
Dr. Patricia Melton –RTI International
Mr. Shane Hamstra –RTI International

This project was a collaborative venture with the University of North Texas (UNT) Health Science Center (HSC), whose primary consultants and discussion leaders were Dr. Bruce Budowle and Mr. Rockne Harmon. Dr. Budowle, the Executive Director of the UNTHSC's Institute of Applied Genetics (IAG) and a Professor in the Department of Molecular and Medical Genetics at UNTHSC, was previously employed by the Federal Bureau of Investigations (FBI) for 26 years and is an expert in forensic genetics. Mr. Harmon retired in 2007 after a 33-year career in the Alameda County District Attorney's Office and has been instrumental in legal issues surrounding implementation of new forensic DNA technologies. Currently, he is an Instructor at the University of California-Davis in the Masters in Forensic Science Program. Project team member Dr. Angie Ambers is a postdoctoral fellow at the IAG and an adjunct professor at UNT, where she teaches Genetics, Heredity, Human Anatomy and Physiology, and Forensic Molecular Biology. Prior to pursuing her doctorate, Dr. Ambers was the lead DNA analyst and laboratory manager of UNT's DNA Sequencing Core Facility.

RTI members of the project team consisted of Dr. Patricia Melton and Mr. Shane Hamstra from RTI's Center for Forensic Sciences. Dr. Melton is a senior research forensic scientist and was the project leader responsible for project coordination and logistics. She has nearly a decade of experience as a forensic DNA analyst and has been on the faculty of two universities. Mr. Hamstra is a research training specialist and was responsible for all technical webinar logistics, including coordination with subject matter experts, graphic artists, and instructional designers. Biographies of the project team members are available in **Appendix B**.

The panelists were deemed an integral part of the overall goal of describing FS. Choosing panelists with backgrounds relevant to the topics presented within each webinar ensured greater impact and more powerful discussion. Panel participants from the legal community ranged from advocacy for FS to opposition of FS. Panel participants from the crime laboratory currently utilize FS and have policies and protocols to support FS; however, these participants vary in the level of experience with FS. As stated previously, the project team was unable to obtain participation from crime laboratory stakeholders who do not participate in FS. **Exhibit 1** summarizes the subject content and participants for the entire webinar series.

Exhibit 1. Summary of Webinar Series

Broadcast Date	Panelists	Affiliation	Subject Content
Webinar 1: May 29,2014	Rockne Harmon	Former prosecutor (retired)	• Define familial DNA searching • Identify commonalities and differences with other searching approaches • What jurisdictions are performing familial DNA searches? • What are some of the potential legal challenges to familial DNA searches?
	Bruce Budowle	Institute of Applied Genetics, UNTHSC, Texas	
	Mike Ambrosino	Unites States Attorney's Office, Washington, D.C.	
	Gary Sims	California Department of Justice, Laboratory Director	
	Mitch Morrissey	District Attorney, Denver, Colorado	
	Gary Molina	Texas Department of Public Safety	
	Brad Jenkins	Virginia Department of Forensic Science	
Webinar 2: June 26, 2014	Rockne Harmon	Former prosecutor (retired)	• What are the existing protocols? • What are the established familial DNA processes? • How were these processes established? • What are the privacy issues and concerns that need to be addressed? • What role did the SWGDAM Familial Search Recommendations play in developing these processes?
	Bruce Budowle	Institute of Applied Genetics, UNTHSC, Texas	
	Christopher Maguire	Deputy Director, Department of Forensic Sciences, Washington, D.C.	
	Gary Sims	California Department of Justice, Laboratory Director	
	Gary Molina	Texas Department of Public Safety	
	Jessica Goldthwaite	Legal aid, New York	
	Susan Friedman	Legal aid, New York	
	Judy Ann Royal	Northwestern Law School, Illinois, Center for Wrongful Convictions	
Webinar 3: July 17, 2014	Rockne Harmon	Former prosecutor (retired)	• Discussion of technical considerations such as thresholds and software options • What is the role of Y STR and mtDNA analysis? • What processes are associated with the investigative follow up? • What types of metrics are used to measure the success of a search?
	Bruce Budowle	Institute of Applied Genetics, UNTHSC, Texas	
	Christopher Maguire	Deputy Director, Department of Forensic Sciences, Washington, D.C.	
	Mitch Morrissey	District Attorney, Denver, Colorado	
	Brad Jenkins	Virginia Department of Forensic Science	
	Greggory Laberge	Denver Crime Laboratory	
	Chris Piwonka	Texas Department of Public Safety – CODIS	
	Matt Piucci	California Department of Justice	
	Rebekah Kay	Utah Department of Public Safety	

(continued)

Exhibit 1. Summary of Webinar Series (continued)

Broadcast Date	Panelists	Affiliation	Subject Content
Webinar 4: August 21, 2014	Rockne Harmon	Former prosecutor (retired)	• What are the genetic privacy implications of familial DNA searching? • What types of safeguards are in place to minimize intrusion? • What are some of the noted experiences associated with familial DNA searches?
	Bruce Budowle	Institute of Applied Genetics, UNTHSC, Texas	
	Christopher Maguire	Deputy Director, Department of Forensic Sciences, Washington D.C.	
	Brad Jenkins	Virginia Department of Forensic Science	
	Mitch Morrissey	District Attorney, Denver, Colorado	
	Chris Piwonka	Texas Department of Public Safety – CODIS	
	Matt Piucci	California Department of Justice	

2. THE ASSESSMENT OF THE LANDSCAPE OF FAMILIAL SEARCHING

2.1 Literature Review

The research team conducted a review of both peer-reviewed and non-peer-reviewed literature, including media, of past and current issues and policies associated with FS, thus providing an overview of the FS landscape. Although comprehensive, the literature review was not intended to be exhaustive; rather, its purpose was to identify key resources that address discussion topics that may assist those considering whether or not to implement an FS policy.

A list of FS news reports and success stories is provided in **Appendix A**. The key sources designated in this appendix may assist decision makers with development of policies and procedures related to FS. The success stories include cases from the United States, the United Kingdom, and New Zealand, and the news stories include information on the implementation of FS policies in Australia and The Netherlands. Although these sources indicate that the application of FS occurs in countries beyond the United States, the project team generally did not evaluate FS policies and procedures of other countries, and instead prioritized U.S.-based examples. This focus was based on the belief that state agencies in the United States would more likely look for FS implementation guidance from other states, given their similar legal systems.

2.2 Familial DNA Searching Webinars

2.2.1 Familial DNA Searching Webinar 1

The objectives of the first *Familial DNA Searching Webinar: Understanding the Current State of Affairs* were to define and discuss the following:

1. What is a familial DNA search?
2. What are the general policies and procedures governing familial searches?
3. What legal challenges exist for familial DNA searches?

To facilitate discussion of these topics, panelists were provided discussion questions prior to the webinar. **Exhibit 2** presents the discussion questions for Webinar 1.

Exhibit 2. Webinar 1 Discussion Questions

Q1	What is familial searching?
Q2	Does it refer only to interrogating databases?
Q3	Would you alert an investigator if a suspect had a similar profile compared with the evidence?
Q4	Does your state law explicitly authorize the sharing of partial match investigative leads with law enforcement?
Q5	Do you use lineage testing such as Y-STR analysis or mtDNA analysis for partial matching?
Q6	Which do you think might be more successful in solving crimes: partial matches or familial searching?
Q7	Does your lab perform familial searching?
Q8	What process did you undertake to use familial searches?
Q9	Have you obtained legal advice about implementing it under authority of your existing law?
Q10	What policy issues must be considered and addressed in any familial search protocol?
Q11	What are potential legal challenges to FS?

Two-hundred and twenty (220) participants attended the first webinar. The majority of the participants (73%) listed themselves as a forensic professional, while 7.3% listed themselves as a law enforcement and legal representative. Specific demographic and impact information for Webinar 1 based on a survey of participants is captured in an Events Performance Sheet provided in **Appendix C** of this report**. Exhibit 3** presents the survey questions and respective metrics for the first webinar.

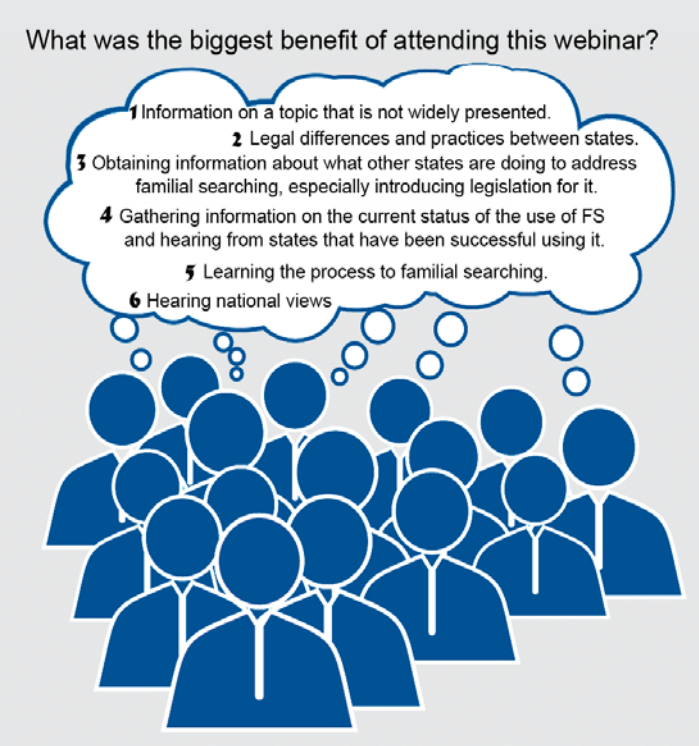
Exhibit 3. Survey Questions and Respective Metrics – Webinar 1

Question	Response
How informative was the webinar?	• Highly Informative: 59% • Somewhat Informative: 36% • Not Very Informative: 7%
Will the information presented today assist in addressing familial DNA searching questions/policies in your agency?	• Yes: 32% • Possibly: 61% • No: 7%
How likely are you to share the information presented in this webinar with other policy makers associated with your agency?	• Highly Likely: 49% • Somewhat Likely: 34% • Not Likely: 17%

Specific Outcomes of Webinar 1

At the end of the webinar, participants were asked the question, "What was the biggest benefit of attending this webinar?" Responses to this question include those shown in **Exhibit 4.**

Exhibit 4. Participant Feedback



In summary, the webinar introduced the concept of FS as a two-step process involving a specific search of a DNA database. The search is undertaken only after a direct DNA profile search does not produce a match, after all investigative leads have been exhausted, and typically only for cases involving serious crimes. The FS process entails ranking potential candidates in the database using autosomal STR data followed by lineage marker (Y-STR) testing to reduce the candidate list to individuals who have a high probability of being a relative of the donor source of the evidence DNA profile. After the two-step process, the candidate list has been reduced to none (i.e., no potential relative identified), or to one or two potential relatives (e.g., the latter a case where two sons of the true source of the evidence were in the database).

To date, there have been no known cases where a false association has been made following the two-step process. FS is essentially another tool for utilizing a DNA database to generate investigative leads and identify perpetrators of crime, and just as importantly, to help exonerate wrongfully convicted individuals. In this webinar, FS was distinguished from the practice of partial matching (PM), which uses arbitrary, low-stringency, or moderate-stringency search criteria to identify relatives of the donor source of an evidence sample. Although there appears to be overwhelming acceptance by many agencies to use PM as a means of generating investigative leads, PM is not intended to be a deliberate search; rather, it is an artifact of current direct match searches in the CODIS. Most importantly, PM is an ineffective, low-probability practice where, in situations where full-siblings are present in the database, 99.9% of full siblings will be missed.

During the first webinar, discussion was raised about the possibility that FS may violate Fourth Amendment rights of the perpetrator and his/her relatives. It was pointed out that consideration of the use of FS must strike a balance between protecting privacy and ensuring public safety. The statutory purpose of FS was defined, with FS being the "means" and criminal identification being the "purpose." The search practices described above contribute substantially to minimizing privacy concerns. Advocates, as well as the FBI, suggest that each state should evaluate their individual legislative policies and criminal justice goals to decide whether FS is implicitly authorized in their state database law for use in investigations. In addition, additional conditions should be placed on the decision to use FS to ensure due process.

Currently, nine states overtly use the practice of FS (California, Colorado, Florida, Michigan, Texas, Utah, Virginia, Wisconsin, and Wyoming). The FS policies and practices across these states are very similar, but not identical. None of the states changed laws to explicitly authorize the practice of FS. In addition, there have been no legal challenges that specifically pertain to the use of FS in these states. In fact, to date, several of the FS successes have gone to jury trial, and no legal challenges were lodged against using FS in the investigation.

Some states have sought explicit legislative authorization to conduct FS; however, the outcomes for these states have been mixed: a Tennessee bill was denied, a Pennsylvania bill recently failed to pass, and a Minnesota bill was approved to conduct a pilot project using FS on cold cases only. No state that has sought explicit statutory authorization has been successful in obtaining it. Maryland and Washington, D.C., at the other end of the spectrum, strictly prohibit the use of FS.

2.2.2 Familial DNA Searching Webinar 2

The objectives of the second webinar were as follows:

1. Describe the underlying criteria of existing protocols.
2. Discuss the privacy implications of familial searches.
3. Assess the Scientific Working Group on DNA Analysis Methods (SWGDAM) Familial Search Recommendations.

In order to facilitate discussion of these topics, panelists were provided discussion questions prior to the webinar. **Exhibit 5** presents the discussion questions for Webinar 2.

Exhibit 5. Webinar 2 Discussion Questions

Q1	Describe the process criteria.
Q2	Who established the process criteria?
Q3	Is the protocol publicly available?
Q4	What case criteria are used to determine if familial searching is allowed?
Q5	Who submits the request for a familial DNA search?
Q6	Are the case requests prioritized?
Q7	Has there been any consideration given to familial DNA searching being available to a defendant or inmate under appropriate conditions?
Q8	What points from the SWGDAM familial search recommendations are you in agreement with?
Q9	What points from the SWGDAM familial search recommendations are you NOT in agreement with?
Q10	What are the considerations for the traditional 13 core loci versus the new expanded loci?
Q11	How should familial searching considerations be addressed for laboratories that are not currently conducting Y STR analysis?
Q12	What are the genetic privacy implications of familial DNA searching?
Q13	How do privacy violations occur during the process?
Q14	What safeguards could satisfy these concerns?

The second webinar was attended by 211 participants. The majority of participants (60%) listed themselves as a DNA Analyst/Technician, 13% listed themselves as a DNA Laboratory Technical Leader, and 13% listed themselves as a Forensic Professional. Legal representation was 7%; however, there was no representation from law enforcement.

As was done for all the webinars, the project team conducted a survey of webinar participants to obtain specific demographic and impact information. This information was collected in an Events

Performance Sheet, which is provided in **Appendix D** of this report. **Exhibit 6** presents the survey questions and respective metrics for the second webinar.

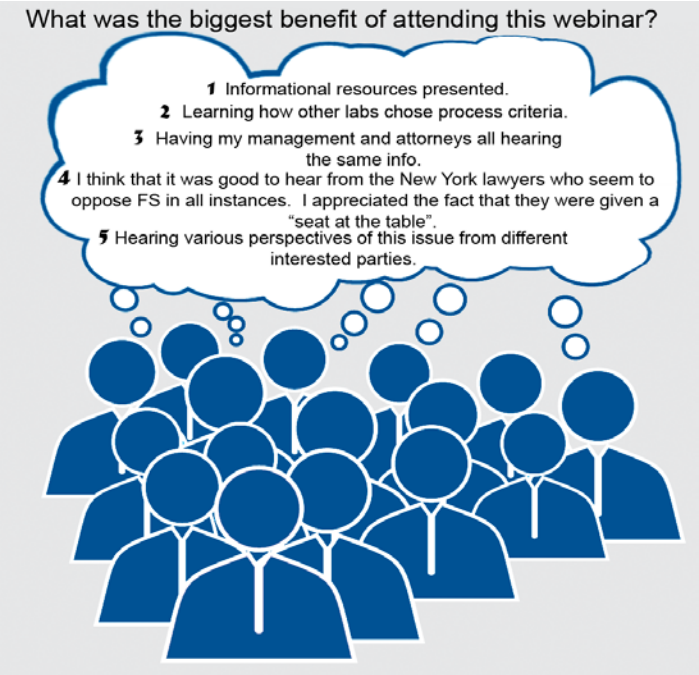
Exhibit 6. Survey Questions and Respective Metrics – Webinar 2

Question	Response
Choose the option that best describes why you are viewing this webinar.	• My agency is considering familial DNA searching: 14% • I want to know how other agencies are addressing familial DNA searches: 16% • I want to know more about familial DNA searching in general: 70% • Other: 0%
How informative was the webinar?	• Highly Informative: 67% • Somewhat Informative: 33% • Not Very Informative: 0%
Based on the information presented today, do you believe there are suitable criteria for developing a sound familial DNA searching process?	• Yes: 80% • Possibly: 18% • No: 2%
Based on the information presented today, are there situations where you would advocate familial DNA searching with your state or laboratory?	• Yes: 75% • Possibly: 25% • No: 0%
How likely are you to share the information presented in this webinar with other policy makers associated with your agency?	• Highly Likely: 60% • Somewhat Likely: 40% • Not Likely: 0%

Specific Outcomes of Webinar 2

At the end of the webinar, participants were asked the question, "What was the biggest benefit of attending this webinar?" Responses to the question included those shown in **Exhibit 7**.

Exhibit 7. Participant Feedback



In summary, the second webinar delved further into the current practices and policies of states using FS protocols in criminal investigations. Panelists who represented laboratories in California, Colorado, and Texas, and one representative formally from the United Kingdom but currently located in

Washington D.C., discussed their current and (in the case of the D.C. representative) former jurisdiction's FS procedures. All require a formal request for FS be submitted by an investigating agency for cases generally involving violent offenses and for which FS could be useful in producing investigative leads. The United Kingdom policy differs from that of the United States in that it does not require an investigation to hit a "dead end" prior to submitting a request for FS.

California requires that the District Attorney approve all FS requests; that a committee of upper management personnel meet to review and discuss the FS process and results; that the DNA profile from an evidentiary sample be single-source; and that Y-STR analysis be completed prior to releasing the FS results to the investigating agency. In contrast, the United Kingdom may not require Y-STR typing, instead opting for use of readily available meta-data. California placed unanimous emphasis on training and informing investigators on the legal and proper conduct responsibilities associated with using FS results in a criminal investigation. Both California and Denver have an educational component for the law enforcement agency at point of disclosure of the investigative lead. Texas researched the FS policies of California, Denver, and the United Kingdom prior to developing and adopting its own, similar FS policy.

Another topic discussed during this webinar was the SWGDAM recommendations on the use of FS in criminal investigations. Due to technical limitations, FS is practiced at state and local levels only. SWGDAM does not recommend the use of FS at the NDIS (national) level. A significant factor in the SWGDAM position is the lack of Y-STR capabilities among many government CODIS labs. A copy of the SWGDAM recommendations on FS can be found at www.swgdam.org.

Generally, the users of FS did not rely on the SWGDAM recommendations and instead followed the leads of both California and Denver on how to proceed with the development of FS policies. All of the panelists agreed that state and local FS practices should be transparent and open to allow any interested party to review policies and to give guidance to additional agencies who may be interested in implementing FS. The California Department of Justice FS policy is posted at http://projects.nfstc.org/fse/13/13-14.html, and the Denver FS policy can be found at www.denverda.org on the DNA Resource page.

Once again, genetic privacy implications of FS were discussed by webinar participants. The legal community provided a wide span of views ranging from whether authorization exists within the current framework to use FS, to the application of whether FS may violate Fourth Amendment rights, to the belief that under no circumstances should FS be utilized. The composition of the panel for this discussion

ranged from front-line criminal defense attorneys representing those charged with crimes, to attorneys who typically represent convicted inmates seeking to utilize DNA evidence for exoneration purposes.

Advocates pointed to the successful use of FS for solving crimes and exonerating the innocent, with current practices balancing privacy and the needs of the state. Critics conveyed concerns that FS is a form of race-based genetic surveillance and that the practice is racially disproportionate (given the prevalence of minority profiles in offender databases), as well as potential Fourth Amendment concerns. Some discussion of these concerns is outlined in various law review articles that are included in the literature review portion of this document (see **Appendix A**); however, these articles do not address such concerns within the context of the current practices and policies in place and, thus, tend to be of limited value. For example, almost none of the law review articles discuss the use of lineage testing (as every FS laboratory recommends and conducts) to confirm/refute the potential relatedness of offenders with the source of an unknown evidence profile. During the panel discussion, those opposed to using FS were asked to identify where in the FS process privacy rights or violation of Fourth Amendment rights were implicated. No specific point or issue was identified during the webinar.

To stimulate the discussion of the potential utility of FS and other constraints that may arise, the webinar reviewed a highly publicized case from Illinois. Juan Rivera was convicted in three separate trials of murdering 11-year-old Holly Staker. In the third trial, DNA evidence from sperm found in Staker's vagina was shown to be from another perpetrator, not Rivera. Upon appeal, the conviction was reversed and the charges were ordered to be dismissed due to insufficient evidence of guilt. Subsequently post-conviction, DNA testing of evidence in another homicide case produced a DNA profile that matched the sperm profile found in the Holly Staker case, but that does not match the current defendant in the homicide. This profile has been uploaded and searched in SDIS/NDIS with no ensuing match.

This situation was selected to illustrate the tension that exists among defense attorneys who have different agendas for their respective clients, and also law enforcement personnel who deal with a profile match in a cold case and a post-conviction testing case. The Holly Staker murder remains unsolved. The defendant in the other homicide is seeking to be exonerated but remains convicted. No request has been made by either the defense attorney or the law enforcement agency to utilize FS in this situation. The panelists' views on the utility of FS for this case varied from full support to no support, depending on their respective roles in the system.

2.2.3 Familial DNA Searching Webinar 3

The objectives of the third webinar were the following:

1. Present an overview of familial DNA searching protocols, including thresholds.
2. Discuss the role of additional analysis, such as Y-STR and mitochondrial DNA (mtDNA).
3. Discuss the process for investigative follow-up.

In order to facilitate the discussion of these topics, panelists were provided discussion questions prior to the webinar. **Exhibit 8** presents the questions for Webinar 3.

Exhibit 8. Webinar 3 Discussion Questions

Technical Considerations	
Q1	What are the protocols that are being used?
Q2	What are the thresholds used for candidate selection? a) LR (likelihood ratio) b) Allele counting c) Or other information
Q3	What software is being used?
Q4	What thresholds are used for subsequent follow up? a) Statistical b) Number of candidates c) Genetic marker based
Q5	Are analysis such as YSTRs and mitochondrial DNA being used to reduce the candidate list?
Q6	How is the outcome different without Y STRs or mitochondrial DNA?
Investigative Follow Up on Familial DNA Search Results	
Q7	What is this internal process prior to release of information?
Q8	What method(s) of communication does the submitting agency employ after the release of an investigative lead?
Success Metric	
Q9	Has your agency made any effort to calculate the success rate of familial searching efforts in order to compare to the efficiency of CODIS offender hits?

This webinar was attended by 161 participants. The majority of participants (28%) listed themselves as a DNA Analyst/Technician; 21% listed themselves as a DNA Laboratory Technical Leader; and 11% listed themselves as a Forensic Professional. For this webinar, 14% listed themselves as Academia/Educators/Students, which was a group that had not participated in the previous webinars. Participants from the law enforcement and legal representation fields was below 5%. The Events

Performance Sheet for Webinar 3 is located in **Appendix E. Exhibit 9** presents the survey questions and respective metrics for the third webinar.

Exhibit 9. Survey Questions and Respective Metrics – Webinar 3

Question	Response
Choose the option that best describes why you are viewing this webinar.	• My agency is considering familial DNA searching: 16% • I want to know how other agencies are addressing familial DNA searches: 62% • I want to know more about familial DNA searching in general: 17% • Other: 5%
How informative was the webinar?	• Highly Informative: 38% • Somewhat Informative: 62% • Not Very Informative: 0%
Based on the information presented today, are there situations where you would advocate familial DNA searching with your state or laboratory?	• Yes: 82% • Possibly: 18% • No: 0%
Based on the information presented today, do you believe there are suitable criteria for developing a sound familial DNA searching process?	• Yes: 95% • Possibly: 5% • No: 0%
How likely are you to share the information presented in this webinar with other practitioners associated with your agency?	• Highly Likely: 77% • Somewhat Likely: 23% • Not Likely: 0%
If your agency permits familial searching, have you made any effort to establish a success metric?	• Yes: 0% • No: 100%
If your agency permits familial searching, what threshold do you consider for additional follow up?	• Statistical: 50% • Number of Candidates: 0% • Genetic markers used: 0% • Other: 0% • My agency does not permit familial searching: 50%

Specific Outcomes of Webinar 3

At the end of the webinar, participants were asked the question, "What was the biggest benefit of attending this webinar?" Responses to the question include those shown in **Exhibit 10**.

2.2.4 Familial DNA Searching Webinar 4

The objectives for this webinar were as follows:

1. Present an overview of familial DNA searching
2. Describe the privacy considerations associated with searches
3. Summarize key elements and considerations
4. Discuss experiences associated with familial DNA searches.

Exhibit 10. Participant Feedback

Specific discussion questions for the fourth webinar were not presented to panelists ahead of time because the topics discussed related to previously established questions, although some questions were addressed in greater detail or more depth. This webinar summarized key conversation topics and condensed an overview of the current familial DNA searching landscape from both a legal and technical perspective. This webinar was attended by 75 registrants, the majority (67%) of which listed themselves as a Forensic Professional. The Events Performance Sheet for Webinar 4 is provided in **Appendix F** of this report

Specific Outcomes of Webinar 4

Participants were asked the question, "What was the biggest benefit of attending this webinar?" Responses to the question include those shown in **Exhibit 11**.

Summarizing Webinars 3 and 4, it was clear that all U.S. laboratories practicing FS follow a similar protocol of searching for potential relatives and ranking them based on meeting a minimal likelihood ratio (LR) value. A list of candidates is selected based on a minimum LR, and a number of candidates are subjected to further lineage testing; the latter being a systematic approach based on predicted success, resources, and labor.

Exhibit 11. Participant Feedback

Panelists from California, Denver, Texas, and the United Kingdom discussed the parameters for determining a minimum LR for use in FS. Some advocated a LR >200,000, although it was acknowledged that this number cannot necessarily be applied universally in all jurisdictions because the value will change with size of the database interrogated. Colorado uses a minimum likelihood ratio of 200,000 and has found that the success of finding a true relative via FS drops substantially with lower LRs. Geography was broached as a potential database search limitation, as there may be a higher degree of relatedness among samples in small, local (LDIS) databases as opposed to those in larger SDIS databases. However, given the diversity of STRs, this concern was not perceived as increasing the risk of falsely identifying a relative, especially since the two-step process includes Y-STR typing, which has the power to effectively exclude all non-relatives in this context.

All participants agreed that a selected cutoff threshold impacts cost and time because that will determine the Y-STR typing effort with each FS. One suggested approach to reduce this burden was to develop an STR kit that contains the core CODIS markers and several Y-STR markers so that the two-step process could, in effect, become a one-step process. In terms of a standard number of candidates, California will conduct lineage testing on approximately 160 candidates. Denver, Texas, and the United Kingdom currently conduct lineage testing on the top 30–50, 100, and 30 candidates, respectively (assuming that the number of samples meets the minimum LR threshold). Software programs used in the calculation of LRs and the selection of candidates also were discussed. California, Denver, and UNTHSC (used by Texas) have developed software that enables FS LR calculations.

An alternative screening process to generate a candidate list was the number of alleles shared with the evidence profile. Initially, allele sharing was the primary approach used for identifying candidates; this was based on the assumption that the greater the number of alleles shared, the higher the probability was that the candidate would be a relative. Allele counting has been supplanted by the LR threshold approach. Although a minimum LR is more widely accepted currently, a high number of concordant alleles between profiles should not be ignored. It could be useful when multiple populations are evaluated, where LRs may vary substantially or when a LR does not meet a previously determined minimum threshold. In other words, LRs and allele counting should not be mutually exclusive.

One limitation to the functionality of FS regarded laboratories that currently do not perform Y-STR testing. Follow-up lineage testing cannot be performed by laboratories that are not conducting Y-STR analysis. Indeed, one of the limitations that motivated SWGDAM to not advocate FS was that a number of laboratories nationwide do not perform Y-STR testing. In the webinar discussions, this

position was overwhelmingly rejected. The viewpoint of the panelists was that Y-STR typing is an invaluable tool for forensic analyses and should be part of the repertoire of any DNA laboratory regardless of whether FS is performed. However, in the interim, for a laboratory that does not conduct Y-STR testing but is considering implementing a FS policy, the necessary follow-up Y-STR analysis could be outsourced. This would ensure that the serious cases that would be facilitated by FS can still be addressed.

Another limitation discussed is when an evidentiary sample is consumed during autosomal STR typing (therefore leaving nothing available for subsequent lineage testing). The follow-up Y-STR typing (or other similar filters) is considered a fundamental part of FS. Therefore, this limitation could be minimized with the potential development of one kit that could amplify both autosomal STRs and lineage markers (e.g., Y-STRs or mitochondrial DNA) in a single reaction.

Those states that currently conduct FS do so with only single-source samples. This includes DNA profiles that can be deconvoluted from mixtures. Currently, a full autosomal STR profile (i.e., those containing the 13 core STR loci) is necessary for a request for FS to proceed. However, it was pointed out that a partial profile may produce a sufficiently large LR, especially if the profile contains a rare allele(s). Therefore, it may be worth considering using certain partial autosomal STR profiles with FS.

Most laboratories currently analyze a full panel of 17 or more Y-STR loci. Between true relatives, there may be a difference at one or two loci due to mutation. Currently, there is no formalized approach for investigative purposes to account for possible mutations in the lineage marker system. Panelists agreed that allowances should be permitted, but noted that a candidate sample should be excluded as a potential relative in the event of more than two mismatches.

Upon completion of FS, most states will release the name of the relative. California has an additional review before the name is released, but to date, has always released the name to the proper authority. Each state with an active FS policy has an educational component that precedes the release of a name to ensure that law enforcement appreciates the meaning of the investigative lead and proceeds with the information appropriately.

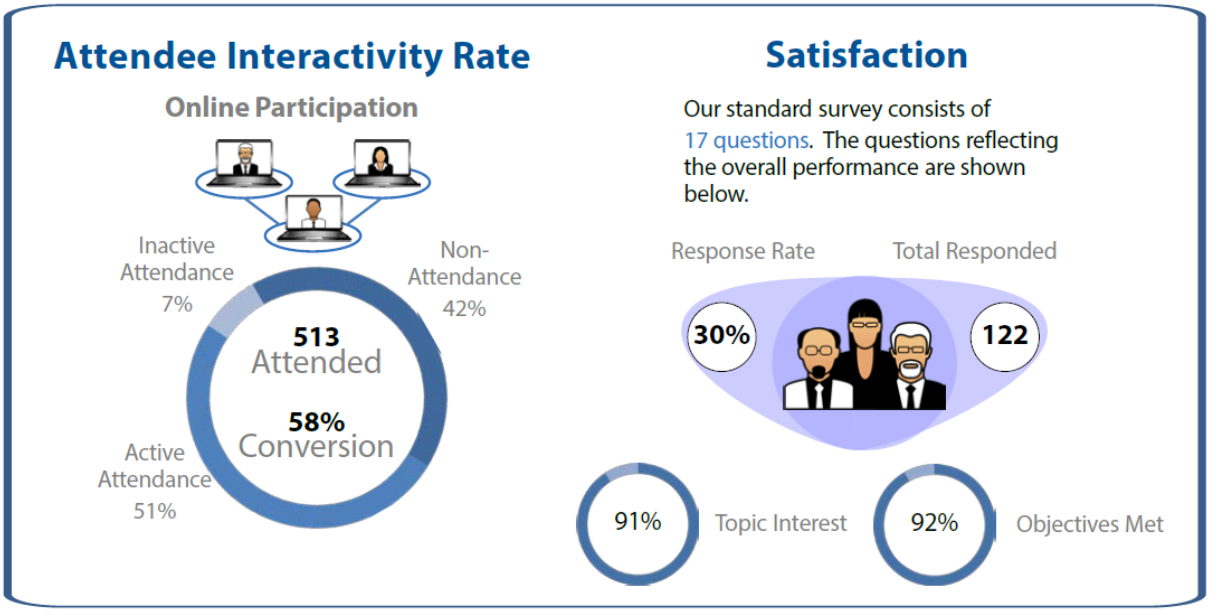
Lastly, success metrics are important to assess whether performing FS is a fruitful practice. An effort was made to calculate a success metric for FS using the same criteria that the FBI uses to calculate the effectiveness of CODIS. Of the 90 FS cases in Denver to date, 23 of the database searches resulted in identification of a true biological relative of the evidentiary sample (a success rate of approximately 26%). California's success metric is 26/66, or 39%. At the time of this webinar, the United Kingdom had

processed 260 FS cases, of which 54 identified a relative of the offender (21% success rate). These percent success rates are comparable to those for direct matching in CODIS but will have a higher translation success because of the greater commitment initially by all parties with FS. Metrics on how "hits" translate into identifications and convictions are needed for FS and direct searches of CODIS to assess the value of DNA databases and the contribution that FS makes to utilizing CODIS. Currently, there are approximately 326,000 unidentified forensic profiles in NDIS that have not been associated with aiding an investigation. If the success rate of FS is maintained at the same rate as that in Denver (26%), then one could expect FS to produce valuable investigative leads in about 84,760 additional cases.

3. SESSION HIGHLIGHTS

This webinar series was attended by over 500 online participants from around the world representing forensic professionals such as laboratory directors and technicians, legal and law enforcement representatives, academics ,and advocates. A cumulative Events Performance Sheet for the entire webinar series is provided in **Appendix G** of this report. A snapshot of the overall Events Performance Sheet is presented in **Exhibit 12**.

Exhibit 12. Events Performance Sheet for All Webinars Combined



This webinar series revealed that there are nine states that currently utilize FS. The procedures and policies are very similar, with all attempting to maximize success while minimizing possible intrusions. All nine states have policies in place to effectively meet those goals. Interestingly, none of

these states changed their laws to explicitly authorize the practice of FS, instead interpreting that current legislation provides authorization. Several other states have sought legislative change to explicitly authorize FS; however, all have been unsuccessful. There has been little discussion of the issues surrounding the two approaches regarding authorization by legal professionals and policymakers. Use of FS in California and Denver reveals a success rate that rivals and actually may be greater than that of CODIS. Presumably, this higher rate may be due to the greater commitment by all investigative parties. Within our discussion, the majority of panelists felt that there was nothing raised about FS itself that violates the Fourth Amendment. There have been no court cases to date invoking Fourth Amendment issues where FS was used to identify the suspect. Indeed, in the four FS investigations that have gone to trial, there was no legal challenge to the practice.

4. ADDITIONAL CONSIDERATIONS

Based on the information presented in this webinar series, discussed heavily by subject matter experts proficient in the full support, partial support, or no support of FS, several additional considerations are presented below. These considerations are presented to drive additional deliberation and further fine-tune policy and practices regarding FS:

1. For those who decide to apply FS, practices and policies exist that can serve as guidance models to ensure that the proper balance of privacy and the needs of the state can be met.
2. More investigative leads can be developed based on the current demonstrated FS successes.
3. Formal internal laboratory review committees should be implemented to (1) assess the statistical significance of FS results, (2) properly handle the disclosure of FS results to investigating agencies, (3) train investigators on the meaning of the results, and (4) emphasize the legal and proper conduct restrictions on how the information can be applied in a criminal investigation.
4. If no true biological relatives of the perpetrator are identified via FS, states should establish provisions in FS policies that allow laboratories to revisit the profile and perform FS again in subsequent years, as thousands of new sample profiles are uploaded to these databases annually.

5. SUMMARY

FS is a process used to attempt to identify a close relative (e.g., parent, child, or sibling) of the true source of a crime scene sample when an initial search at LDIS, SDIS, and/or NDIS fails to provide a direct match. The scientific basis of FS is that biologically related persons generally will share more alleles than unrelated individuals. The process currently is limited to single-source samples from evidence from violent offenses, and often in cases in which all other investigative leads have been exhausted.

There are a number of features that are common to laboratories utilizing FS:

- Law enforcement/ prosecutor commitment
- Standard Operating Protocols
- Software
- Two-part process of generating a candidate list and follow up with lineage testing (i.e., Y-STR typing)
- Disclosure of name only after lineage testing
- Typically, if no concordant lineage test result is obtained, then no investigative lead is reported.

The two-step FS protocol involves (1) the use of specialized software to identify and prioritize candidate samples (via a likelihood ratio and/or allele counting approach) and 2) lineage testing (e.g., Y-STRs or mtDNA) of a ranked set of candidate profiles to confirm or refute potential relatedness. Only individuals from the candidate list that share the same DNA lineage markers or haplotypes are considered a viable investigative lead. Identification of close relatives of the true source of the evidence from a crime scene can provide an important investigative lead in cases that otherwise may remain unsolved.

FS is not explicitly authorized by statute at the federal (NDIS) level. In 2008, SWGDAM made recommendations regarding the technical application of FS practices in criminal investigations for state and local jurisdictions. Currently, nine U.S. states that have formally adopted FS policies (i.e., California, Colorado, Florida, Michigan, Texas, Utah, Virginia, Wisconsin, and Wyoming). None of these states have passed legislation that explicitly authorizes FS; rather, they operate and conduct FS protocols under the premise of implicit generic legislation. Some FS users (e.g., California, Colorado) have made their official FS policy publicly available both for scrutiny and transparency, and to inform other jurisdictions considering the adoption of FS. Copies of the FS policies of both the California Department of Justice and the Colorado Bureau of Investigation are included in **Appendix H** of this report.

There has been a number of successful FS outcomes both in the United States and abroad (e.g., New Zealand, the United Kingdom). Although concerns have been raised regarding Fourth Amendment civil liberty violations that may arise as a result of the use of FS, states have taken extensive precautions to ensure that a balance is struck between maintaining genetic privacy and protecting public safety interests when making decisions to use FS in a criminal investigation.

Appendix A. Literature Review and Success Stories

NIJ Forensic Technology Center of Excellence

Award Number 2011-DN-BX-K564

Familial DNA Searching: Literature Review, Success Stories and News Reports

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Introduction

At the request of the National Institute of Justice (NIJ), the Forensic Technology Center of Excellence (FTCoE, Award: 2011-DN-BX-K564) and the Institute of Applied Genetics (University of North Texas Health Science Center) executed a series of tasks that represented a focused federal effort to organize and disseminate information on the current state of familial DNA searching in the United States. Familial DNA searching is the practice of developing investigative leads in cases where a DNA profile obtained from crime scene evidence and DNA profiles in a database do not directly match but share similarities. Some states have adopted familial DNA searching policies, while legislatures in Maryland and the District of Columbia have voted to prohibit the practice. The primary focus of this project is to ensure that existing research, information, knowledge, and derived policies or best practices are transferred or made broadly accessible to criminal justice practitioners and other stakeholders. The ultimate goal is to produce a consumable document for federal, state, and local agencies (e.g., forensic laboratories, law enforcement), legal professionals, and policy makers that addresses current approaches, issues, and positions involved in using or not using familial DNA searches in criminal investigations. The purpose of the document herein is to provide a comprehensive literature review consisting of independent and dependable informational resources that can serve as guidance for jurisdictions considering adopting a familial searching program. The literature review is divided into two parts: a listing of peer-reviewed articles with key findings identified and a listing of news reports that highlight the application of familial searching to specific cases and their outcomes.

Reference Articles

1. Kruijver M., Meester R., Slooten K. (2014). Optimal strategies for familial searching, *Forensic Sci. Int. Genet., 13*, 90-103.

Key Points and Findings:

1) Reviewed four proposed familial searching strategies: top-*k* of KIs, fixed-KI threshold, profile-centered method, and conditional method.
2) Investigated theoretical properties as well as the empirical behavior of each strategy via a comprehensive simulation study using mock databases.
3) Found that, in general, it is most efficient to work with a fixed-KI threshold (but it may be more convenient for some labs to apply a top-*k* strategy).
4) The effectiveness of a familial search is highly dependent on the case profile and tuning parameters.
5) Additional considerations must be made when searching heterogeneous databases (i.e., those in which not all profiles comprise the same loci).
6) Discusses composite searching for multiple types of kinship.

2. Maguire C.N., McCallum L.A., Storey C., Whitaker J.P. (2014). Familial searching: A specialist forensic DNA profiling service utilizing the National DNA Database® to identify unknown offenders via their relatives — The UK experience, *Forensic Sci. Int. Genet.*, 8, 1-9.

Key Points and Findings:

1) The U.K. National DNA Database (NDNAD) was established in April 1995 and now contains DNA profiles of approximately 6 million individuals. The size of this database makes familial searching a particularly effective investigative tool.
2) In 2002, Forensic Science Service Ltd. (FSS) introduced familial searching of the U.K. NDNAD to support the progression of criminal investigations in which a full DNA profile was available, but the profile did not match any profile of individuals retained in the NDNAD.
3) The DNA profile from the crime scene was designated the "target profile" (under the assumption that the target profile is that of the true offender and is relevant to the offense), and the NDNAD profile data generated via the familial search process were designated as "candidate lists."
4) No legislation exists in the U.K. that specifically mandates or allows forensic professionals and police to use familial searching of the NDNAD to solve cases.
5) Between 2002–2011, the FSS Forensic Intelligence Bureau (FIB) provided familial DNA searching services for 188 police investigations involving serious crimes and/or "cold case" reviews; 70 cases are still active; results led to the identification of 41 perpetrators or suspects.
6) Discusses the scientific basis of the familial search approach, and outlines the processes/steps utilized by the U.K. to initiate and carry out a familial search of the NDNAD.

3. Balding D.J., Krawczak M., Buckleton J.S., Curran J.M. (2013). Decision-making in familial database searching: KI alone or not alone?, *Forensic Sci. Int. Genet., 7*, 52-54.

Key Points and Findings:

1) Current familial searching strategies generally are based on either Identity-By-State (IBS) (i.e., number of shared alleles) or likelihood ratio (i.e., kinship index [KI]) assessments.
2) Conducted a simulation-based assessment of two decision rules for familial database searching—the bivariate decision rule (IBS plus KI) and the univariate decision rule (KI alone).
3) Found that a previously-proposed bivariate decision rule conflicts with the Neyman-Pearson Lemma of statistics (which states that the likelihood ratio alone provides the most powerful criterion for distinguishing between two competing hypotheses).
4) Results of a large simulation study supported the authors' contention that the theoretical expectation that KI alone provides better resolution than KI combined with IBS.

4. Rohlfs R.V., Murphy E., Song Y.S., Slatkin M. (2013). The influence of relatives on the efficiency and error rate of familial searching, *PLoS Genetics, 8*(8), e70495.

Key Points and Findings:

1) Investigated (via simulation) the consequences of adopting the familial searching criteria used by the State of California.
2) Concluded that, for Y-chromosome-sharing first-degree relatives, California's protocol has a high probability of identifying their relationship (~80-99%).
3) For unrelated individuals, there is a low probability that an unrelated person in the database will be identified as a first-degree relative.
4) Revealed unexpectedly that, for more distant Y-haplotype-sharing relatives (half siblings, first cousins, second cousins), there is a substantial possibility that the more distant relative will be incorrectly identified as a first-degree relative (e.g., there is a 3-18% probability that a first cousin will be identified as a full sibling, depending on the population background).
5) This risk of falsely identifying a distant relative as a first-degree relative falls disproportionately on ethnic groups that are currently overrepresented in DNA databases.

5. Recommendations from the SWGDAM ad hoc working group on familial searching. http://swgdam.org/SWGDAM%20Recs%20on%20Familial%20Searching%20APPROVED%2010072013.pdf

6. Bottomley M., Holt C. (2013). The continued use of familial DNA searching post Protection of Freedoms Act 2012. http://www.denverda.org/DNA_Documents/Familial_DNA/Continued_Use_of_Familial_DNA_Post_PoFA.PDF

Key Points and Findings:

1) Enactment of the Protection of Freedoms Act (PoFA) 2012 removed the investigative option to utilize an individual's DNA B scrape within a familial DNA search strategy.
2) PoFA 2012 has made the use of Y-STR profiling in familial searching more difficult.
3) Use of Y-STR profiling is still possible post-PoFA. Investigators will need to visit persons identified within the familial search results and re-swab them.
4) Provides new advice for senior investigating officers (SIOs) regarding familial DNA searching post FoPA. This is a guidance document signed off by the National DNA Operations Group in support of the National DNA Database Strategy Board.

7. Murphy E.E. (2012). Familial DNA searches: The opposing viewpoint, *Criminal Justice, 27*(1). http://www.americanbar.org/content/dam/aba/publications/criminal_justice_magazine/sp12_dna_search_opposing.authcheckdam.pdf

Key Points and Findings:

1) One of the most troubling concerns about FS lies in the lack of formal legal rules to govern its operation (or the lack of clarity on how the technique can be applied).
2) Unlike convicted offenders and arrestees, relatives have forfeited no privacy and since the Constitution precludes mandatory DNA sampling of all persons, it also should preclude a "back door" effort to achieve the same result.
3) A relative is, in a sense, a "joint occupant" of a genetic profile, and the mere presence of the offender profile within the relative's profile should not alone suffice to forfeit the relative's privacy.
4) There is high potential for abuse with FS. However, the architects of California's formal FS policy should be commended for their thoughtful and cautious approach (e.g., limiting its use to serious or cold cases, separating the scientists responsible for analyzing the matches from law enforcement officials invested in the case, developing software to find leads, imposing specific threshold match criteria, and withholding the names of leads until necessary for final investigation).

8. Chamberlain M. (2012). Familial DNA searches: A proponent's perspective, *Criminal Justice, 27*(1). http://www.americanbar.org/content/dam/aba/publications/criminal_justice_magazine/sp12_dna_search_proponents.authcheckdam.pdf

Key Points and Findings:

1) An important consideration in the potential application and success of FS is that DNA databases have been shown empirically to actually contain profiles of related individuals.
2) When a crime has been committed, constructing kinship estimates by initially looking at other DNA profiles in a database is a process blind to who those people are, as well as to race, geography, and other socioeconomic factors.
3) The composition of a DNA database is determined by law, with no discretion on the part of law enforcement as to who to include. Hence, databases reflect the demographics of the criminal justice system and therefore the argument that FS is racially disparate fails.
4) In measuring the success of an FS program, the metric used should reward protocols that error on the side of nondisclosure, minimize privacy-related implications for convicted offenders and their family members, and promote efficient expenditure of police agency resources by incentivizing the disclosure of useful leads only.
5) Investigators should use the least intrusive practical means of identifying the suspect, while bearing in mind that a family's privacy interests do not exist in a vacuum. The interests of victims, their families, and society at large provide important context when considering the use of FS.

9. U.S. Dept. of Justice, Global Justice Information Sharing Initiative (2012). *An introduction to familial DNA searching for state, local, and tribal justice agencies: Issues for consideration.* https://www.ncjrs.gov/app/publications/abstract.aspx?ID=260650

10. Rohlfs R.V., Fullerton S.M., Weir S.M. (2012). Familial identification: Population structure and relationship distinguishability, *PLoS Genetics, 8*(2), e1002469.

Key Points and Findings:

1) Statistical confidence that a partially matched DNA profile belongs to a true genetic relative needs further exploration.
2) Defined confidence intervals on estimated likelihood ratios for familial identification, and considered familial searching in a structured population.
3) The ability of familial searching to distinguish relatives from unrelated individuals varies over population samples and is affected by inaccurately assumed population background.
4) Relatives and unrelated individuals from populations with lower gene diversity are less distinguishable.
5) As a less appropriate population sample (and thus allele frequency distribution) is assumed, relatives and unrelated individuals become more difficult to distinguish.
6) Relationship distinguishability increases with the number of markers analyzed.

7) Relationship distinguishability decreases with discordance between true and assumed population samples (decreases for more distant genetic familial relationships).
8) If an inappropriate genetic population group is assumed, individuals from certain marginalized groups may be disproportionately more often subject to false familial identification.
9) Caution is warranted in the application of familial searching in structured populations (such as the U.S.).

11. Ge J., Chakraborty R., Eisenberg A., Budowle B. (2011). Comparisons of familial DNA database searching strategies, *J. Forensic Sci., 56*(6), 1448-1456.

Key Points and Findings:

1) Investigated different familial searching strategies that are currently used or proposed in the U.S., and summarized the false-negative and false-positive rates of the thresholds used for each strategy.
2) Concluded that combining Identity-By-State (IBS) values (i.e., number of shared alleles) and likelihood ratios (i.e., kinship indices [KI]) may be better than IBS or KI alone.
3) Population substructure has relatively higher effects on familial searching results than mutation.
4) Distributions of related and unrelated relationships were more resolved when 15 STRs were included in the search, as opposed to the standard 13 Core CODIS STRs.
5) Lineage markers (Y-STRs and mitochondrial DNA) can reduce adventitious hits (false positives).
6) Developed familial searching software (https://sites.google.com/site/gejianye/research/familial-searching).

12. Gershaw J.G., Schweighardt A.J., Rourke L.C., Wallace M.M. (2011). Forensic utilization of familial searches in DNA databases, *Forensic Sci. Int. Genet. , 5*, 16-20.

Key Points and Findings:

1) Discusses both positive and negative outcomes of familial DNA searches.
2) Each of the fifty U.S. states has its own local DNA database, with varying inclusion criteria. Individual state codes dictate which profiles are uploaded to DNA databases and how the profiles in the databases can be searched.
3) Familial searches will yield a larger number of possible suspects by incorporating low stringency matches. Low stringency matches may indicate a close relative to the source of the unknown

forensic sample (thereby broadening the inclusion criteria of the searched database to include not only offenders, but also the offenders' relatives).

4) Familial searches have been based on three separate approaches: a) searching for rare alleles, b) searching for a high number of matching alleles ("allele counting"), and c) calculation of likelihood ratios to indicate relatedness.
5) In terms of policy and legislation, most U.S. states have remained ambiguous on FS.
6) Familial searching should only be used as an investigative tool (i.e., it should not be the first step or sole source of information in an investigation).
7) Advocates claim it should only be used when all other leads have been exhausted.
8) Critics and policymakers remain adamant that privacy violations may occur.

13. Meyers S.P., Timken M.D., Piucci M.I., Sims G.A., Greenwald M.A., Weigand J.J., Konzak K.C., Buoncristiani M.R. (2011). Searching for first-degree familial relationships in California's offender DNA database: Validation of a likelihood ratio-based approach, *Forensic Sci. Int. Genet., 5*, 493-500.

Key Points and Findings:

1) California's State DNA Index System (SDIS) database contains ~ 1,000,000 autosomal STR profiles.
2) Validation study measured effectiveness of using a LR-based approach to search for possible first-degree familial relationships (full-sibling and parent-child).
3) Test searches involved autosomal STR and Y-STR profiles from 100 "artificial" test families.
4) With 15-locus assay (Identifiler®), search identified 96% of fathers and 72% of full siblings.
5) When profile was limited to the 13 Core CODIS loci, search identified 93% of fathers and 61% of full siblings.
6) Developed a procedure that uses STR-based LR calculations, analytical thresholds, and subsequent Y-STR analyses to perform familial searches of the California offender database.
7) Investigative lead using this process led to arrest in Los Angeles' Grim Sleeper serial murder case.

14. Slooten K., Meester R. (2011). Statistical aspects of familial searching, *Forensic Sci. Int. Genet. Suppl. Series, 3*, e167-e169.

Key Points and Findings:

1) Presented mathematical models that can be used to interpret all obtained likelihood ratios between the target and the database together, and to calculate posterior probabilities of relatedness.
2) Presented two strategies to finding subsets of a database that are most likely to contain a relative.

15. Kim J., Mammo D., Siegel M., Katsanis S.H. (2011). *Familial searching of the U.S. forensic DNA databank*, Duke Institute for Genome Sciences and Policy.

Key Points and Findings:

1) Report for Capstone Course in Duke University's Genome Sciences and Policy Program.
2) Introduction to familial searching and CODIS; constitutional definition of a search.
3) Discusses the impact of familial searching on society, families, and law enforcement.
4) Identifies policy considerations for familial searching.
5) Describes emerging familial searching policies and strategies.

16. Budowle B. (2010). Familial searching: Extending the investigative lead potential of DNA typing. https://www.promega.com/resources/profiles-in-dna/familial-searching-extending-the-investigative-lead-potential-of-dna-typing/

Key Points and Findings:

1) Familial searching is based on the principle that first-order relatives will share features of their DNA profiles on average more so than unrelated individuals.
2) A 1996 *Bureau of Justice Statistics* report found that 42.8% of inmates in U.S. correctional institutions have close relatives who have also been incarcerated (an *a priori* reason to assume that familial searching will have some success in criminal investigations).

17. Suter S.M. (2010). All in the family: Privacy and DNA familial searching, *Harvard Journal of Law and Technology, 23*(2), 310-399.

Key Points and Findings:

1) Familial DNA searching should not be embraced solely because it offers the capability to solve more crimes.
2) With the adoption of FS policies, several prima facie duties will potentially be in conflict with each other (prima facie duties to protect privacy, to promote justice, to protect the public, to honor the interests of victims, and to exonerate the innocent).
3) FS, if conducted with care and with appropriate safeguards, is legitimate in a number of circumstances.
4) Discusses the privacy issues (and potential Fourth Amendment violations) affiliated not just with surreptitious searches of relatives' "abandoned" DNA, but also with the long-term retention of such samples by individual laboratories and/or in privately-held (undocumented) databases.
5) High tech tools like FS may seduce investigators away from more traditional lines of investigation, resulting in confirmation bias (i.e., the seeming infallibility of genetics may result in investigators using standard techniques/skills such as interviewing and problem-solving less frequently).
6) Familial searching, when used in the context of solving violent crimes such as rape and murder, satifactorily fulfills the requirement that the prima facie duty to protect the public is serious enough to justify violation of the prima facie duties to protect the privacy and civil liberty interests of those affected by such a search.

18. Murphy E. (2010). Relative doubt: Familial searches of DNA databases, *Michigan Law Review, 109*, 291-348.

Key Points and Findings:

1) Provides an overview of the mechanics of familial DNA searching and its accuracy.
2) Discusses privacy issues with FS and potential resultant ethnic/racial discrimination.
3) FS shows promise for aiding criminal investigations, but also raises serious concerns of fairness, equality, civil liberty, and government accountability.
4) Jurisdictions contemplating adoption of a FS policy should understand that application of such a sophisticated technological method of investigation warrants a sophisticated means of coordination and control.

19. Hicks T., Taroni F., Curran J., Buckleton J., Castella V., Ribaux O. (2010). Use of DNA profiles for investigation using a simulated national DNA database: Part II. Statistical and ethical considerations on familial searching, *Forensic Sci. Int. Genet., 4*, 316-322.

Key Points and Findings:

1) Conducted a simulation study where profiles of simulated siblings were searched for in a virtual Swiss national DNA database (NDNAD) of 100,000 individuals with sub-structure.
2) Searches were conducted using two methods: allele counting and likelihood ratios.
3) Results confirmed that the likelihood ratio approach outperforms the allele counting method.

20. Pope S., Clayton T., Whitaker J., Lowe J., Puch-Solis R. (2009). More for the same? Enhancing the investigative potential of forensic DNA databases (REF 0415), *Forensic Sci. Int. Genet. Suppl. Series, 2*, 458-459.

Key Points and Findings:

1) In 1995, the U.K. Forensic Science Service introduced two additional search services to exploit data held in the NDNAD to greater effect than using standard direct-matching algorithms.
2) Familial DNA searching (fDNA) was introduced in 2003 and has been applied in more than 100 cases involving serious offenses. The authors present an overview of U.K. familial searching data and discuss beneficial refinements made to the search strategy based on their collective experiences.
3) Performed operational testing of DNAboost(r)—proprietary software that de-convolutes complex DNA mixtures into all feasible individual profiles so that a standard search can be performed.
4) Both methods further assist investigations that may otherwise stall.

21. Colorado Bureau of Investigation, DNA Familial Search Policy, CBI Policy Statement, (October 22, 2009). http://www.denverda.org/DNA_Documents/Familial_DNA/CBI%20DNA%20Familial%20Search%20Policy%20Oct%202009%20-%20Signed.pdf

Key Points and Findings:

1) Outlines the state's familial DNA searching procedures, including the circumstances (and categories of crimes) under which such a search would be conducted.
2) Attempts to mitigate privacy concerns, while at the same time providing information that may be useful in solving violent offenses.
3) Discusses how an investigative law enforcement agency should put together a case file and submit a special request to have the case approved for FS.
4) Discusses the criteria considered by CBI in determining whether the agency can proceed with familial DNA searching in a particular case.
5) Lists specific identifying information to be included in the post-FS report, and delineates guidelines and restrictions on how the law enforcement agency can proceed with the information.

22. Steinberger E., Sims G. (2008). Finding criminals through the DNA of their relatives –– Familial searching of the California Offender DNA Database, Prosecutor's Brief, Vol. XXXI (Nos. 1 &2). http://www.denverda.org/DNA_Documents/Familial_DNA/CDAA%20familial%20search%20article.pdf

Key Points and Findings:

1) California's DNA Data Bank was formally established in 1990, contains 1.1 million offender and arrestee DNA profiles, and is the fourth largest DNA data bank in the world.
2) Law enforcement agencies may formally request a familial search for a particular case from the California DOJ. The Familial Search Committee reviews all requests to ensure that the technique is used only for cases involving major violent crimes (which pose a serious risk to public safety) and for which all other investigative leads have been exhausted.
3) California's first DNA data bank search was conducted in October 2008.
4) In its current configuration, CODIS is a very poor tool for finding familial relationships.
5) The California DOJ familial searching approach is limited to looking for close relatives of the perpetrator (i.e., parents and their children, or full siblings).
6) California DOJ developed a statistical software application called the "Ratiometer" that calculates kinship likelihood ratios of a given DNA profile with their 1.1 million databank profiles.
7) "Candidate relatives" are ranked according to the kinship values generated, and subsequent Y-STR testing is used to filter out the majority of unrelated persons.

23. Cowen S., Thomson J. (2008). A likelihood ratio approach to familial searching of large DNA databases, *Forensic Sci. Int. Genet. Suppl. Series, 1*, 643-645.

Key Points and Findings:

1) Created a large simulated DNA database of five million unrelated profiles (mimicking the U.K. NDNAD as closely as possible), with the addition of 500,000 more profiles (duplicates of existing profiles).
2) Developed a familial searching protocol that uses a combination of filtering by number of shared alleles and ordering by likelihood ratios.
3) Found that profiles containing rare alleles are more amenable to familial searching.
4) Repeatedly searched the simulated database (using a series of related profiles) and found that the true relative was included in the top 20 hits in ~50% of cases.

24. Reid T.M., Baird M.L., Reid J.P., Lee S.C., Lee R.F. (2008). Use of sibling pairs to determine the familial searching efficiency of forensic databases, *Forensic Sci. Int. Genet., 2*, 340-342.

Key Points and Findings:

1) Seeded known DNA profile data of true siblings into a simulated CODIS-like offender database.
2) Investigated whether known siblings could be identified in a large database via familial DNA searching, using two different methods: degree of allele sharing and the kinship analysis approach.
3) The allele sharing method detected 62 of 109 known sibling pairs (57%). There was very little correlation between degree of allele sharing and number of hits required to find a true match; hence, use of this method would result in a large number of false associations.
4) The kinship analysis approach detected 90 of 109 known sibling pairs (83%). Kinship matching was more efficient at identifying true sibling pairs, with the caveat that relatively high kinship indices were required to locate a true match.

25. Grimm D.J. (2007). The demographics of genetic surveillance: Familial DNA testing and the forensic community, *Columbia Law Review, 107*, 1164-1194.

Key Points and Findings:

1) Familial DNA searching (FS) will disproportionately affect the Hispanic community.
2) Hispanics represent the demographic group with the highest rate of natural population growth.
3) FS ensures that groups with more children and large families relative to other groups will be at higher risk for genetic surveillance.
4) Examines likely constitutional challenges to FS (Fourth and Fourteenth Amendments).
5) Asserts that U.S. DNA databank systems are not "racially neutral."

26. Greely H.T., Riordan D.P., Garrison N.A., Mountain J.L. (2006). Family ties: The use of DNA offender databases to catch offenders' kin, *J. Law Med. Ethics*, 248-262.

Key Points and Findings:

1) Familial searching has substantial potential to extend the usefulness of DNA databases in generating investigational leads from crime scene DNA.
2) Discusses the scientific basis for and plausibility of familial DNA searching techniques.
3) Identifies various unsettling political and legal arguments against familial searching.
4) FS puts African Americans under much greather investigational scrutiny due to their disproportionate representation in U.S. databases (which may not be unconstitutional, but seems unfair).
5) Racial implications of FS would disappear if a population-wide DNA identification database existed (but the legal, practical, and political obstacles to such a database are numerous).

27. Bieber F.R., Brenner C.H., Lazer D. (2006). Finding criminals through the DNA of their relatives, *Science, 312*, 1315-1316.

Key Points and Findings:

1) Authors demonstrate the potential value of kinship analysis for identifying promising leads in criminal investigations (via "Monte Carlo" simulations).
2) Simulations revealed that kinship analsysis can be used effectively to identify individuals in population databases who are the parents, children, or siblings of the source of DNA evidence.
3) Suggests that a familial search could be further refined by additional data (e.g., large numbers of SNPs).
4) Psychology and psychiatric studies indicate a strong probabilistic tendency between the chances of conviction of parents and their children, as well as among siblings.
5) U.S. Department of Justice survey revealed that 46% of jail inmates indicated that they have at least one close relative who is currently or has been incarcerated.

28. Haimes E. (2006). Social and ethical issues in the use of familial searching in forensic investigations: Insights from family and kinship studies, *J. Law Med. Ethics*, 263-276.

Key Points and Findings:

1) Offers the U.K. perspective on FS and identifies widespread international concerns about the cultural, ethical, and social implications of its use.
2) FS could be considered a violation of the privacy of the (potentially large) pool of possible relatives discovered via a familial search procedure, who would not otherwise be included in police investigations.
3) FS could reinforce views about the alleged prevalence of criminality within certain families or ethnic/racial groups.
4) FS could reveal the absence of a genetic link which individuals thought had existed, or conversely, could reveal a previously unknown genetic link between individuals.

5) U.S. critics contend that familial DNA searching introduces the possibility of "indirect lifelong surveillance of citizens" who will be included by association even though they have never been convicted of a crime.

6) Discusses issues related to adoption and assisted conception (and the secrecy associated with such cases).

7) Careful consideration should be taken when associations/links are identified via a familial search; personnel should be trained on how to appropriately use this information to advance a criminal investigation with minimal impact on the identified relative of the perpetrator.

News Reports

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2. **First Use of Familial DNA Test Leads to Charges in Serial Sex Assaults, *Milwaukee Wisconsin Journal Sentinel,* July 11, 2014. http://www.jsonline.com/news/crime/new-dna-technique-leads-to-serial-raper-charges-say-b99309491z1-266827171.html**

3. **Rules Needed for Familial DNA Testing, *The Post Crescent,* June 11, 2014. http://archive.postcrescent.com/article/20140612/APC0602/306120111/**

4. **Wisconsin DOJ Preparing for Familial DNA Testing, *Washington Times,* May 8, 2014. http://www.washingtontimes.com/news/2014/may/8/wisconsin-doj-preparing-for-familial-dna-testing/**

5. **Brother's DNA Leads to Rape Conviction in Williamsburg, *Time Dispatch,* February 22, 2014. http://www.timesdispatch.com/news/local/crime/brother-s-dna-leads-to-rape-conviction-in-williamsburg/article_90431ad3-5989-5122-b274-05805ea30a77.html**

6. **Seven Years for Taxi Rapist Trapped by Family DNA, *Yorkshire Post,* January 8, 2014. http://www.yorkshirepost.co.uk/news/main-topics/local-stories/seven-years-for-taxi-rapist-trapped-by-family-dna-1-2605538**

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10. **Double Rapist Caught 27 Years on After His Son Was Arrested for Separate Offence and Gave DNA Sample, *UK Mail Online,* April 12, 2013. http://www.dailymail.co.uk/news/article-2308073/Double-rapist-caught-27-years-SON-arrested-separate-offence-gave-DNA-sample.html**

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13. **Sacramento 'Roaming Rapist' Suspect Arrested 14 Years After First Attacks, *CBS Sacramento,* November 9, 2012. http://sacramento.cbslocal.com/2012/11/09/sacramento-county-sheriff-roaming-rapist-in-custody/**

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Familial DNA Searching: Success Stories

The table below lists many of the successes in solving violent crimes and cold cases with the use of familial DNA searching. Three of these cases resulted in the exoneration of wrongfully convicted individuals who had been imprisoned for numerous years for the crimes.

Recent Successes Using Familial DNA Searching to Solve Violent Crimes and Cold Cases

Year	Jurisdiction	Case/Defendant	Offense/Date
2002	U.K.	"Saturday Night Strangler" (Joseph Kappen)	serial rape/homicide (3 victims) (1973)
2003	U.K.	Jason Thomas Ward	rape/homicide (2002)
2003	U.K.	Jeffrey Gafoor	homicide (1988)
2004	U.K.	Daniel Alderson	rape (1992-1997)
2004	U.K.	Craig Harman	manslaughter (2003)
2004	North Carolina	Willard Brown*	rape/homicide (1984)
2005	Kansas	"BTK Killer" (Dennis Rader)	serial homicide (10 victims) (1974-1991)
2006	U.K.	"The Shoe Rapist" (James Lloyd)	serial rape (1980s)
2006	U.K.	Christopher Downes	rape (1984-1985)
2006	U.K.	Graham Darbyshire	rape (2 victims) (1993-1995)
2006	U.K.	Tahir Mahmood	rape (1993)
2006	U.K.	Ian O'Callaghan	rape/homicide (1994)
2007	U.K.	Ronald Castree**	rape/homicide (1975)
2007	U.K.	Geoffrey Godfrey	rape (1993)
2008	U.K.	Russell Bradbury	rape (1986)
2008	U.K.	Dale Burrows	rape (1989)
2008	New Zealand	Wayne Jarden	rape (2 victims) (1988-1996)
2008	U.K.	Derek Young	serial rape (3 victims) (1990-1994)
2008	U.K.	James Ben Davies	serial rape (3 victims) (1998-2000)
2008	U.K.	David Newton	serial rape (3 victims) (1997-2006)
2009	U.K.	David Lace***	homicide (1979)
2009	U.K.	Robert Morley	homicide (1985)
2009	U.K.	Harry Musson	rape (1990)
2009	New Zealand	Joseph Reekers	homicide (2001)
2009	Denver, Colorado	Luis Jaimes-Tinajero	automobile thefts
2010	U.K.	Paul Stewart Hutchinson	homicide (1983)
2010	U.K.	Phil Collins	rape (1990)
2010	U.K.	"Isle of Wight Rapist" (Keith Davison)	rape (1990)
2010	California	"The Grim Sleeper" (Lonnie David Franklin Jr.)	serial homicide (10 victims) (1985-2010)
2011	U.K.	Robert Saint	rape (1989)
2011	California	Elvis Lorenzo Garcia	rape (2008)
2011	U.K.	Kevin Holmes	rape (2010)
2012	California	James Brown	rape/homicide (1978)
2012	U.K.	"Pot-bellied Rapist" (Michael Acey)	rape (1984)
2012	U.K.	David Bryant	kidnapping/rape (4 victims) (1982-1995)
2012	Texas	Jack Wesley Melton	homicide (1994)
2012	U.K.	Jon Molt	rape (1997)
2012	U.K.	Keith Henderson	rape (2001)
2012	California	"Roaming Rapist of Sacramento" (Dereck Sanders)	serial rape (10 victims) (1998-2003)
2013	U.K.	Barry Howell	rape (1989)
2013	U.K.	Salvador Orozco	rape (1990)
2013	U.K.	Ian Phipps	rape (2 victims) (1986-1991)
2013	U.K.	Hilland Matthews	rape (1992)
2014	Virginia	Tyrone Lamont Holloway	rape (2001)
2014	Wisconsin	Michael L. Dixon	serial rape (2002-2012)
2014	Wisconsin	Antoine Devon Pettis	rape (2014)

***Led to the exoneration of Darryl Hunt, who was wrongfully convicted and spent 18 years in prison for the crime.**

****Led to the exoneration of Stefan Kiszko, who was wrongfully convicted and sentenced to 16 years in prison for the crime.**

*****Led to the exoneration of Sean Hodgson, who was wrongfully convicted and spent 27 years in prison for the crime.**

Appendix B. Biographies of Project Team

Bruce Budowle

Dr. Bruce Budowle received a PhD in genetics in 1979 from Virginia Polytechnic Institute and State University. From 1979-1982, Dr. Budowle was a postdoctoral fellow at the University of Alabama at Birmingham. Working under a National Cancer Institute fellowship, he carried out research predominately on genetic risk factors for such diseases as insulin-dependent diabetes mellitus, melanoma, and acute lymphocytic leukemia.

In 1983, Dr. Budowle joined the research unit at the FBI Laboratory Division to carry out research, development, and validation of methods for forensic biological analyses. The positions he has held at the FBI include research chemist, program manager for DNA research, chief of the Forensic Science Research Unit, and the senior scientist for the Laboratory Division of the FBI. Dr. Budowle has contributed to the fundamental sciences as they apply to forensics in analytical development, population genetics, statistical interpretation of evidence, and quality assurance. Some of his technical efforts have been (1) developing analytical assays for typing myriad protein genetic marker systems; (2) designing electrophoretic instrumentation; (3) developing molecular biology analytical systems to include RFLP typing of VNTR loci and PCR-based SNP assays, VNTR and STR assays, and direct sequencing methods for mitochondrial DNA; (4) developing new technologies; and (5) designing image analysis systems. Dr. Budowle has worked on laying some of the foundations for the current statistical analyses in forensic biology and defining the parameters of relevant population groups. He has published more than 500 articles; made more than 650 presentations (many of which were as an invited speaker at national and international meetings); and testified in well over 250 criminal cases in the areas of molecular biology, population genetics, statistics, quality assurance, and forensic biology. In addition, he has authored or co-authored books on molecular biology techniques, electrophoresis, protein detection, and microbial forensics. Dr. Budowle has been involved directly in developing quality assurance (QA) standards for the forensic DNA field. He has been a chair and member of the Scientific Working Group on DNA Methods, chair of the DNA Commission of the International Society of Forensic Genetics, and a member of the DNA Advisory Board. He was one of the initial architects of the CODIS National DNA Database, which maintains DNA profiles from convicted felons, from evidence in unsolved cases, and from missing persons.

Some of Dr. Budowle's efforts over the last decade also are in counterterrorism, including identification of victims from mass disasters and in efforts involving microbial forensics and bioterrorism. Dr. Budowle was an advisor to New York State in the effort to identify the victims from the WTC attack. In the area of microbial forensics, Dr. Budowle has been the chair of the Scientific Working

Group on Microbial Genetics and Forensics, whose mission was to set QA guidelines, develop criteria for biologic and user databases, set criteria for a National Repository, and develop forensic genomic applications. He also has served on the Steering Committee for the Colloquium on Microbial Forensics sponsored by the American Society of Microbiology, as an organizer of four Microbial Forensics Meetings held at The Banbury Center in the Cold Spring Harbor Laboratory, and on steering committees for NAS-sponsored meetings.

In 2009, Dr. Budowle became executive director of the Institute of Applied Genetics and professor in the Department of Molecular and Medical Genetics at the University of North Texas Health Science Center at Fort Worth, Texas. His current efforts focus on the areas of human forensic identification, microbial forensics, and emerging infectious disease.

Rockne P. Harmon

Mr. Rockne P. Harmon is currently employed as a consultant to numerous law enforcement agencies dealing with cold case investigation and other issues related to forensic DNA typing. He is currently an instructor at U.C. Davis in the Masters in Forensic Science program. He retired in 2007 after a 33-year career as a senior deputy district attorney for Alameda County, California.

Mr. Harmon graduated from the United States Naval Academy in 1967 and served four years active duty. He served a combat tour in Vietnam as Officer in Charge of a Navy Swift Boat and received the Purple Heart for wounds received in combat. After his military service, he attended the University of San Francisco School of Law and graduated in 1974. He is a fellow of the American Academy of Forensic Sciences.

Mr. Harmon was the prosecutor in a triple murder case that established the general acceptance of conventional serological methods, the precursor to today's DNA technology (People v. Lawrence Reilly). As a result of that case, he was in a position to assist the forensic science community as it began the implementation of DNA typing soon thereafter. He has written and lectured extensively on the subject of the admissibility of forensic evidence, particularly DNA evidence. In 1998, he received an award from the FBI director for his efforts supporting the FBI in their first decade of DNA typing. In 2003, he received the Achievement Award from the International Homicide Investigators' Association for his work on cold cases. He was the chairman of the California District Attorneys' Association Forensic Science Committee and was on the Advisory Board to the International Homicide Investigators' Association for many years. At Alameda County, he developed a highly successful protocol for solving old or unsolved cases using DNA typing. He was the driving force behind the California Attorney General's decision to implement familial DNA searching in California, which led to the arrest of the

"Grim Sleeper" serial killer in 2010. Mr. Harmon was one of the prosecutors in People v. O. J. Simpson.

Patricia Melton

Dr. Patricia Melton is currently a senior research forensic scientist in the Center for Forensic Sciences at RTI International. In this capacity, she implements and procures educational courses to facilitate the knowledge transfer of current forensic DNA technology to law enforcement and judicial practitioners. She also serves as a project team member for the knowledge transfer and best practices development within the forensic community for responses to sexual assaults. Dr. Melton possesses the following specialized skills in forensic sciences: serological screening for biological fluids; nuclear DNA extraction of swabs; bloodstains, tissue, bone, hair roots, and teeth; and nuclear DNA extraction from "touch" DNA samples. In addition, she has specialized skills in short tandem repeat (STR) analysis. Dr. Melton has experience with providing courtroom testimonies and exceeds the education requirements for a DNA Forensic Casework Analyst as established by the FBI Quality Assurance Standards. Dr. Melton has been on the faculty of two universities and actively participates in the certification program for crime laboratories under the American Society of Crime Laboratory Directors/Laboratory Accreditation Board (ASCLAD/LAB) regulations and requirements (legacy and International Organization for Standardization [ISO] programs).

Shane Hamstra

Mr. Shane T. Hamstra has more than 10 years of professional experience in media production and training development. He is currently a training specialist in RTI's Center for Forensic Sciences (CFS). He serves as the online training production manager to oversee project development and delivery through on-demand, live online, and on-site workshop channels. Mr. Hamstra manages production schedules and directives to meet critical deadlines and ensure the completion of deliverables for the successful release of each training opportunity. Before joining RTI, he managed productions for national cable networks such as the *National Geographic Channel* and the *Discovery Channel*, independent films, and educational training and corporate videos. In his previous and current work, Mr. Hamstra coordinates with subject matter experts, graphic artists, instructional designers, Web developers, voice talent, recording engineers, and editorial resources to bring projects to fruition.

Angie Ambers

Dr. Angie Ambers received her PhD in molecular biology from the University of North Texas (UNT) with an emphasis in forensic genetics and human identification. Her dissertation involved an

investigation of methods (e.g., whole genome amplification, DNA repair) for improving autosomal and Y-STR typing of degraded and low copy DNA from human skeletal remains and environmentally-damaged biological materials. Dr. Ambers also has master's degrees in forensic genetics from the University of North Texas Health Science Center and in criminology from the University of Texas at Arlington. Her thesis research involved developing and optimizing a DNA-based multiplex screening tool for the separation of fragmented and commingled skeletal remains. Since 2005, Dr. Ambers has been an adjunct professor at the University of North Texas (teaching genetics, heredity, and human anatomy and physiology). In 2008, she developed the curriculum for a course in forensic molecular biology, in which she teaches DNA analysis/methodology to undergraduate students enrolled in the FEPAC-accredited forensic science certificate program. Before pursuing her doctorate, Dr. Ambers was lead DNA analyst and lab manager of UNT's DNA Sequencing Core Facility, and during that time, she had the opportunity to work on various ancient DNA projects involving archaeological specimens from Greenland. Her latest work has involved DNA testing of various historical human skeletal remains, including those of an American Civil War guerrilla scout, several Finnish World War II soldiers, and unidentified late-19th-century skeletal remains discovered in Deadwood, South Dakota. Dr. Ambers is currently a postdoctoral fellow at the Institute of Applied Genetics (IAG) at the University of North Texas Health Science Center.

Appendix C. Familial DNA Searching: Current Approaches – Webinar Session 1

RTI INTERNATIONAL

www.rti.org

Event Performance Statement

Familial DNA Searching: Current Approaches - Session One

NIJ Live Online Workshop

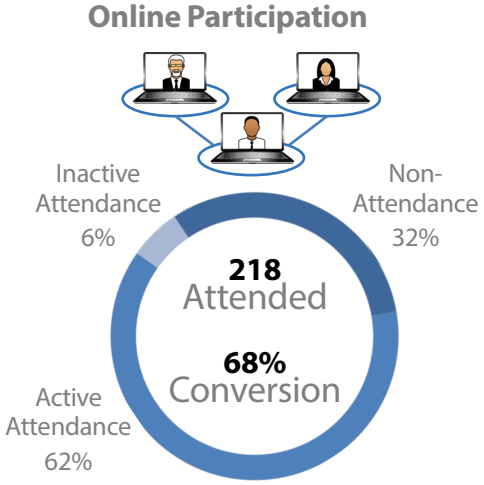
MAY 29
2014

2 PM ET
Duration: 90 minutes

Format: Live Online
Registration Maximum: 700 for Online

This four-part panel discussion series will elucidate the current landscape of policies and procedures addressing familial DNA searching. These discussions will be used to generate a report designed to educate legal professionals, policy makers, law enforcement and forensic laboratory practitioners of state and local agencies about the current issues, approaches and positions involved with familial DNA searches as they apply to criminal investigations. As the decision to employ and how to employ familial DNA searching varies from state to state, we will discuss the various policies and practices associated with familial DNA searches including technical considerations, legal challenges, comparison with other types of DNA searches and implementation ramifications.

Attendee Interactivity Rate



Instruction Minutes: 19,944
Activity Minutes: 31,900
Registered: 319

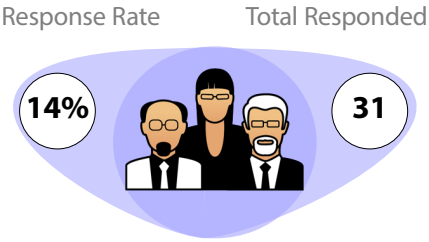
Each event is tracked by the following:
Non-attendance rate: Those who registered but did not attend divided by registration (an indication of conversion from registration to attendance).

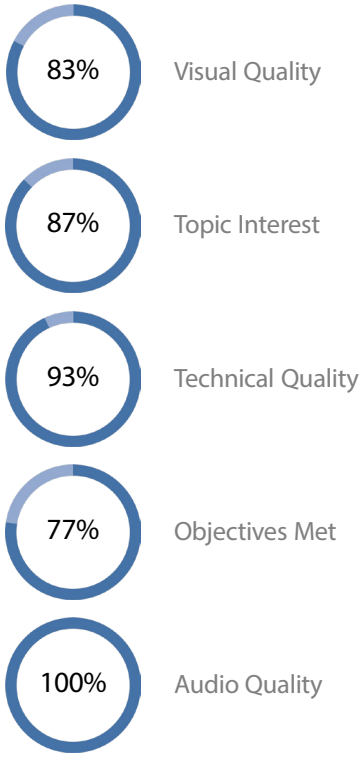
Active attendance rate: Rate at which registrants attend and interact consistently throughout the event. For a day-long event, we expect this rate to be lower because attendees will attend sessions of interest, but not necessarily the entire date. For perspective, we see inactive attendance rates for purely online, 90-minute events of ~5%.

Inactive attendance rate: Rate at which registrants attend but do not stay active for the entire event. We do not have the ability to estimate this interaction of on-site attendees.

Satisfaction

Our standard survey consists of 17 questions. The questions reflecting the overall performance are shown below.

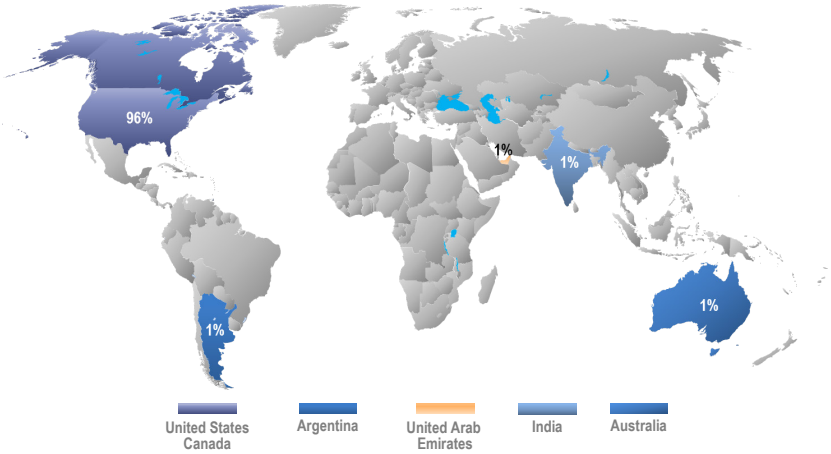




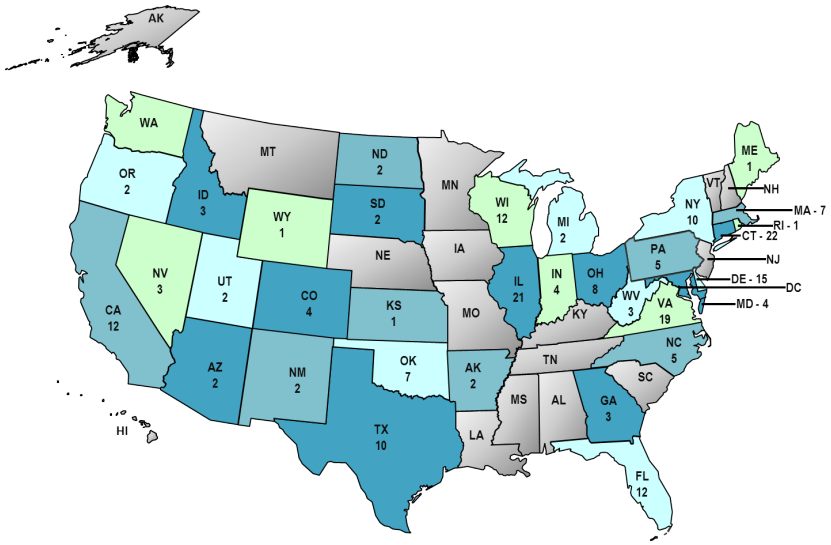
Attendance

Values are a percentage of the attendees throughout the day.

International Online Attendance

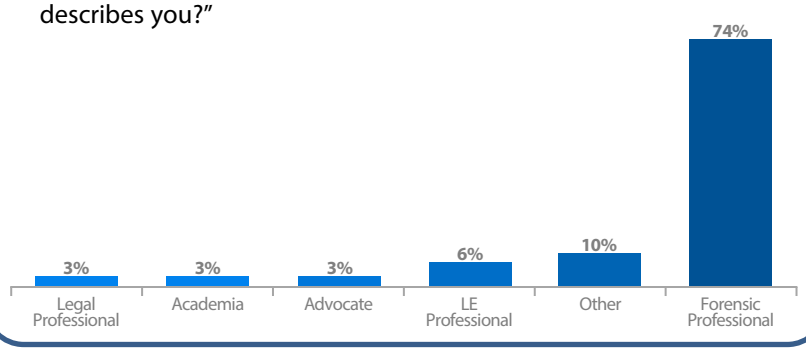


U.S. Online Attendance



Which Best Describes You?

At the beginning of each event attendees are polled "Which best describes you?"



"The biggest benefit was gaining information on the current status of the use of familial searching and hearing from the states that have been successful using this type of search."

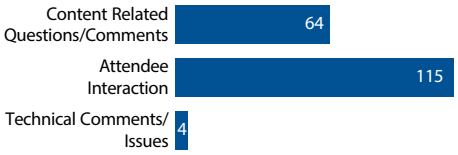
—Online Attendee Response

"Beginning a series of training for our work in helping family members of missing persons to get answers.. my mentally ill brother is missing 28 years and I am working with NAMUS and hope to work on the overall DNA and ID issues in our state for all needs."

—Online Attendee Response

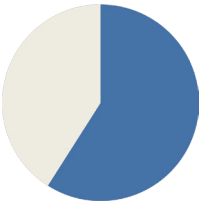
Chat Interactions

An open chat is used in each event. The host and ghost host encourage interaction from attendees to the subject matter expert. New conversation topics brought up by attendees will be extracted from the chat and further discussed.



Chatter

Based on 1 hour and 30 minutes of content delivered



1 chat every .55 minutes

Contact

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866.252.8415

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Research Triangle Park, NC
27709-2194 USA

Event Performance Statement

Appendix D. Familial DNA Searching: Current Approaches – Webinar Session 2

RTI INTERNATIONAL

www.rti.org

Event Performance Statement

Familial DNA Searching: Current Approaches - Session Two

NIJ Live Online Workshop

JUNE 26
2014

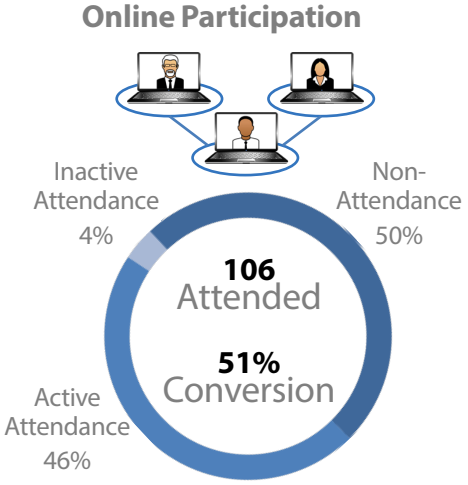
1 PM EST
Duration: 120 minutes

Format: Live Online
Registration Maximum: 600 for Online

This four-part panel discussion series will elucidate the current landscape of policies and procedures addressing familial DNA searching. These discussions will be used to generate a report designed to educate legal professionals, policy makers, law enforcement and forensic laboratory practitioners of state and local agencies about the current issues, approaches and positions involved with familial DNA searches as they apply to criminal investigations.

In this particular session, the discussion topic will focus around current existing protocols and specifically address questions such as; what are the established familial DNA searching processes, how were these processes established and how do these processes address privacy concerns as well as what role did the SWGDAM Familial Search Recommendations play in the development of these processes?

Attendee Interactivity Rate



Instruction Minutes: 11,773
Activity Minutes: 25,200
Registered: 210

Each event is tracked by the following:
Non-attendance rate: Those who registered but did not attend divided by registration (an indication of conversion from registration to attendance).

Active attendance rate: Rate at which registrants attend and interact consistently throughout the event. For a day-long event, we expect this rate to be lower because attendees will attend sessions of interest, but not necessarily the entire date. For perspective, we see inactive attendance rates for purely online, 90-minute events of ~5%.

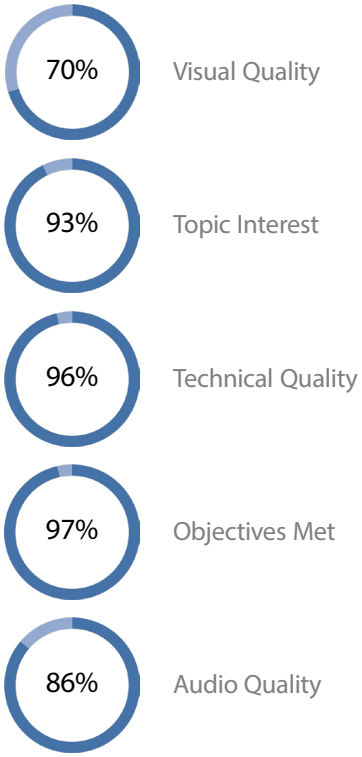
Inactive attendance rate: Rate at which registrants attend but do not stay active for the entire event. We do not have the ability to estimate this interaction of on-site attendees.

Satisfaction

Our standard survey consists of 17 questions. The questions reflecting the overall performance are shown below.

Response Rate 27%

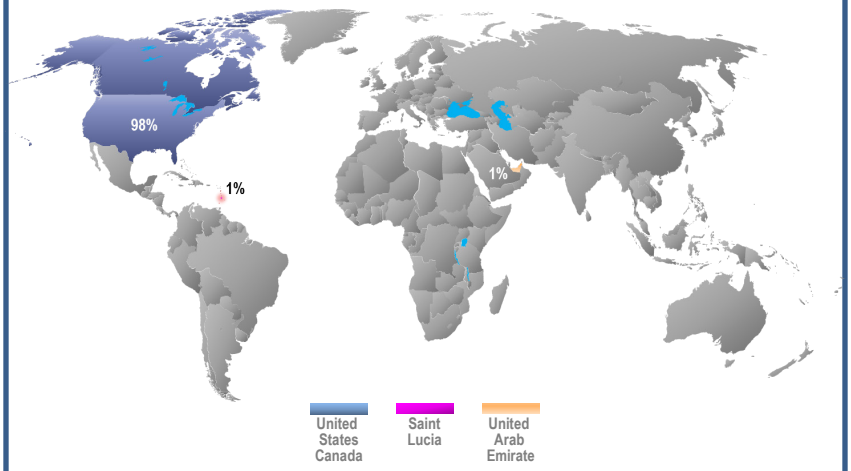
Total Responded 29



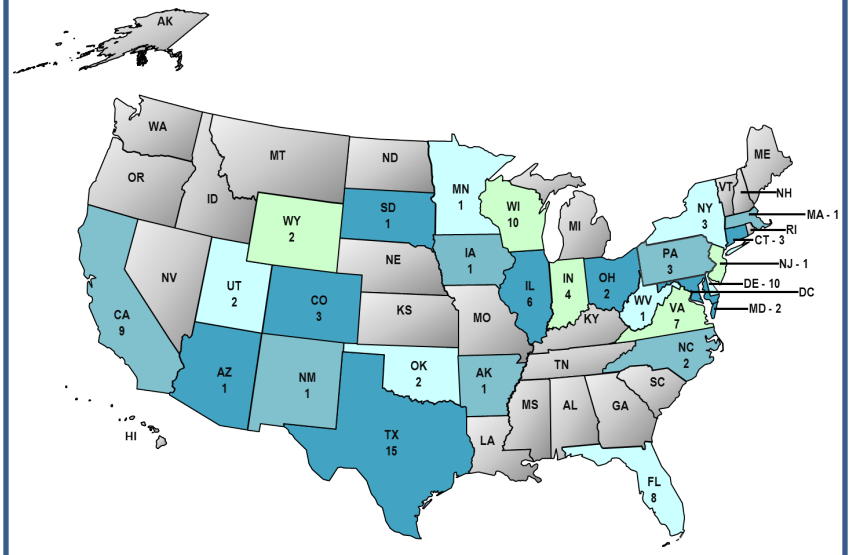
Attendance

Values are a percentage of the attendees throughout the day.

International Online Attendance

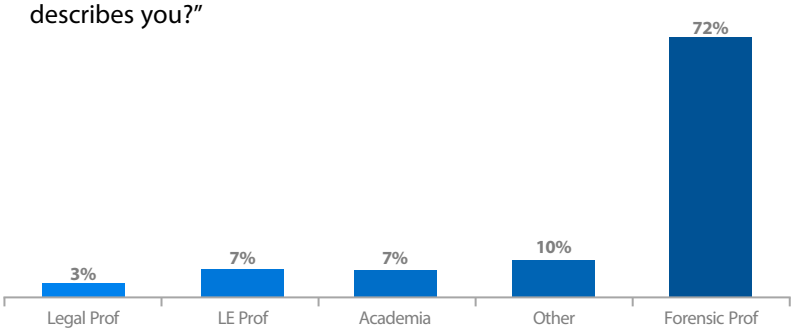


U.S. Online Attendance



Which Best Describes You?

At the beginning of each event attendees are polled "Which best describes you?"



"I think that it was good to hear from the New York lawyers who seem to oppose FS in all instances. I'm not sure that I understand their concerns - given that the states that are doing FS are using Y-STR testing to narrow the "list" down to one or two "good" candidates. At any rate, I appreciated the fact that the New York lawyers were given a "seat at the table"."

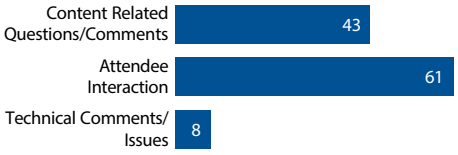
—Online Attendee Response

"What benefitted me was having my management and attorneys in the county all hearing the same info I have been hearing at conferences."

—Online Attendee Response

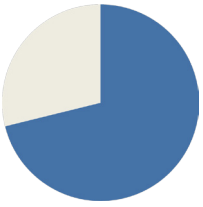
Chat Interactions

An open chat is used in each event. The host and ghost host encourage interaction from attendees to the subject matter expert. New conversation topics brought up by attendees will be extracted from the chat and further discussed.



Chatter

Based on 1 hour and 20 minutes of content delivered



1 chat every 1.07 minutes

Contact

Center for Forensic
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866.252.8415

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3040 E. Cornwallis Road, PO Box 12194
Research Triangle Park, NC
27709-2194 USA

Event Performance Statement

Appendix E. Familial DNA Searching: Current Approaches – Webinar Session 3

RTI INTERNATIONAL

www.rti.org

Event Performance Statement

Familial DNA Searching: Current Approaches - Session Three

NIJ Live Online Workshop

JUL 17
2014

1 PM ET
Duration: 120 minutes

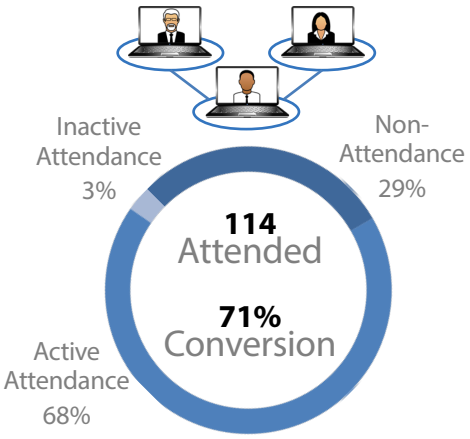
Format: Live Online
Registration Maximum: 600 for Online

This four-part panel discussion series will elucidate the current landscape of policies and procedures addressing familial DNA searching. These discussions will be used to generate a report designed to educate legal professionals, policy makers, law enforcement and forensic laboratory practitioners of state and local agencies about the current issues, approaches and positions involved with familial DNA searches as they apply to criminal investigations. As the decision to employ and how to employ familial DNA searching varies from state to state, we will discuss the various policies and practices associated with familial DNA searches including technical considerations, legal challenges, comparison with other types of DNA searches and implementation ramifications.

In this particular session, the discussion topics will focus around the process of investigative follow up from these leads including costs and resources, methods of communication from all parties involved, and the release of information.

Attendee Interactivity Rate

Online Participation



Instruction Minutes: 13,124
Activity Minutes: 19,320
Registered: 161

Each event is tracked by the following:
Non-attendance rate: Those who registered but did not attend divided by registration (an indication of conversion from registration to attendance).

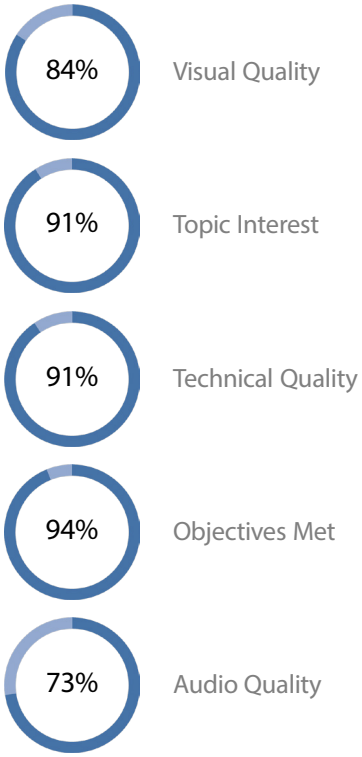
Active attendance rate: Rate at which registrants attend and interact consistently throughout the event. For a day-long event, we expect this rate to be lower because attendees will attend sessions of interest, but not necessarily the entire date. For perspective, we see inactive attendance rates for purely online, 90-minute events of ~5%.

Inactive attendance rate: Rate at which registrants attend but do not stay active for the entire event. We do not have the ability to estimate this interaction of on-site attendees.

Satisfaction

Our standard survey consists of 17 questions. The questions reflecting the overall performance are shown below.

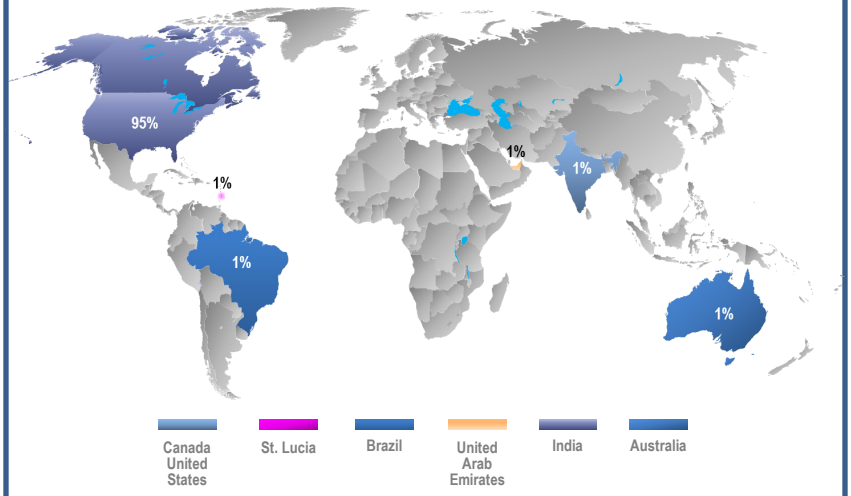
Response Rate | Total Responded



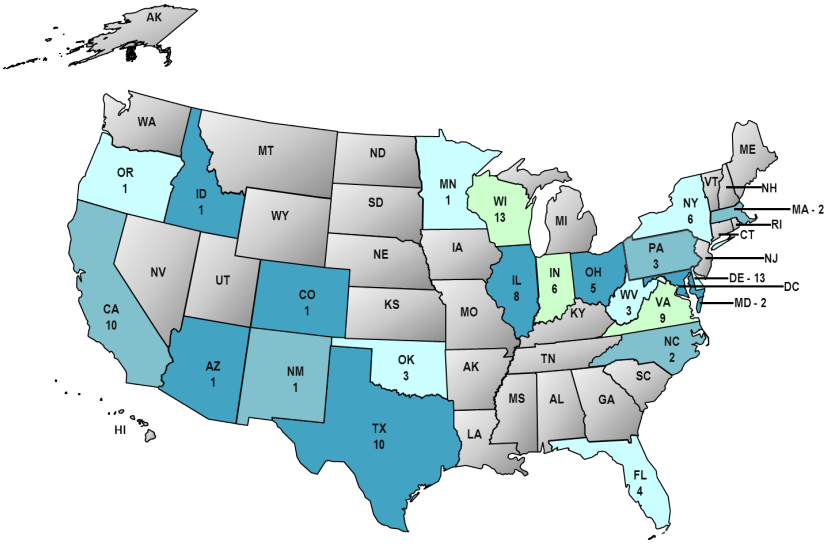
Attendance

Values are a percentage of the attendees throughout the day.

International Online Attendance

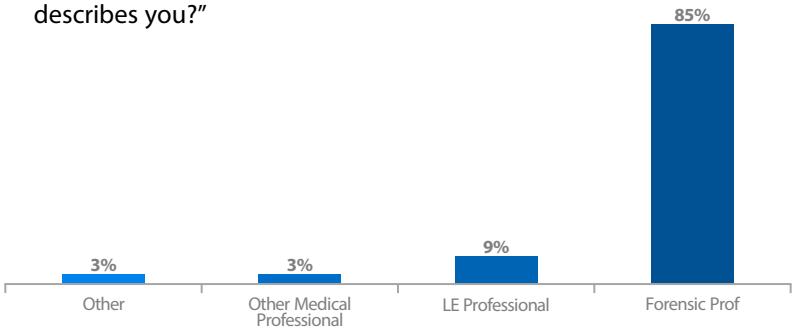


U.S. Online Attendance



Which Best Describes You?

At the beginning of each event attendees are polled "Which best describes you?"



"Good technical knowledge gained specifically about protocols. I may be tasked with validating familial searching software for my lab soon, and the topic was very pertinent and timely."

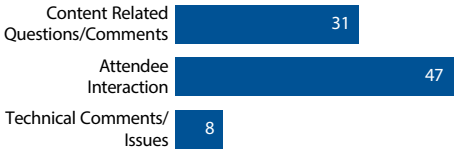
—Online Attendee Response

"Great to hear how other agencies are using this tool. Will help us tremendously if we ever get to do it also."

—Online Attendee Response

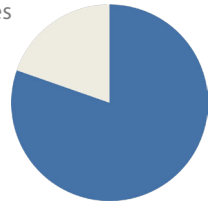
Chat Interactions

An open chat is used in each event. The host and ghost host encourage interaction from attendees to the subject matter expert. New conversation topics brought up by attendees will be extracted from the chat and further discussed.



Chatter

Based on 120 minutes of content delivered



1 chat every 1.36 minutes

Contact

Center for Forensic
cfs-forensic-ed@rti.org
866.252.8415

RTI International
3040 E. Cornwallis Road, PO Box 12194
Research Triangle Park, NC
27709-2194 USA

Event Performance Statement

Appendix F. Familial DNA Searching: Current Approaches – Webinar Session 4

Familial DNA Searching: Current Approaches - Session Four

NIJ Live Online Event

AUG 21
2014

1 PM ET
Duration: 120 minutes

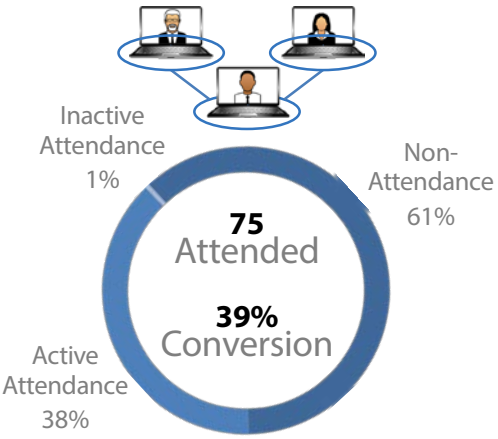
Format: Live Online
Registration Maximum: 600 for Online

This four-part panel discussion series will elucidate the current landscape of policies and procedures addressing familial DNA searching. These discussions will be used to generate a report designed to educate legal professionals, policy makers, law enforcement and forensic laboratory practitioners of state and local agencies about the current issues, approaches and positions involved with familial DNA searches as they apply to criminal investigations. As the decision to employ and how to employ familial DNA searching varies from state to state, we will discuss the various policies and practices associated with familial DNA searches including technical considerations, legal challenges, comparison with other types of DNA searches and implementation ramifications.

In this particular session, the discussion topics will focus around current technical protocols including software considerations, candidate thresholds derived by likelihood ratio and allele counting, as well as addressing the number of candidates and subsequent analysis to reduce the number of potential candidates including the role of Y STR and mtDNA analysis.

Attendee Interactivity Rate

Online Participation



Instruction Minutes: 8,877
Activity Minutes: 23,400
Registered: 195

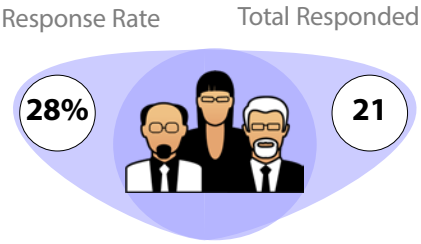
Each event is tracked by the following:
Non-attendance rate: Those who registered but did not attend divided by registration (an indication of conversion from registration to attendance).

Active attendance rate: Rate at which registrants attend and interact consistently throughout the event. For a day-long event, we expect this rate to be lower because attendees will attend sessions of interest, but not necessarily the entire date. For perspective, we see inactive attendance rates for purely online, 90-minute events of ~5%.

Inactive attendance rate: Rate at which registrants attend but do not stay active for the entire event. We do not have the ability to estimate this interaction of on-site attendees.

Satisfaction

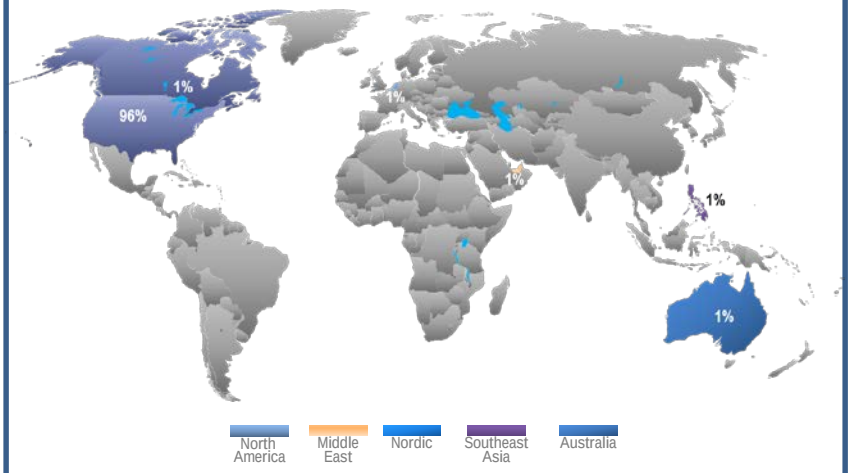
Our standard survey consists of 17 questions. The questions reflecting the overall performance are shown below.



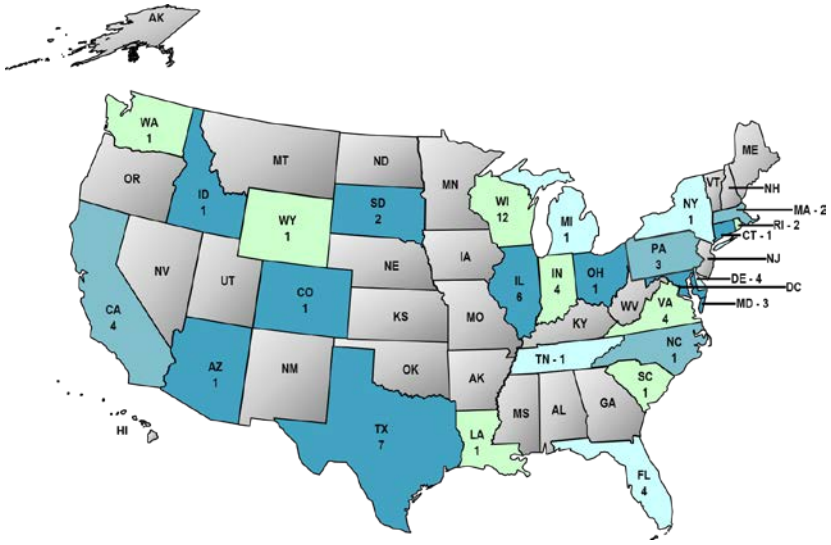
Attendance

Values are a percentage of the attendees throughout the day.

International Online Attendance

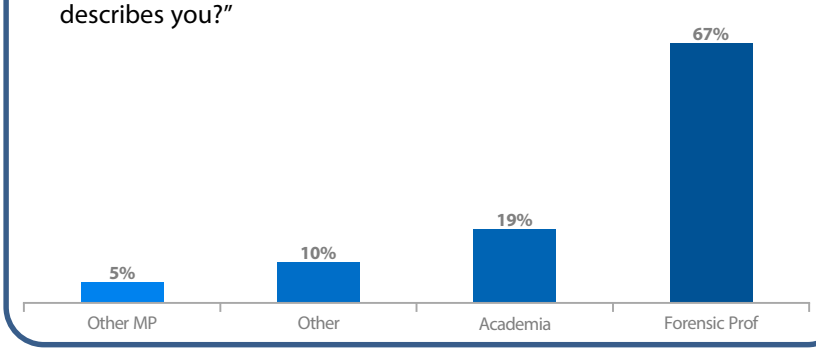


U.S. Online Attendance



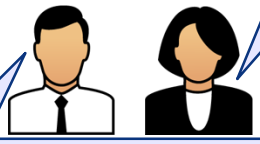
Which Best Describes You?

At the beginning of each event attendees are polled "Which best describes you?"



"This RTI training is the best use of taxpayer money ever-ever as it trains me and there is never a charge to the FBI or INTERPOL for our work. The rest of the Feds should run as frugal as this. Thanks RTI."

—Online Attendee Response

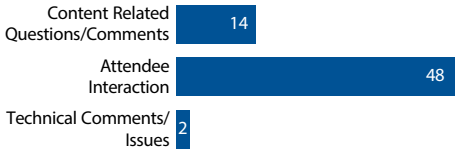


"The biggest benefit was that we were able to obtain additional information about familial searching that is critical for my lab as we will be doing familial searching within the next year."

—Online Attendee Response

Chat Interactions

An open chat is used in each event. The host and ghost host encourage interaction from attendees to the subject matter expert. New conversation topics brought up by attendees will be extracted from the chat and further discussed.



Chatter

Based on 2 hours of content delivered

1 chat every 1.87 minutes

Contact

Center for Forensic
cfs-forensic-ed@rti.org
866.252.8415

RTI International
3040 E. Cornwallis Road, PO Box 12194
Research Triangle Park, NC
27709-2194 USA

Appendix G. Familial DNA Searching: Current Approaches – Combined Webinar Sessions

www.rti.org

Event Performance Statement

Familial DNA Searching: Current Approaches - All Sessions

NIJ Live Online Workshop

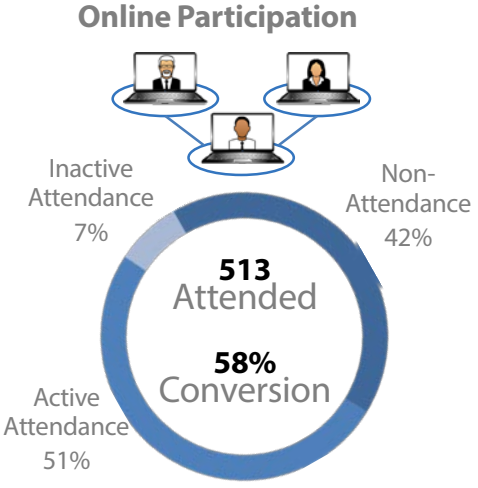
5/29, 6/26, 7/17, 8/21
2014

1 PM ET each day
Duration: 120 minutes each

Format: Live Online
Registration Maximum: 500 for Online

This four-part panel discussion series will elucidate the current landscape of policies and procedures addressing familial DNA searching. These discussions will be used to generate a report designed to educate legal professionals, policy makers, law enforcement and forensic laboratory practitioners of state and local agencies about the current issues, approaches and positions involved with familial DNA searches as they apply to criminal investigations. As the decision to employ and how to employ familial DNA searching varies from state to state, we will discuss the various policies and practices associated with familial DNA searches including technical considerations, legal challenges, comparison with other types of DNA searches and implementation ramifications.

Attendee Interactivity Rate



Instruction Minutes: 53,718
Activity Minutes: 106,200
Registered: 885

Each event is tracked by the following:
Non-attendance rate: Those who registered but did not attend divided by registration (an indication of conversion from registration to attendance).

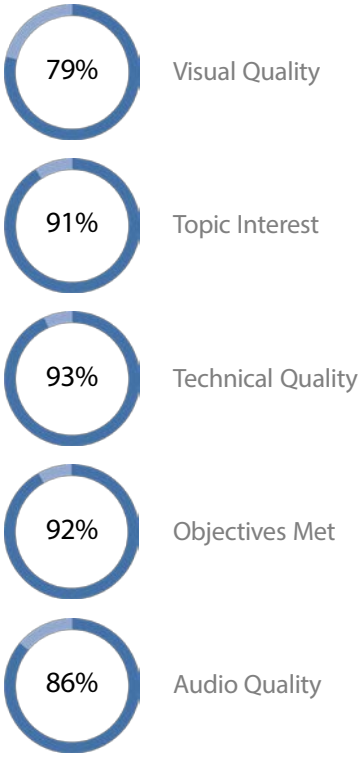
Active attendance rate: Rate at which registrants attend and interact consistently throughout the event. For a day-long event, we expect this rate to be lower because attendees will attend sessions of interest, but not necessarily the entire date. For perspective, we see inactive attendance rates for purely online, 90-minute events of ~5%.

Inactive attendance rate: Rate at which registrants attend but do not stay active for the entire event. We do not have the ability to estimate this interaction of on-site attendees.

Satisfaction

Our standard survey consists of 17 questions. The questions reflecting the overall performance are shown below.

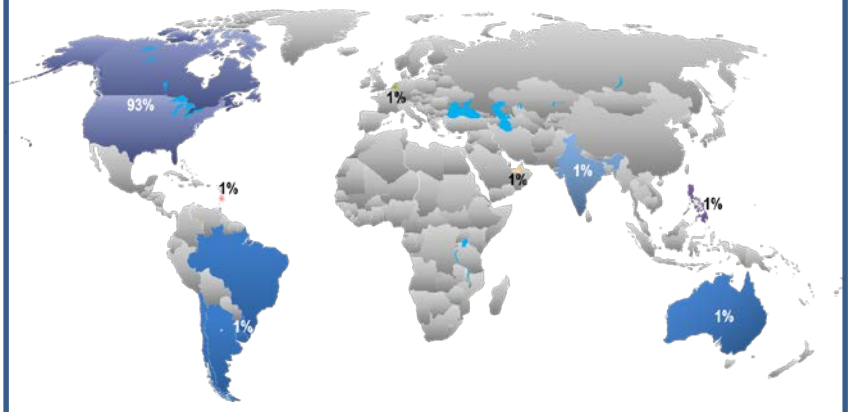
Response Rate | Total Responded



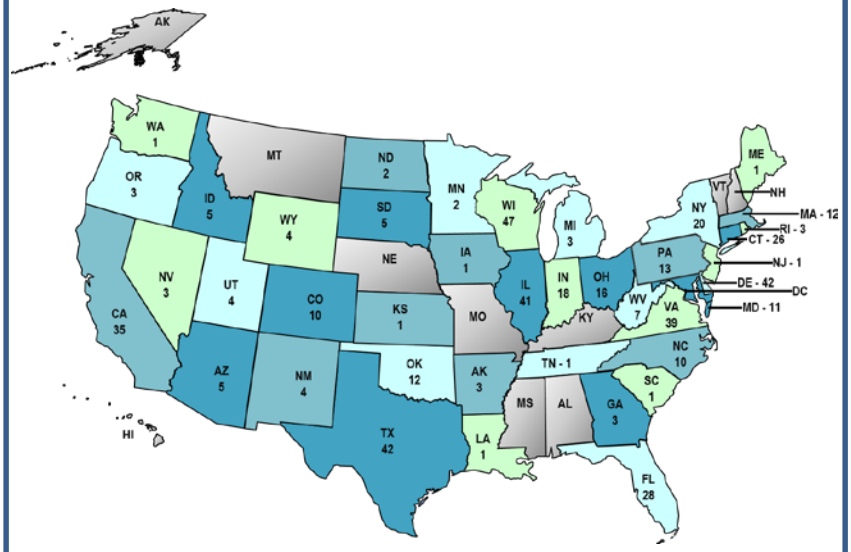
Attendance

Values are a percentage of the attendees throughout the day.

International Online Attendance

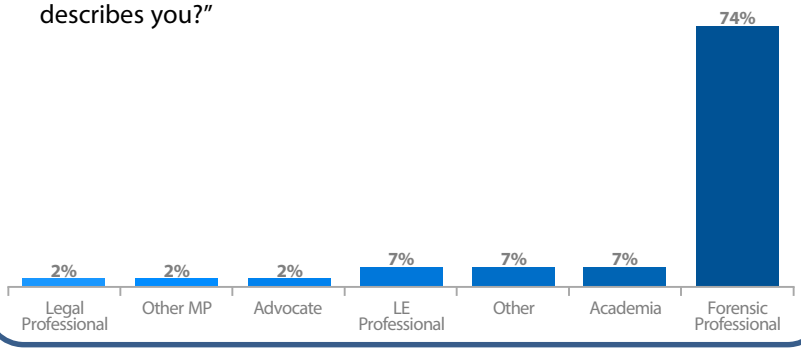


U.S. Online Attendance

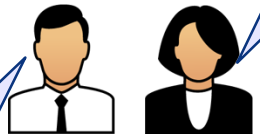


Which Best Describes You?

At the beginning of each event attendees are polled "Which best describes you?"



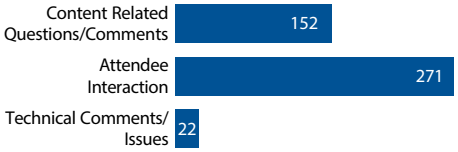
"The biggest benefit was gaining information on the current status of the use of familial searching and hearing from the states that have been successful using this type of search."
—Online Attendee Response



"Good technical knowledge gained specifically about protocols. I may be tasked with validating familial searching software for my lab soon, and the topic was very pertinent and timely."
—Online Attendee Response

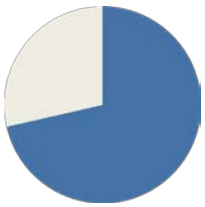
Chat Interactions

An open chat is used in each event. The host and ghost host encourage interaction from attendees to the subject matter expert. New conversation topics brought up by attendees will be extracted from the chat and further discussed.



Chatter

Based on 480 minutes of content delivered



1 chat every 1.08 minutes

Contact

Center for Forensic
cfs-forensic-ed@rti.org
866.252.8415

RTI International
3040 E. Cornwallis Road, PO Box 12194
Research Triangle Park, NC
27709-2194 USA

Event Performance Statement

Appendix H. Familial DNA Shared Protocols

California Department of Justice (DOJ) Familial Searching Policy

Bureau of Forensic Services

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Section Title: CODIS Unit Technical Procedures Issued by: Jill Spriggs, Bureau Chief	Issue Date: 10/27/08	Revision 0.1

Familial Search Procedure

Familial Search: Introduction

This document outlines the steps to be followed when conducting a search of CA SDIS (CAL-DNA) for the purpose of attempting to identify a putative perpetrator of a crime by comparing a forensic unknown profile with offender profile(s) that may be from a genetic relative. This process is known as "familial searching." Familial searching is the last resort in the use of the offender database when attempting to identify the perpetrator of an unsolved crime.

DOJ Familial Search Policy

Based on the recommendations of the Bureau of Forensic Services (BFS) Partial Match and Familial Search Committee (PM&FSC), the Division of Law Enforcement (DLE) Bulletin 2008-BFS-01 was issued on April 24, 2008 (Appendix 5E) documenting the California Department of Justice (DOJ) policy on partial matches and familial searching.

The Bureau of Forensic Services subsequently renamed the PM&FSC as the Familial Search Committee (or FSC, per Memorandum dated 10-24-08, Appendix 5F), to execute and implement the DOJ policy in 2008-BFS-01. This section of the CODIS Unit Technical Procedure is a direct result of the FSC's work with the assistance of a Familial Search Technical Support Group (TSC) comprising members of Jan Bashinski DNA Laboratory staff, supervision and management.

Familial Search Process

When invoked, after all other leads have failed, the objective of this procedure is to obtain a candidate offender or limited list of candidates, who may be related to the true perpetrator of a crime, through the use of the convicted offender database. As part of this process the initial candidate list of offenders' DNA samples will be profiled for Y-STR type. The samples to be tested are selected by priority based primarily on kinship indices, but may include an evaluation of the numbers of shared alleles. Any offenders not eliminated by the Y-STR type comparison could be patrilineally related to the true perpetrator and will be candidates for further investigation and consideration as potential genetic relatives of the true perpetrator. This process is designed to provide the most useful investigative lead(s) while limiting the number of potential contacts with individuals not related to the perpetrator.

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Familial Search Procedure, Continued

Confidentiality

Beyond the rigorous restrictions already imposed on Data Bank Program employees concerning disclosure of information, the results of the familial search conducted by the CODIS Unit and subsequent Y-STR typing, if any, will be released only to the Familial Search Committee via the Chair or designee. Any wider distribution of results or data will occur only at the direction of the Chair. This precludes direct contact with the submitting laboratory by the CODIS Unit, in contrast to routine CODIS searching and operations. Because CODIS autosearch software is not utilized in the familial search process there is no automatic notification of the LDIS laboratory of the results of the familial search. Direct contact with law enforcement or the prosecution will always be made by the FSC as opposed to the usual involvement of the CODIS Unit. The FSC Chair generally retains the authority to release any familial search information to client groups in accordance with policy.

Practical Considerations

The chance of success in identifying a genetic relative of a perpetrator in the existing offender database is affected by these practical considerations:

1. There may be no such genetic relative in the database at the time of the search.
2. Estimates of the likelihood of familial relationships are made based on the sharing of STR alleles and the rarity of those alleles.
3. The search for genetic relatives is practical only for "first degree" relatives, i.e., full sibs (sharing both parents) and parent/child relationships.

In contrast to the identification of a putative perpetrator (or an identical twin) as a result of a confirmed offender hit, the output of a familial search can only indicate whether a statistically significant potential exists that an offender in the database may be a relative of the true putative perpetrator, based on the specific forensic unknown DNA profile submitted. Since multiple offenders' profiles may yield similar statistical results for kinship or allele sharing when compared to the forensic unknown STR profiles, further extensive investigation may be necessary to even confirm the existence of relatives to the offender identified via familial search, as well as to determine whether any of that offender's relatives could have committed the crime. In any case, the results represent another form of an investigative lead in the investigation, rather than a more direct association or identification of an offender.

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Familial Search Procedure, Continued

Documentation of Familial Search Process, Results & Communications

Throughout the process of conducting any familial searches in CAL-DNA or in the resolution of partial matches, the following requirements for documentation will be met:

- Lists of the specimen identifiers (Spec Ids) of the candidate offenders' will be retained and included in the appropriate file (referred to as DFS or DPM files, respectively, as noted below) associated with the requested search.
- Any communications with an outside agency concerning the requested search will be documented in the communications log of the appropriate file.

Note: DFS and DPM file contents are described in Appendices 5G and 5H.

Overview: Familial Search using the Ratiometer and the Ratiometer Output Analyzer

BFS DNA Laboratory has adopted the approach of conducting a statistical comparison of the forensic unknown DNA profile with all of the offender profiles in CAL-DNA in an attempt to identify potential familial relationships. A software utility, the "Ratiometer" was developed and validated to accomplish this task.

The Ratiometer generates kinship indices (KIs) for sibship and paternity to quantify the statistical likelihood that the forensic unknown profile may be from a first-degree relative of an offender in the database. The output of the Ratiometer is a list of offender profiles with KIs above established thresholds.

Another software utility, the "Ratiometer Output Analyzer" (ROA), ranks the listed offender profiles from the Ratiometer by their KIs. The most statistically favorable candidates for relatedness to the true perpetrator are selected for Y-STR typing. Up to 168 candidates may be selected in this way with the collaboration of the TSG (through the FSC Chair) in the prioritization.

Initial handling of Request Completed Prior to Search

Per the policies set forth in DLE Bulletin 2008-BFS-01, requests for a Familial Search received from a law enforcement agency will be routed through the office of the Chief of the Bureau of Forensic Services (BFS) to the DOJ Familial Search Committee (FSC) for review, approval and assignment of a DNA Familial Search (DFS) file number.

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Familial Search Procedure, Continued

Familial Search MOU: Y-STRs and Identifiler

Per policy, prior to initiating this procedure, a Memorandum of Understanding (MOU) (Appendix 5I) will be executed by a representative of the law enforcement agency requesting the familial search and by a representative of DOJ. Among the essential criteria these critical items require compliance prior to initiation of this procedure:

- The requesting agency will have successfully determined the Y-STR profile of the forensic unknown (using Yfiler® or PowerPlex® Y).
- The requesting agency will have considered, attempted or succeeded in obtaining a full, single source 15-locus profile of the forensic unknown with Identifiler®.

Preliminary Standard Search

Upon receipt of direction and authorization from the DOJ Familial Search Committee (FSC) chairperson, the CODIS Unit of the BFS Jan Bashinski DNA Laboratory (CODIS Unit) will receive the forensic unknown DNA profile(s) of interest and the associated DFS file.

- To confirm that a direct match to a perpetrator is not present, a preliminary, moderate stringency, manual or "keyboard" search, with routine CAL-DNA Data Bank search settings, will be conducted of the forensic unknown against the usual offender and forensic indexes in the database immediately prior to initiating any modified search. The negative state match detail report will be retained in the DFS file.
- In the event of an offender hit, standard confirmatory processing will be initiated, the familial search will be terminated and the FSC Chair immediately notified.
- If a "partial match" is obtained, it will be noted and the state match detail report will be retained. The specimen involved will be considered for inclusion in the Y-STR processing list generated later at the discretion of the FSC Chair.

12 High + 1 Mismatch Search

- As an additional quality assurance step in Standard Searching, a search of the forensic unknown will be conducted at high stringency at twelve loci with one mismatch allowed. Any resultant candidate matches under these search conditions will be documented and evaluated as potential offender hits in consultation with the FSC Chair.
- In the event of an offender hit, standard confirmatory processing will be initiated, the familial search will be terminated and the FSC Chair immediately notified.

Operation of the Ratiometer

The stepwise instructions for the operation of the Ratiometer are found in Appendix 5J. Only the Convicted Offender Index will be searched.

Continued on next page

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Familial Search Procedure, Continued

Operation of the Ratiometer Output Analyzer	The stepwise instructions for the operation of the Ratiometer Output Analyzer (ROA) are found in Appendix 5K.
Selection of Y-STR Candidates	In consultation with the FSC Chair and TSG members as needed, the CODIS Unit will identify the offender samples that require Y-STR typing. Guidelines for offender sample selection are in Appendix 5L.
Y-STR Typing and Upload	Y-STR typing of the selected candidate offenders' samples will be performed by the validated Data Bank Y-STR analysis method (see Data Bank Procedures Manual, Appendices 3I and 4M). As documentation the resultant Y-STR profiles will be imported into the Y-STR Index in CAL-DNA using standard procedures for uploading profiles.
Y-STR Comparison of Target with Candidates	The Y-STR profile of the target forensic unknown is compared against the set of Y-STR profiles obtained from the candidate offender samples identified by the ROA. The presence or absence of concordant offender Y-STR types is evaluated and documented according to the interpretation guidelines of the Y-STR analysis procedure utilized.
Memo: Results Reported to FSC Chair	The CODIS State Administrator will notify the FSC Chair by memorandum of the existence or absence of offender Y-STR profiles concordant with the Y-STR profile of the target forensic unknown. (See sample memoranda in Appendices 5A.7 and 5A.8)
FSC Action: No Offender Candidates	Where no appropriate investigative leads are identified, the FSC Chair will draft a letter for the BFS Chief's signatures communicating the negative result of the familial search to the requesting agency.

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Familial Search Procedure, Continued

FSC Action: Offender Candidates Identified	Where a potential investigative lead exists, the FSC Chair will provide the BII FSC member with the information developed by the Data Bank with regard to the requested familial search. BII will initiate a background investigation on each candidate to determine whether that candidate can be eliminated by historical facts, relationships or circumstances as being a potential relative of the true perpetrator.
Background Investigation Results Returned to FSC	Upon return of the background investigation results to the Chair, the FSC will meet and confer. Unless there is a reason not to do so, the FSC will release to the requesting agency the name(s) of the relevant offender(s) that may be possible relative(s) of the perpetrator. Before rendering a final disclosure determination, the DOJ committee will discuss the case with the Investigating Agency, the local prosecutor, and the laboratory that analyzed the crime scene DNA evidence. These investigative leads will be communicated in a letter to the requesting agency drafted by the FSC Chair for the signatures of the BFS and BII Chiefs.
Partial Matches	Because of the independent assortment of alleles inherited from biological parents by human offspring and siblings, it is expected that DNA profiles from genetically related persons will share some but not all alleles at the examined forensic STR loci. (In the case of identical twins, of course, sharing is complete.) The standard CODIS search employed at CAL-DNA uses the moderate stringency comparison to allow for the identification of an offender with a crime scene DNA profile that may be incomplete or a mixture. Candidate matches can occur using these search criteria that are not direct matches, but which may be to a potential relative of the true perpetrator. These candidate matches are classified as "partial matches."
Initial handling of Request Completed prior to Partial Match Processing	Per the policies set forth in DLE Bulletin 2008-BFS-01, requests for a Partial Match examination received from a law enforcement agency will be routed through the office of the Chief of the Bureau of Forensic Services (BFS) to the DOJ Familial Search Committee (FSC) for review, approval and assignment of a DNA Partial Match (DPM) file number.

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Familial Search Procedure, Continued

Partial Match MOU: Y-STRs and Identifiler

Per the above referenced policies, prior to initiating this procedure, a Memorandum of Understanding (MOU) (Appendix 5M) will be executed by a representative of the law enforcement agency requesting the partial match processing and by a representative of DOJ, typically the Chief of BFS, the Chair of the FSC, or the Designated State Official for CODIS. Among the essential criteria these critical items require compliance prior to initiation of this procedure:

- The requesting agency will have successfully determined the Y-STR profile of the forensic unknown (using Yfiler® or PowerPlex® Y).
- The requesting agency will have considered, attempted or succeeded in obtaining a full, single source 15-locus profile of the forensic unknown with Identifiler®.

Partial Match Evaluation

The CODIS Unit will verify that the candidate partial match meets the defining criteria in the FBI CODIS Bulletin BT072006 (Appendix 5N).

Preliminary Standard Search

Upon receipt of direction and authorization from the DOJ Familial Search Committee (FSC) chairperson, the CODIS Unit of the BFS Jan Bashinski DNA Laboratory (CODIS Unit) will receive the CODIS match identifier(s) of interest and the associated DNA Partial Match (DPM) file.

- To confirm that a direct match to a perpetrator is not present, a preliminary, manual, standard moderate stringency search will be conducted of the forensic unknown against the usual offender and forensic indexes in the database immediately prior to initiating any partial match processing. The resulting state match detail report(s) will be retained in the DPM file.
- In the event of an offender hit, standard confirmatory processing will be initiated, the partial match process will be terminated and the FSC Chair immediately notified.
- If a new, additional "partial match" is obtained, it will be noted and the state match detail report will be retained. The specimen involved will, at the discretion of the FSC Chair, be considered for inclusion in the Y-STR processing list that is generated later in the process.

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Familial Search Procedure, Continued

12 High + 1 Mismatch Search	• As an additional quality assurance step in Standard Searching, a search of the forensic unknown will be conducted at high stringency at twelve loci with one mismatch allowed. Any resultant candidate matches under these search conditions may be evaluated as potential offender hits in consultation with the FSC Chair. • In the event of an offender hit, standard confirmatory processing will be initiated, the familial search will be terminated and the FSC Chair immediately notified.
Y-STR Typing and Upload	Y-STR typing of the partially matched offender sample will be performed by the validated Y-STR Data Bank method (see Data Bank Procedures Manual, Appendices 3I and 4M). As documentation, the resultant Y-STR profile will be imported into the Y-STR Index in CAL-DNA using standard procedures for uploading profiles. Alternatively, the Jan Bashinski DNA Laboratory Casework Section may do Y-STR typing according to existing Casework DNA protocols.
Y-STR Comparison	The Y-STR profile of the partially matched forensic unknown is compared against the Y-STR profile obtained from the partially matched offender sample. The presence or absence of concordant Y-STR types is noted.
Memo: Results Reported to FSC Chair	The CODIS State Administrator will provide the FSC Chair by memorandum the results of the comparison of the offender Y-STR profile with the Y-STR profile of the partially matched forensic unknown. (See sample memoranda in Appendices 5A.9 and 5A.10)
FSC Action: No Offender Candidates	Where no appropriate investigative lead is identified, the FSC Chair will draft a letter for the BFS Chief's signature communicating the negative result of the familial search to the requesting agency.
FSC Action: Offender Candidates Identified	Where a potential investigative lead exists, the FSC Chair will provide the BII FSC member with the information developed by the Data Bank with regard to the requested familial search. BII will initiate a background investigation on the candidate involved to determine whether that candidate can be eliminated by historical facts, relationships or circumstances as being a potential relative of the true perpetrator.

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Familial Search Procedure, Continued

Background Investigation Results Returned to FSC

Upon return of the background investigation results to the Chair, the FSC will meet and confer. Unless there is a reason not to do so, the FSC will release to the requesting agency the name of the relevant offender that may be a possible relative of the perpetrator. Before rendering a final disclosure determination, the DOJ committee will discuss the case with the Investigating Agency, the local prosecutor, and the laboratory that analyzed the crime scene DNA evidence. This investigative lead will be communicated to the requesting agency in a letter drafted by the FSC Chair for the signatures of the BFS and BII Chiefs.

References

Listed below are references relating to these Familial Search procedures.

- J. Buckleton, C. Triggs "Relatedness," Ch. 4 in *Forensic DNA Evidence Interpretation*, ed., CRC Press, Boca Raton (2005);
- J. Buckleton, C. Triggs, T. Clayton "Disaster Victim Identification, Identification of Missing Persons, and Immigration Cases," Ch. 11 in *Forensic DNA Evidence Interpretation*.
- "SWGDAM Recommendations to the FBI Director on the Interim Plan for the Release of Information in the Event of a Partial Match at NDIS," S. Myers (personal communication, 2008).
- J.M. Butler "Kinship and Parentage Testing" (Chapter 23) and "Mass Disaster DNA Victim Identification" (Chapter 24) in *Forensic DNA Typing*, 2nd edition, Elsevier Academic Press, Burlington, MA (2005).
- F.R. Beiber, C.H. Brenner, D. Lazer "Finding Criminals Through DNA of Their Relatives," *Science*, v. 312, pp. 1315-1316 (2006).
- T.M. Reid, M.L. Baird, J.P. Reid, S.C. Lee, R.F. Lee "Use of Sibling Pairs to Determine the Familial Searching Efficiency of Forensic Databases," *Forensic Sci Int. Gene.* (2008), doi:10.1016/j.fsigen.2008.04.008 (electronic edition).

Colorado Bureau of Investiogation Familial Searching Policy

COLORADO BUREAU OF INVESTIGATION

DNA FAMILIAL SEARCH POLICY

OCTOBER 22, 2009

CBI POLICY STATEMENT

The Colorado Bureau of Investigation (CBI) has developed a DNA Familial Search Policy that may result in investigative information provided to law enforcement officials in unsolved cases where other investigative leads have been exhausted. A familial search is a deliberate search for biologically-related relatives of a contributor of an evidentiary profile conducted with specialized (non-CODIS) software designed for this purpose. Because the information that is ultimately provided will be the name or names of an offender or offenders in Colorado's DNA database who may be related to the actual perpetrator, the process developed requires special DNA testing and review of the offender's non-DNA information. The process specified in the policy was developed keeping privacy concerns in mind, while at the same time providing information that may be useful in solving a violent offense and preventing potential victimization.

BACKGROUND

Colorado's DNA Data Bank consists of a database of DNA profiles from persons charged with felony offenses as of September 30, 2010 and persons who are convicted felony offenders ("offender database") and a database of crime scene evidence profiles. The two DNA offender databases form the Colorado CODIS. When a crime scene profile is searched against the offender database, a match is declared if the crime scene profile is the same as the offender's DNA profile. If the profiles are not exact, but there is a scientific connection, the source of the crime scene profile may be a relative of the offender. With the recent advances of DNA technology, DNA testing beyond the standard profiling for individual identification can now be conducted to provide additional information as to whether individuals may be related.

PROCEDURES

1. A familial search of the state offender DNA database, using specialized non-CODIS software designed for the application, at the discretion of the Director of the Colorado Bureau of Investigation, may be conducted in any of the following general categories:

    a. A potential match is obtained from a CODIS search and the case is under investigation and is unsolved, or
    b. A special request for a familial search of a CODIS profile has been made by the chief law enforcement officer of the investigating law enforcement agency, or by the district attorney of the jurisdiction. The preferred practice is a joint request from the chief law enforcement officer and the district attorney. This special request shall be based upon an active investigation having significant public safety concerns, or
    c. A routine familial search performed by the CBI.

2. When submitting a special request pursuant to paragraph 1(b), the chief law enforcement officer or district attorney shall provide to CBI written certification of the following:

   a. That the evidentiary DNA profile is from a case having significant public safety concerns and the familial search result is critical to advancing the investigation;
   b. That the request from the investigating law enforcement agency includes a case summary and a specimen ID produced in accordance with the "Procedure for Conducting a Familial Search";
   c. That the investigating law enforcement agency and/or the district attorney agree to follow the CBI's investigative policies and procedures relative to this type of evidence;
   d. That the lead investigator assigned to the case has received CBI approved training in the use of DNA familial search evidence;
   e. That standard investigative leads have been exhausted, or a specific exception is articulated; and
   f. That the agency agrees to further investigate the case after CBI releases the identifying information to the requesting agency.

3. In determining whether a DNA familial search can be conducted, CBI will utilize the following procedures:

   a. The evidentiary DNA profile must be entered as either a single-source profile or a clearly defined major component of a mixture with all 13 loci noted.
   b. When the request for a search is received, a new case number will be assigned.
   c. For male candidate results, a sample will be provided for Y-STR analysis to a CODIS eligible DNA laboratory.
   d. Upon completion of the Y-STR analysis, the local law enforcement agency shall return any remaining sample to the CBI for destruction and certify in writing that all extracts and amplified product have been destroyed.
   e. For female candidate results, Y-STRs are of no value.
   f. Prior to CBI's release of identifying information, the laboratory performing the Y-STR comparison will provide to CBI written results of the Y-STR analysis from the sample provided by CBI and the forensic unknown.

4. The identifying information in the CBI case report provided to the chief law enforcement officer and/or the district attorney shall include the following:

   a. Identifying information of any individual having sufficient DNA markers in common with the DNA offender profile, to include the name, date of birth, and ethnicity for each individual;
   b. The CBI case report will include the following statement: "***This information is for law enforcement investigatory purposes only. It is not a statement of identity. The release of the DNA profiles to non-law enforcement agencies/personnel is a violation of both state and federal statutes.***"
   c. The CBI case report will be mailed or hand-delivered to the law enforcement agency but shall not be electronically transmitted.

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5. After receiving from CBI identifying information on DNA profiles determined by the familial search, the investigating law enforcement agency agrees to abide by the following policies, procedures and requirements:

   a. The CBI, or its delegate, will conduct an initial review of the familial search results to determine individuals or families of immediate interest to the investigation.

   b. When an individual is identified through the familial search, the investigating law enforcement agency shall investigate whether the identified individual is related to the DNA database offender. As applicable, the investigator may construct a "family tree" of male relatives connected through the DNA and passed through the y-chromosome.

   c. To determine possible familial relationships, the investigating law enforcement agency, with assistance from CBI, as needed, shall conduct a full background check of the identified individual and family members, including use of the following sources, as available and applicable:

      i. CCIC/NCIC criminal history checks
      ii. Inmate profiles from DOC
      iii. Visitor logs from DOC
      iv. Presentence investigative reports
      v. Jail records including visitor logs and telephone logs.
      vi. Court records searches
      vii. Public records searches
      viii. Rocky Mountain Information Network (RMIN)
      ix. State vital records
      x. Other public resources

   d. Following a thorough records investigation of the individual or individuals identified through the DNA familial search as related to the CODIS offender, the investigating law enforcement agency shall examine the investigative records of the subject crime and determine whether this individual is or these individuals are possible suspect(s). Investigative steps and resources that could be utilized include:

      i. Surveillance data
      i. DNA samples obtained surreptitiously
      ii. Work or employment background
      iii. Adult and juvenile criminal histories
      iv. Motor vehicle records (driver's license, ID card, vehicle registration)
      v. Housing records
      vi. Financial searches
      vii. Additional interviews or re-interviews of informants, witnesses, or victims

e. Based upon information obtained through the investigation, the investigating law enforcement agency should prepare an application for a Colorado Rules of Criminal Procedure, Rule 41.1 Court Order for Nontestimonial Identification, to obtain a DNA sample from the identified suspect. Use of familial DNA alone shall not be the sole basis upon which an investigator requests the Rule 41.1 court order. Additional, articulable evidence must be demonstrated to support the petition for a court order.

   i. Individuals from whom DNA samples are taken pursuant to a Rule 41.1 court order may not be interrogated during the procedures required to obtain the sample.
   ii. The sample obtained from the suspect will be compared with the forensic profile. CBI or another CODIS eligible laboratory will provide the results of this comparison to the investigating law enforcement agency and the district attorney's office.

f. Absent exigent circumstances, family members and relatives should only be contacted after initial investigative steps have been taken during the investigative process, to include first obtaining information from public and law enforcement authorized databases. Care should be taken to insure consideration of potential family issues before contacting family members. Potential issues constituting reasons for delaying contact with family members include:

   i. The possibility that a father is not aware of the existence of an offspring (the "unknown child" issue).
   ii. The possibility that a family might have assumed a child's father is someone else (the "misbelieved paternity")
   iii. The existence of other possible family privacy concerns.

Ronald C. Sloan
CBI Director Ronald C. Sloan

10/22/09
Date