20th International Forensic Science Managers Symposium
INTERPOL Headquarters, Lyon, France
10 November 2022

Recent Advances in Forensic Biology and Forensic DNA Typing 2019-2022

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Overview of Papers Reviewed

20th International Forensic Science Managers Symposium

Years Examined	2019, 2020, 2021, 2022 (through October 2022)
Number of Papers	**636 +137 = 773**
Number of Journals	**96** (*FSI Genetics* = 240)
Topics Covered	15+

17th INTERPOL Review on DNA (2010-2013) examined **114 articles** (Jolicoeur 2013)
18th INTERPOL Review on DNA (2013-2016) examined **75 articles** (Laurent & Pene 2016)
19th INTERPOL Review on DNA (2016-2019) examined **235 articles** (Butler & Willis 2019)

The 2016-2019 INTERPOL DNA Review

Discussed 235 references from 35 journals

Review of forensic biology and DNA publications from 2016 to 2019

- Category selection and article selection:
  1. Core Loci Expansion
  2. Rapid Analysis of STR Markers
  3. Investigative Genetic Genealogy
  4. Next-Generation Sequencing
  5. DNA Mixture Interpretation and Probabilistic Genotyping Software
  6. DNA Transfer and Activity Level Evaluations
  7. Forensic Biology and Body Fluid Identification
  8. DNA Phenotyping
  9. Privacy and Ethical Issues
  10. Guidance Documents (SWGDAM, OSAC, ASB, ENFSI, UK Regulator)
  11. Contamination Avoidance and DNA Success Rates
  12. Recent Special Issues and Review Articles of Note

https://www.interpol.int/content/download/14458/file/Interpol%20Review%20Papers%202019.pdf

Search Strategy

Seeking to learn from Ménard, H., et al. (2021) Research trends in forensic science: a scientometric approach to analyze the content of the INTERPOL reviews. *WIREs Forensic Sci. 2:* e1147. doi: 10.1002/wfs2.1447

- Scopus *and Web of Science* searched "forensic DNA" from March 7, 2022, combined **(4087)**
- Removed duplicates and those not associated with forensic DNA based on title **(1891)**
  - Sorted by 26 MVP topics and added 6 other topic areas
  - Removed Chinese-only articles (e.g., *Fa Yi Xue Za Zhi*) (44)
  - Removed German-only articles (e.g., Rechtsmedizin) (9)
  - Resulted in **1779 articles** (68 pages of 8pt font single-spaced separated in 32 categories)
- Added FSI Reports, which were not in Scopus (40 from manual search of 256 total on 3/29/22)
- Added WIREs Forensic Science, which were not in Scopus (28 from manual search 3/31/22)
- Added other articles as identified in specific searches
- **3/31/2022: references from which to start writing the review (1860)**
  - Continuing to add additional references as they become available and located with supplemental searches
- 6/13/2022: performed another Scopus search "forensic DNA" from 2019 to 2022 (3,059)
- 8/26/2022: performed another Scopus search "forensic DNA" from 2019 to 2022 (3,188)
- 11/1/2022: performed another Scopus search "forensic DNA" from 2019 to 2022 (3,361)

Topics Covered: Forensic Biology and DNA Typing

Hyperlinks to documents in tables and 50 footnotes to relevant websites

	# articles
1. Introduction	
1. Books, Special Issues, and Review Articles of Note	39
2. Guidance Documents (SWGDAM, OSAC, ASB, NIFS, ENFSI, UK Forensic Science Regulator)	70
2. Advancements in Current Practices ***(Practitioner Focused)***	
1. Rapid DNA Analysis	23
2. Use of DNA Databases (Familial Searching, Investigative Genetic Genealogy, Privacy and Ethical Issues, SAKs)	83
3. Forensic Biology and Body Fluid Identification	32
4. DNA Collection and Extraction	34
5. DNA Typing	35
6. DNA Interpretation at the Source or Sub-Source Level (Probabilistic Genotyping Software)	50
7. DNA Interpretation at the Activity Level (DNA Transfer)	45
3. Emerging Technologies, Research Studies, and Other Topics ***(Researcher Focused)***	
1. Next-Generation Sequencing	82
2. DNA Phenotyping (Ancestry, Appearance, Age Predictions) **+ Supplemental File (N=30+51+56)**	27 **+137**
3. Lineage Markers (Y-chromosome, mtDNA, X-chromosome)	67
4. New Markers and Approaches (Microhaplotypes, InDels, Proteomics, Human Microbiome)	69
5. Kinship Analysis, Human Identification, and Disaster Victim Identification	30
6. Non-Human DNA Testing and Wildlife Forensics	26

Sources: Top 30 Countries (# documents published)

1. **United States (717)**
2. China (639)
3. India (256)
4. Australia (254)
5. United Kingdom (226)
6. Italy (185)
7. Germany (175)
8. Spain (136)
9. Netherlands (132)
10. Brazil (97)
11. Japan (94)
12. Switzerland (92)
13. Portugal (71)
14. South Korea (69)
15. Austria (66)
16. New Zealand (64)
17. Canada (60)
18. Poland (60)
19. France (57)
20. Malaysia (54)
21. Denmark (52)
22. Pakistan (49)
23. Russian Federation (47)
24. Sweden (47)
25. Saudi Arabia (47)
26. Thailand (44)
27. Norway (43)
28. South Africa (43)
29. Belgium (38)
30. Indonesia (38)

Based on Scopus search “forensic DNA” and “2019 to 2022”
(1 Nov 2022; 3,361 document results)

Sources: Top 30 Journals (# documents published)

1. **FSI Genetics (466)**
2. Int J Legal Med (288)
3. Forensic Sci Int (201)
4. FSI Genetics Sup (198)
5. J Forensic Sci (116)
6. Legal Med (88)
7. Sci Justice (69)
8. Genes (65)
9. Australian J Forensic Sci (64)
10. Scientific Reports (56)
11. Electrophoresis (55)
12. J Forensic Med (51)
13. Annals Human Biol (49)
14. Forensic Sci Tech (43)
15. Front Genet (38)
16. Indian J Forensic Med Tox (33)
17. Forensic Sci Res (32)
18. J Forensic Legal Med (29)
19. FSI Reports (25)
20. Forensic Sci Med Path (25)
21. PLoS One (25)
22. Egyptian J Forensic Sci (23)
23. FSI Synergy (22)
24. Mol Genet Gen Med (17)
25. Mol Biol Reports (17)
26. Rechtsmedizin (17)
27. Forensic Genet Res Prog (15)
28. Med Sci Law (15)
29. Russian J Genetics (14)
30. Gene (13)

Based on Scopus search “forensic DNA” and “2019 to 2022”
(1 Nov 2022; 3,361 document results)

Top Ten Most Prolific Authors (2019 to 2022)

Scopus search (1 Nov 2022)

in *FSI Genetics only*

1. **Duncan Taylor (29) – Australia**
2. Walther Parson (27) – Austria
3. Jo-Anne Bright (21) – New Zealand
4. Bruce Budowle (18) – USA
5. Chris Phillips (18) – Spain
6. Manfred Kayser (17) – Netherlands
7. Yiping Hou (16) – China (Chengdu)
8. Wojciech Branicki (12) – Poland
8. Leonor Gusmão (12) – Brazil
8. Adrian Linacre (12) – Australia
8. Titia Sijen (12) – Netherlands
8. Catarina Xavier (12) - Austria

In all indexed journals

1. **Bruce Budowle (49) – USA**
2. Walther Parson (47) – Austria
3. Pankaj Shrivastava (43) – India (Sagar)
4. Chengtao Li (39) – China (Shanghai)
5. Duncan Taylor (38) – Australia
6. Adrian Linacre (36) - Australia
7. Jo-Anne Bright (35) – New Zealand
8. Chao Liu (33) – China (Guangzhou)
9. Bofeng Zhu (33) – China (Guangzhou)
10. Guanglin He (32) – China (Xiamen)

Topics Covered: Forensic Biology and DNA Typing

1. Introduction
    1. Books, Special Issues, and Review Articles of Note
    2. Guidance Documents (SWGDAM, OSAC, ASB, NIFS, ENFSI, UK Forensic Science Regulator)
2. Advancements in Current Practices *(Practitioner Focused)*
    1. Rapid DNA Analysis
    2. Use of DNA Databases (Investigative Genetic Genealogy, Privacy and Ethical Issues, SAKs)
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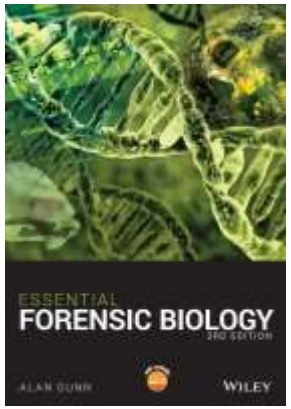
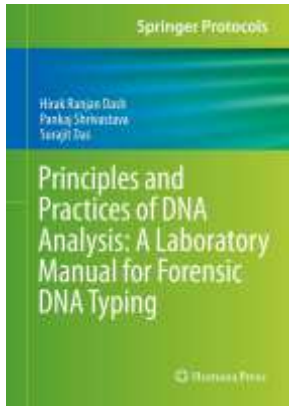
    5. DNA Typing
    6. DNA Interpretation at the Source or Sub-Source Level (Probabilistic Genotyping Software)
    7. DNA Interpretation at the Activity Level (DNA Transfer)
3. Emerging Technologies, Research Studies, and Other Topics *(Researcher Focused)*
    1. Next-Generation Sequencing
    2. DNA Phenotyping (Ancestry, Appearance, Age Predictions)
    3. Lineage Markers (Y-chromosome, mtDNA, X-chromosome)
    4. New Markers and Approaches (Microhaplotypes, InDels, Proteomics, Human Microbiome)
    5. Kinship Analysis, Human Identification, and Disaster Victim Identification
    6. Non-Human DNA Testing and Wildlife Forensics

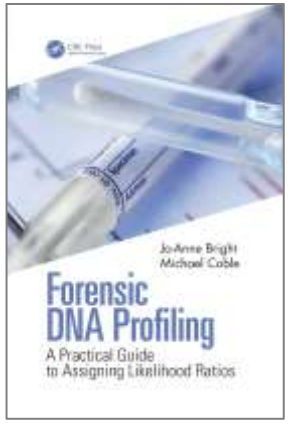
Recent Books on Forensic Biology and Forensic DNA Typing (2019-2022)



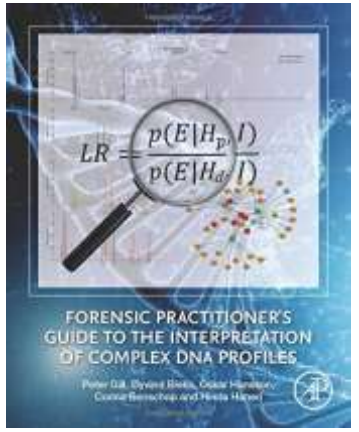
Essential Forensic Biology, Third Edition (2019, Wiley)



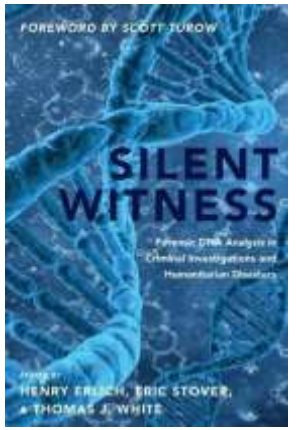
Principles and Practices of DNA Analysis: A Laboratory Manual for Forensic DNA Typing (2020, Humana Press)



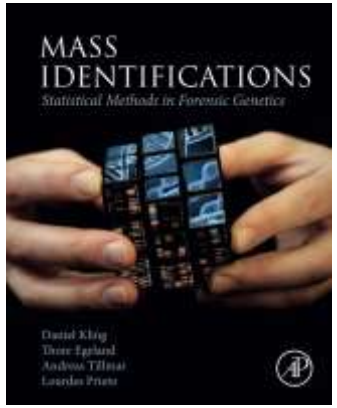
Forensic DNA Profiling: A Practical Guide to Assigning Likelihood Ratios (2020, CRC Press)



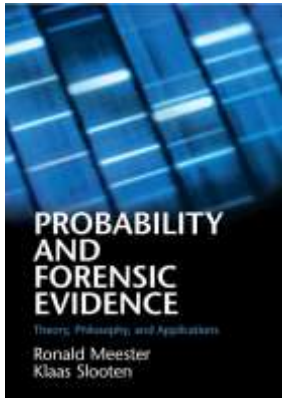
Forensic Practitioner's Guide to the Interpretation of Complex DNA Profiles (2020, Elsevier)



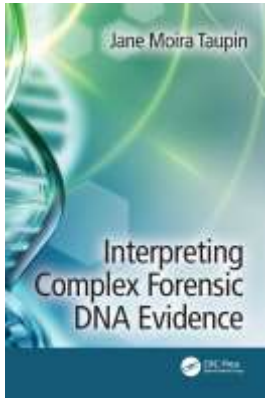
Silent Witness: Forensic DNA Evidence in Criminal Investigations and Humanitarian Disasters (2020, Oxford University Press)



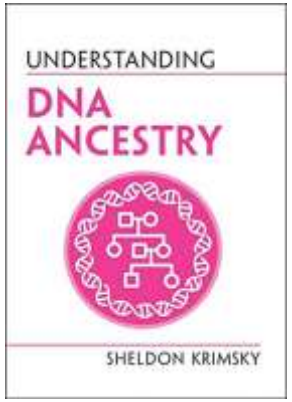
Mass Identifications: Statistical Methods in Forensic Genetics (2021, Elsevier)



Probability and Forensic Evidence: Theory, Philosophy, and Applications (2021, Cambridge University Press)



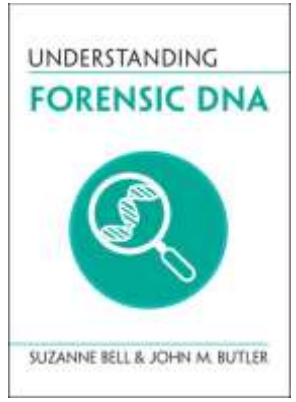
Interpreting Complex Forensic DNA Evidence (2021, CRC Press)



Understanding DNA Ancestry (2022, Cambridge University Press)

Handbook of DNA Profiling, 2 Volumes (2022, Springer)

1206 pages with 54 chapters from 115 contributors representing 17 countries



Understanding Forensic DNA (2022, Cambridge University Press)

FSI Genetics Special Issues

(both guest edited by Manfred Kayser)

Trends and Perspectives in Forensic Genetics (2018/2019)

1. Introduction to special issue
2. DNA transfer in forensic science: A review
3. Evaluation of forensic genetics findings given activity level propositions: A review
4. Probabilistic genotyping software: An overview
5. Match probabilities for Y-chromosomal profiles: A paradigm shift
6. Microhaplotypes in forensic genetics
7. From next generation sequencing to now generation sequencing in forensics
8. Next generation database search algorithm for forensic mitogenome analyses
9. Forensic human identification with targeted microbiome markers using nearest neighbor classification
10. Estimating the postmortem interval using microbes: Knowledge gaps and a path to technology adoption
11. Large scale DNA identification: The ICMP experience
12. Recent progress, methods and perspectives in forensic epigenetics

https://www.sciencedirect.com/journal/forensic-science-international-genetics/special-issue/10TSDS4360H

Forensic Genetics: Unde venisti et quo vadis? (2021/2022)

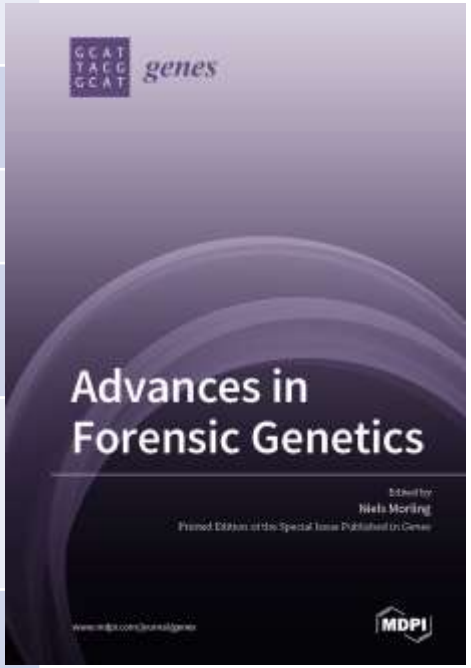
1. Editorial/Prelude (written by ISFG Prize Winners)
2. Massively parallel sequencing is unlocking the potential of environmental trace evidence
3. The germlines of male monozygotic (MZ) twins: Very similar, but not identical
4. Investigative genetic genealogy: Current methods, knowledge and practice
5. Forensic transcriptome analysis using massively parallel sequencing
6. Interpreting NUMTs in forensic genetics: Seeing the forest for the trees
7. Capture enrichment and massively parallel sequencing for human identification
8. Forensic proteomics
9. Progress in forensic bone DNA analysis: Lessons learned from ancient DNA
10. Integrating the human microbiome in the forensic toolkit: Current bottlenecks and future solutions
11. Forensic DNA Phenotyping (ancestry, appearance, age)
12. Microfluidic Technology in Forensic DNA Analysis

https://www.sciencedirect.com/journal/forensic-science-international-genetics/special-issue/10D6PT650B2

Recent or Forthcoming Special Virtual Issues
Related to Forensic Genetics from the Online Journal *genes*

As of 10/31/2022

Special Issue Title (publication dates)	Editor(s)	# Articles
"Forensic Genetics and Genomics" (2020-2021)	Emiliano Giardina & Michele Ragazzo	12
"Forensic Mitochondrial Genomics" (2020-2021)	Mitch Holland & Charla Marshall	11
"Advances in Forensic Genetics" (2021-2022)	Niels Morling	25
"State-of-the-Art in Forensic Genetics" (2022)	Chiara Turchi	10
"Trends in Population Genetics and Identification—Impact on Anthropology" (2022)	Antonio Amorim, Veronica Gomes, & Luisa Azevedo	7
"Identification of Human Remains for Forensic and Humanitarian Purposes: From Molecular to Physical Methods" (2023)	Elena Pilli & Cristina Cattaneo	1
"Improved Methods in Forensic and DNA Analysis" (2023)	Marie Allen	3
"Forensic DNA Mixture Interpretation and Probabilistic Genotyping" (2023)	Michael Coble	
"Advances in Forensic Molecular Genetics" (2023)	Erin Hanson & Claire Glynn	



Since July 2022, available as a 518 page PDF file or a $130 printed book

genes

an Open Access Journal by MDPI

Special Issue (Niels Morling, editor): Advances in Forensic Genetics

https://www.mdpi.com/journal/genes/special_issues/Advances_Forensic_Genetics

25 articles published (2021-2022), topics covered include:

- **PGS Review: EuroForMix, DNAStatistX, STRmix**
- OpenArray for forensic phenotyping
- Skin pigmentation and genetic ancestry
- Eye color prediction
- Ancestry informative markers (VISAGE)
- Single cell analysis for forensic phenotyping
- Animal forensic genetics
- Predicting visible traits in dogs (CaDNAP)
- Single cell analysis for mixture interpretation
- New STR panel for cross-species bird DNA
- Ancient DNA methods improve Korean/WW2 IDs
- **DNA transfer review and recent progress**
- Bayesian Networks for DNA transfer questions
- SNP markers for investigative genetic genealogy (FORCE panel)
- **DNA sampling in burglary investigations**
- Body fluid ID and tissues
- Microbiome analysis
- **Software options for forensic sequencing**
- ChrY and mtDNA statistics/assessment
- Ethical decision-making as lived practice
- Aged rootless hair shafts in Romanov relics

From Table 2 in the 2019-2022 INTERPOL DNA Review

Guidance Documents – United States

With hyperlinks to each document

SWGDAM (see https://www.swgdam.org/publications)

1. SWGDAM (Apr 2019) Mitochondrial DNA Analysis Revisions Related to NGS
2. SWGDAM (Apr 2019) Addendum to Interpretation Guidelines to Address NGS
3. SWGDAM (Feb 2020) Overview of Investigative Genetic Genealogy
4. SWGDAM (July 2020) Report on Y-Screening of Sexual Assault Evidence Kits (SAEKs)
5. SWGDAM (July 2020) Training Guidelines
6. SWGDAM (Jan 2022) YHRD Updates for U.S. Laboratories
7. SWGDAM (March 2022) Interpretation Guidelines for Y-Chromosome STR Typing by Forensic DNA Laboratories
8. SWGDAM (March 2022) Supplemental Information for the SWGDAM Interpretation Guidelines for Y-Chromosome STR Typing by Forensic DNA Laboratories

FBI (drafted by SWGDAM)

1. FBI Quality Assurance Standards for Forensic DNA Testing Laboratories (effective July 1, 2020)
2. FBI Quality Assurance Standards for DNA Databasing Laboratories (effective July 1, 2020)
3. FBI Quality Assurance Standards Audit for Forensic DNA Testing Laboratories
4. FBI Quality Assurance Standards Audit for DNA Databasing Laboratories
5. Guidance Document for the FBI Quality Assurance Standards for Forensic DNA Testing and DNA Databasing

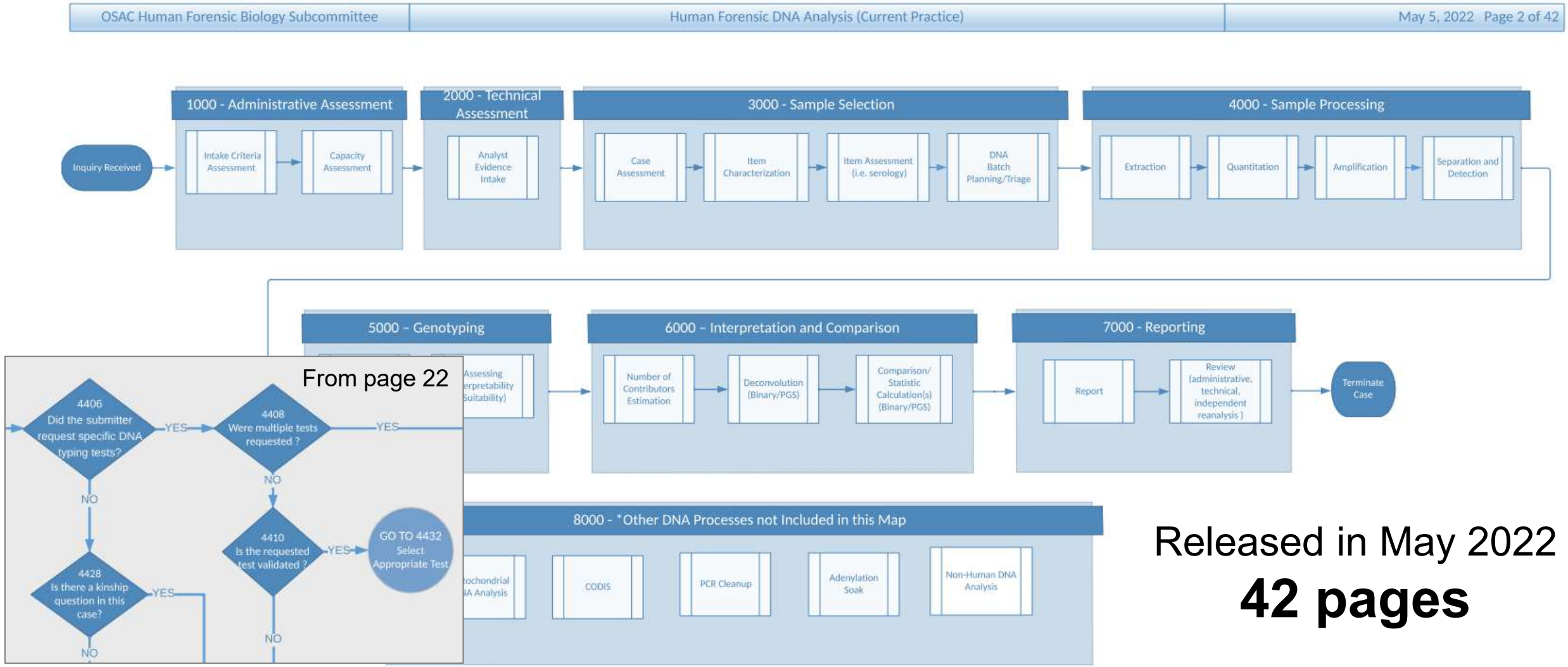
FBI – A Guide to All Things Rapid DNA (13 pages)
https://www.fbi.gov/file-repository/rapid-dna-guide-january-2022.pdf/view

From Table 2 in the 2019-2022 INTERPOL DNA Review

Guidance Documents – United States

DNA Process Map produced by OSAC Human Forensic Biology Subcommittee (with SWGDAM input)

https://www.nist.gov/system/files/documents/2022/05/05/OSAC%20Forensic%20Biology%20Process%20Map_5.5.22.pdf



Released in May 2022

42 pages

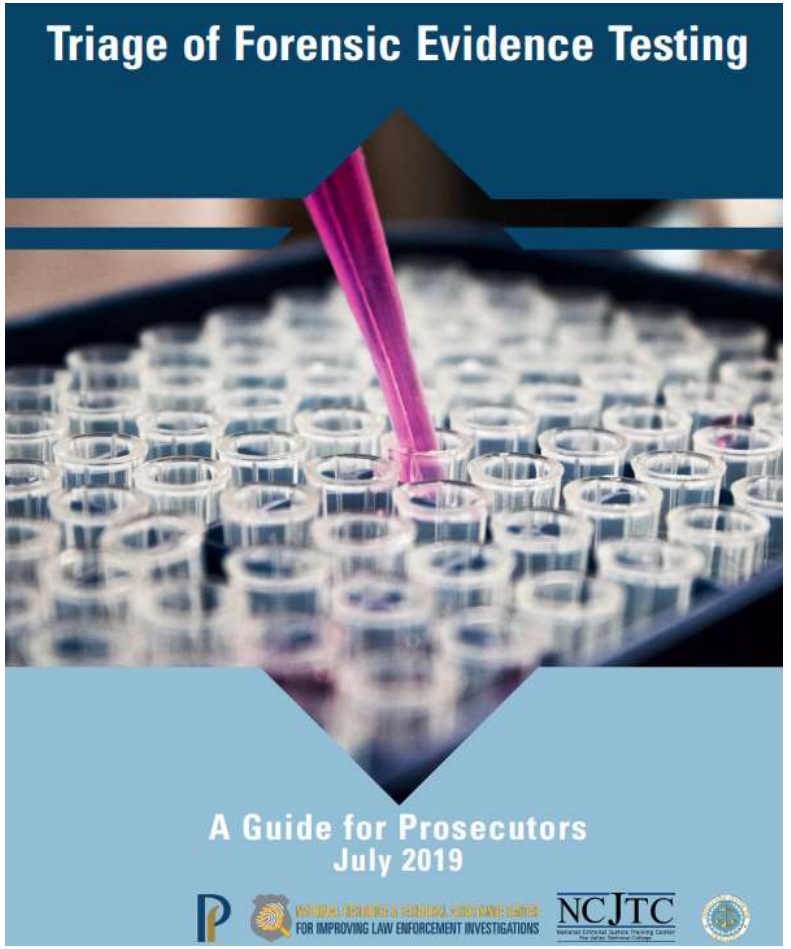
From Table 2 in the 2019-2022 INTERPOL DNA Review

Guidance Documents – United States

1. Bureau of Justice Assistance (BJA) Triage of Forensic Evidence Testing: A Guide for Prosecutors (July 2019)

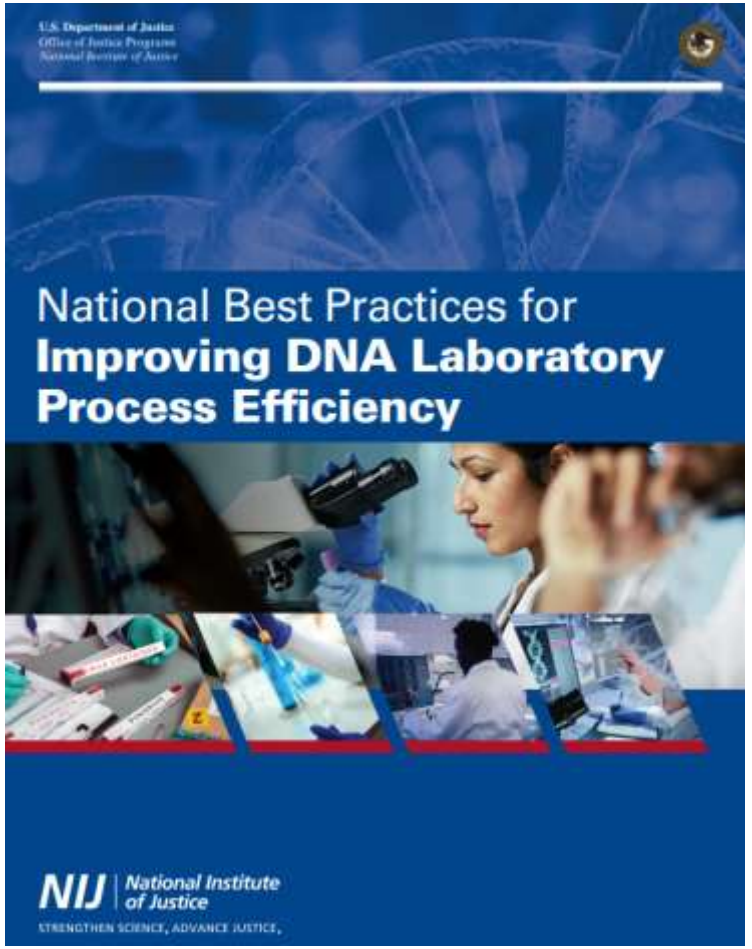
2. National Institute of Justice (NIJ) National Best Practices for Improving DNA Laboratory Process Efficiency (May 2022)

how best to maximize the resources of a public forensic laboratory, with a focus on the prosecutor's perspective



https://bja.ojp.gov/library/publications/triage-forensic-evidence-testing-guide-prosecutors (49 pages)

provides forensic DNA laboratories with a roadmap for managing expected increases in case submissions due to stakeholder demand



https://www.ojp.gov/pdffiles1/nij/304051.pdf (106 pages)

With 67 recommendations

From Table 2 in the 2019-2022 INTERPOL DNA Review

Guidance Documents – UK

Forensic Science Regulator

1. FSR-C-100, Issue 7 – Codes of Practice and Conduct (2021)
2. FSR-C-108, Issue 2 – DNA Analysis: Codes of Practice and Conduct (2020)
3. FSR-C-116, Issue 1 – Sexual Assault Examination: Requirements for the Assessment, Collection and Recording of Forensic Science Related Evidence (2020)
4. FSR-C-118, Issue 1 – Development of Evaluative Opinions (2021)
5. FSR-G-201, Issue 2 – Validation (2020)
6. FSR-G-202, Issue 2, The Interpretation of DNA Evidence (Including Low-Template DNA) (2020)
7. FSR-P-300, Issue 2 – Validation – Use of Casework Material (2020)
8. FSR-P-302, Issue 2 – DNA Contamination Detection: The Management and Use of Staff Elimination DNA Databases (2020)
9. FSR-G-206, Issue 2 – The Control and Avoidance of Contamination in Scene Examination involving DNA Evidence Recovery (2020)
10. FSR-G-207, Issue 2 – The Control and Avoidance of Contamination in Forensic Medical Examinations (2020)

Forensic Science Regulator

11. FSR-G-208, Issue 2 – The Control and Avoidance of Contamination in Laboratory Activities involving DNA Evidence Recovery Analysis (2020)
12. FSR-G-212, Issue 1 – Guidance for the Assessment, Collection and Recording of Forensic Science Related Evidence in Sexual Assault Examinations (2020)
13. FSR-G-213, Issue 2 – Allele Frequency Databases and Reporting Guidance for the DNA (Short Tandem Repeat) Profiling (2020)
14. FSR-G-217, Issue 2 – Cognitive Bias Effects Relevant to Forensic Science Examinations (2020)
15. FSR-G-222, Issue 3 – DNA Mixture Interpretation (2020)
16. FSR-G-223, Issue 2 – Software Validation for DNA Mixture Interpretation (2020)
17. FSR-G-224, Issue 1 – Proficiency Testing Guidance for DNA Mixture Analysis and Interpretation (2020)
18. FSR-G-227, Issue 1 – Y-STR Profiling (2021)
19. FSR-G-228, Issue 1 -- DNA Relationship Testing using Autosomal Short Tandem Repeats (2021)
20. FSR-G-229, Issue 1 – Methods Employing Rapid DNA Devices (2021)

Information Tables in This INTERPOL DNA Review

Table 1: Top ten journals with forensic DNA articles published from 2019 to 2022 based on a Scopus.com search on June 13, 2022

Table 2: Guidance documents (70 total) related to forensic DNA published from 2019 to 2022 ***(with hyperlinks to each document)***

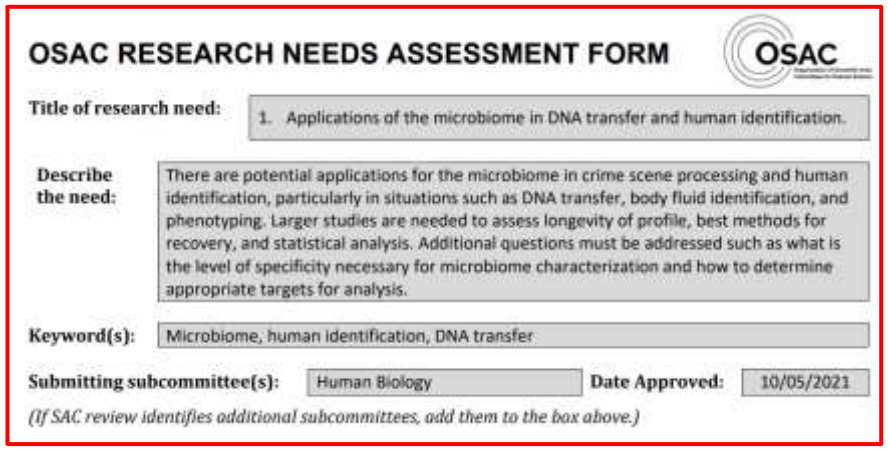
Table 3: Research and development needs in forensic biology as identified by the OSAC Human Forensic Biology Subcommittee ***(with hyperlinks to each document)***

Table 4: Summary of 20 rapid DNA instrument validation and evaluation studies published from 2019 to 2022

Table 5: STR kits assessed with 24 published validation studies from 2019 to 2022

Table 3 in the 2019-2022 INTERPOL DNA Review

OSAC Research & Development Needs



OSAC RESEARCH NEEDS ASSESSMENT FORM

OSAC

Title of research need: 1. Applications of the microbiome in DNA transfer and human identification.

Describe the need: There are potential applications for the microbiome in crime scene processing and human identification, particularly in situations such as DNA transfer, body fluid identification, and phenotyping. Larger studies are needed to assess longevity of profile, best methods for recovery, and statistical analysis. Additional questions must be addressed such as what is the level of specificity necessary for microbiome characterization and how to determine appropriate targets for analysis.

Keyword(s): Microbiome, human identification, DNA transfer

Submitting subcommittee(s): Human Biology **Date Approved:** 10/05/2021

(If SAC review identifies additional subcommittees, add them to the box above.)

OSAC
Organization of Scientific Area Committees for Forensic Science

Human Forensic Biology

1. Applications of the Microbiome in DNA Transfer and Human Identification
2. Assessing DNA Background and Transfer Scenarios in Forensic Casework
3. Best Practices to Minimize Potential Biases in the Generation and Interpretation of DNA Profiles
4. Best Practices for Reporting Likelihood Ratios or Other Probabilistic Results in Court
5. Characterization, Development and Validation of Methods in Single Cell Isolation and Analysis
6. Characterization, Optimization and Comparison of DNA Sequencing Methods
7. Characterizing the Presence and Prevalence of Cell-Free DNA
8. Development of Infrastructure to Compile and Share Raw Electronic Data for Training and Tool Development
9. Efficiency, Throughput and Speed Improvements in Rapid DNA Instrumentation Through the Development of Direct PCR Methods
10. Efficient Collection of DNA at the Scene and from Evidence Items
11. Establishing the Value and Designing a Process for Including Flanking Region SNPs in Massive Parallel Sequencing Based on STRP Casework
12. Improving the Recovery of Male DNA from Sexual Assault Kits
13. Methods in Forensic Genealogy
14. Non-PCR Based Methods for DNA Amplification and/or Detection
15. Optimization of DNA Extraction for Low Level Samples
16. Software Solutions for Low Template and High Order DNA Mixture Interpretation in Sequence and Fragment-Based Methods
17. Software Solutions for Y-STR Mixture Deconvolution
18. Solutions in Phenotyping and Ancestry Analyses

https://www.nist.gov/organization-scientific-area-committees-forensic-science/osac-research-and-development-needs

From Table 4 in the 2019-2022 INTERPOL DNA Review

Rapid DNA Studies (N=20) Published from 2019 to 2022

Publication	Instrument	Cartridge/Kit	Test Performed and Success Rates Reported
Amick & Swiger 2019	RapidHIT ID	ACE and EXT	Performed SWGDAM internal validation studies including known and database-type samples, reproducibility, precision, sensitivity, stochastic effects, mixtures, contamination assessment, and concordance studies
Carney et al. 2019	ANDE 6C	A-Chip	Conducted SWGDAM developmental validation (across 6 labs, 2045 swabs, 13 instruments): species specificity, limit of detection, stability, inhibitors, reproducibility, reference material, mixtures, precision, concordance, signal strength, peak height ratio, stutter, non-template addition, resolution, and contamination assessment; **first-pass success rate (1338 samples with 20 CODIS core loci) = 92%**; successfully interpreted >2000 samples with over 99.99% concordant alleles; data package led to receiving NDIS approval in June 2018
Shackleton et al. 2019a	RapidHIT ID	NGM SElect Express	Described development studies that included process optimization, sensitivity, repeatability, contamination checks, inhibition, swab age, concordance, and overall performance; **success rate (124 samples) = 84.5%** gave a full profile
Shackleton et al. 2019b	RapidHIT 200	NGM SElect Express	Performed some protocol adjustments that enhanced slightly the sensitivity with mock crime scene samples (dilutions of blood and cell line DNA)
Yang et al. 2019	MiDAS	PowerPlex ESI 16 Plus	Described protocols for analysis of reference samples with a fully automated integrated microfluidic system (MiDAS), which is not commercially available
Romsos et al. 2020	ANDE 6C, RapidHIT ID, RapidHIT 200	A-Chip, ACE	Reported results from the July 2018 rapid DNA maturity assessment with multiple instruments organized by NIST; the average success rate for obtaining the 20 CODIS core loci was **85% (n=240)**

Table 5 in the 2019-2022 INTERPOL DNA Review

STR Kits with Validation Studies (N=24) Published from 2019 to 2022

Publication	STR Kit/Primer Set	Comments
Al Janaahi et al. 2019	VeriFiler Plus	Validation studies (sensitivity, peak height ratio, precision, reproducibility, thresholds, mixtures, concordance)
Alsafiah et al. 2019	SureID 23comp Human Identification	Validation studies (following ENFSI and SWGDAM guidelines); has 17 non-CODIS STRs
Bai et al. 2019	DNATyper25	Validation studies (following SWGDAM and China National Standard); has 20 non-CODIS STRs
Cho et al. 2021	Investigator 24plex QS, PowerPlex Fusion, GlobalFiler	Examined 189 casework samples and compared performance across the three kits
Fan et al. 2021	STRtyper-32G	Developmental validation studies (SWGDAM); has 10 non-CODIS STRs
Green et al. 2021	VeriFiler Plus	Developmental validation studies (SWGDAM); concordance checked with Huaxia Platinum kits
Hakim et al. 2020	Investigator 24plex GO!	Validation studies; concordance with GlobalFiler
Harrel et al. 2021	Investigator 24plex QS and GO!	Assessment of sample quality metrics in both kits
Jiang et al. 2021a	STRscan-17LC kit	Validation studies (SWGDAM)
Jiang et al. 2021b	Novel 8-dye STR multiplex	Validation studies (SWGDAM); 18 STRs plus AMEL; detection with GA118-24B Genetic Analyzer
Lenz et al. 2020	VersaPlex 27PY system	Developmental validation studies (SWGDAM); includes D6S1043
Li et al. 2021	SureID S6 system	Validation studies (SWGDAM); concordance with Huaxia Platinum kit; uses lyophilized reagents
Liu et al. 2019	19 autosomal and 27 Y-STRs	Validation studies (Chinese National Standard); 47 loci (Fusion 6C, GlobalFiler, Yfiler Plus) with 6-dyes
Qu et al. 2019	Microreader 20A ID system	Developmental validation studies (SWGDAM)
Qu et al. 2021	Novel 6-dye, 31-plex	Developmental validation studies (SWGDAM and Chinese National Standard); 29 STRs, AMEL, Y-InDel
Wang et al. 2020a	21plex with DYS391 and ABO	Describes a 21plex with 18 autosomal STRs, ABO blood group locus, DYS391, and AMEL
Wang et al. 2020b	Investigator 26plex QS kit	Validation studies (SWGDAM); concordance with AGCU Expressmarker 22 kit
Xie et al. 2020	AGCU Expressmarker 16+22Y	Developmental validation studies (SWGDAM)
Xie et al. 2022	Novel 26plex	Validation studies (SWGDAM); multiple STRs on chromosomes 13, 18, 21, and X for prenatal diagnosis
Yin et al. 2021	Microreader 28A ID System	Developmental validation (SWGDAM); concordance with AGCU Expressmarker 22 kit
Zhang et al. 2020	SiFaSTR 21plex_NCII	Developmental validation (SWGDAM); describes 18 new non-CODIS STR loci
Zhang et al. 2021	AGCU Expressmarker 30 Kit	Developmental validation (SWGDAM); includes 6 non-CODIS STR loci; concordance with AGCU Expressmarker 22 kit
Zheng et al. 2019	SiFaSTR 23-plex panel	Developmental validation (SWGDAM and Chinese National Standard)
Zhong et al. 2019	Huaxia Platinum PCR kit	Developmental validation (SWGDAM and Chinese National Standards)

Recent Major Conferences on Forensic DNA (2019-2022)

American Academy of Forensic Sciences (AAFS)

2019 (Baltimore, MD) | 2020 (Anaheim, CA) | 2021 (virtual) | 2022 (Seattle, WA)

MVPs MVPs

European Academy of Forensic Science (EAFS)

EAFS | STOCKHOLM 2022

MVPs

THE EUROPEAN ACADEMY OF FORENSIC SCIENCE

International Symposium on Human Identification

2019

2020

2021

2022

International Society for Forensic Genetics

Prague, Czech Republic
Sept **2019**

347 extended abstracts published

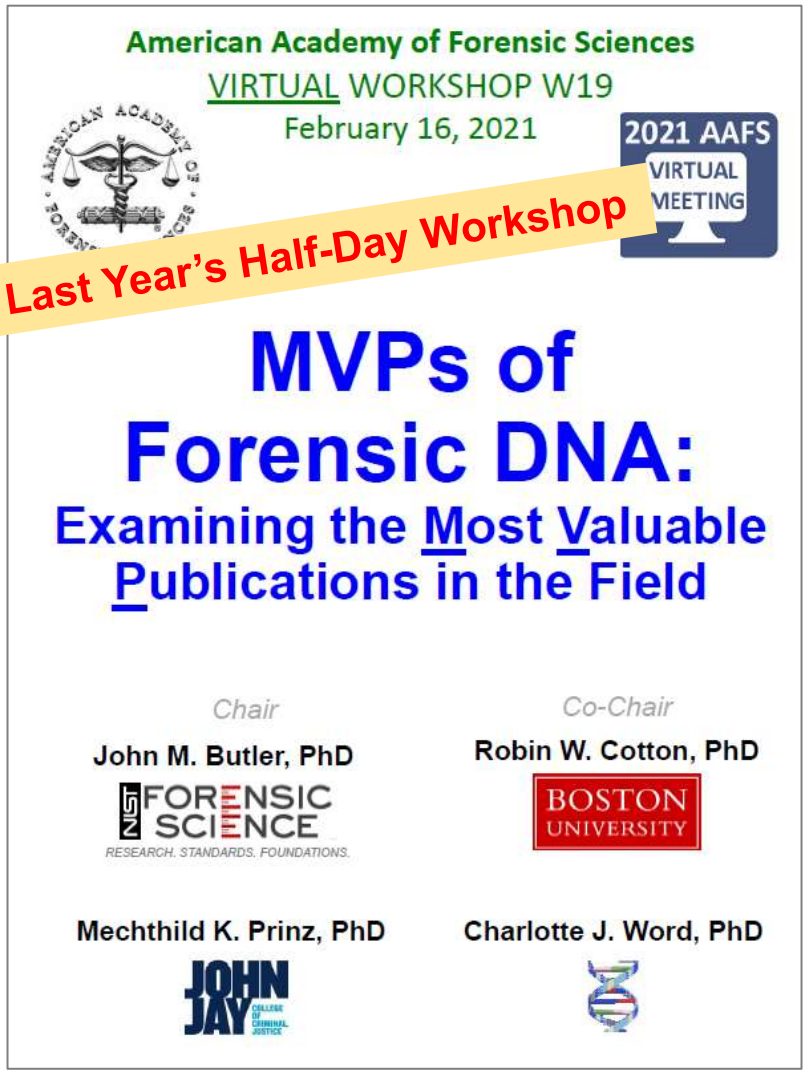
Washington, D.C., USA
Aug/Sept **2022**

~126 extended abstracts published

ISFG Proceedings published in *Forensic Science International: Genetics Supplement Series*

MVPs (Most Valuable Publications) of Forensic DNA

AAFS 2021 MVPs Workshop



https://strbase.nist.gov/pub_pres/AAFS2021-W19-Handouts.pdf

- **4-hour virtual workshop** with pre-recorded videos from each presenter
- **116-page handout** (available on STRBase)
  - **240 slides and a 33-page reference list**
- **480 references in 26 categories + 17 books**
  - Built on lists from SWGDAM July 2020 Training Guidelines and OSAC October 2020 Informative Literature for Forensic Biology and DNA
  - Valuable input from co-presenters is gratefully acknowledged: Robin Cotton, Mecki Prinz, and Charlotte Word
- Discussed principles, MVP trends (article citations, journals used), and **value of the #1 article in each category**
  - **Covered 17 of 26 categories in 10 modules**
  - Also discussed training standards and value of a knowledge base for forensic DNA analysts

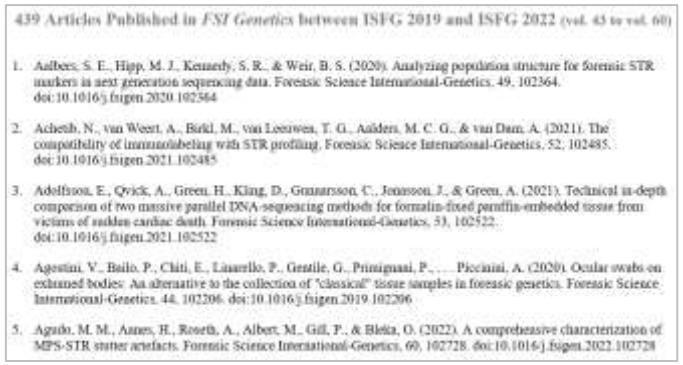
2022 Revised (and Reduced) MVPs = 85 references
https://strbase.nist.gov/pub_pres/AAFS2022-W2-NIST-Forensic-DNA-Activities-FINAL.pdf (pp. 77-84)

FSI Genetics Publications between ISFG 2019 and ISFG 2022

18 volumes (18 issues)

439 articles

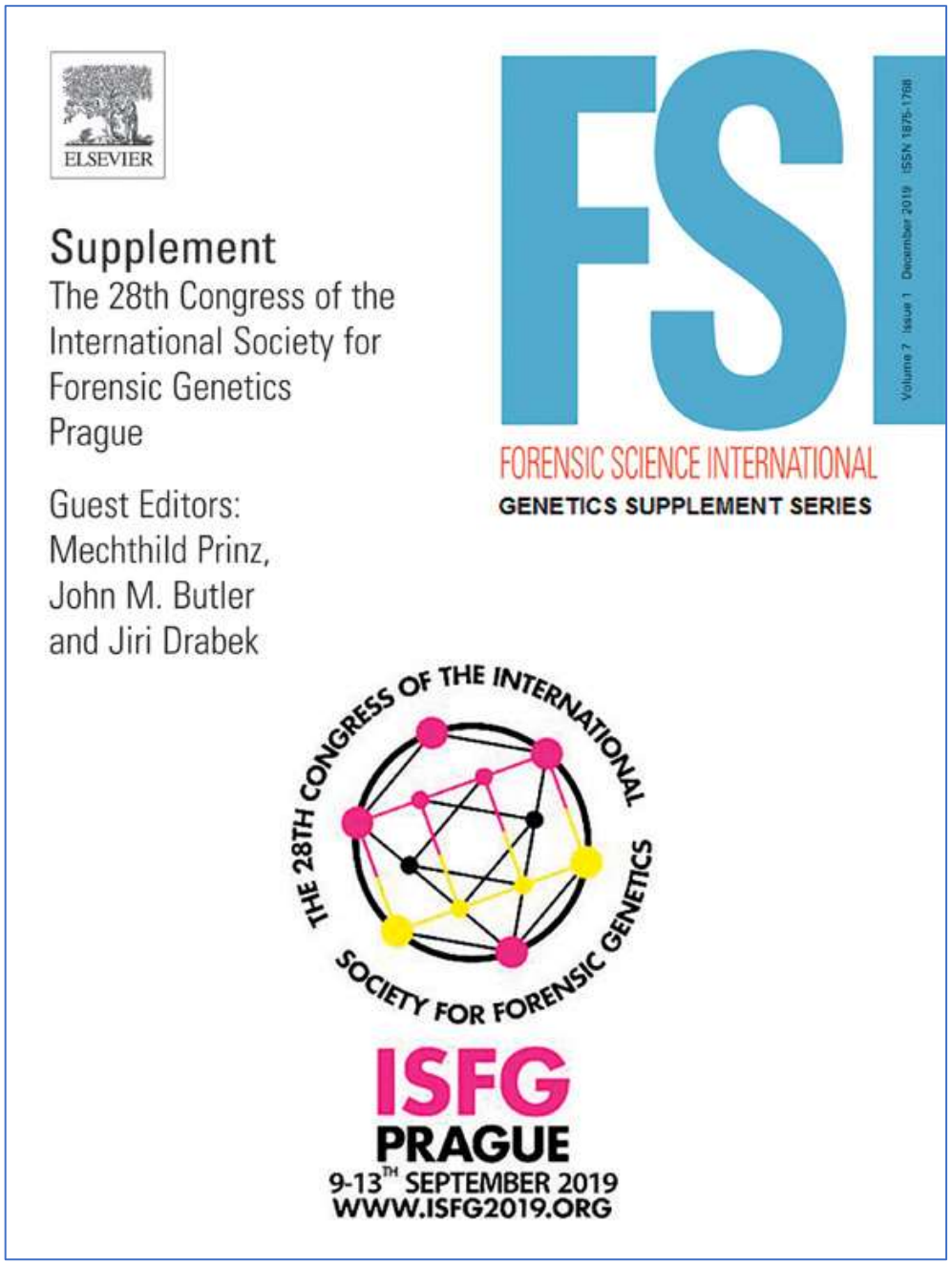
2019	(v38)	(v39)	(v40)	(v41)	(v42)	(v43)
2020	(v44)	(v45)	(v46)	(v47)	(v48)	(v49)
2021	(v50)	(v51)	(v52)	(v53)	(v54)	(v55)
2022	(v56)	(v57)	(v58)	(v59)	(v60)	(v61)



439 Articles Published in *FSI Genetics* between ISFG 2019 and ISFG 2022 (vol. 43 to vol. 60)

1. Aalbers, S. E., Hipp, M. J., Kennedy, S. R., & Weir, B. S. (2020). Analyzing population structure for forensic STR markers in next generation sequencing data. Forensic Science International-Genetics, 49, 102364. doi:10.1016/j.fsigen.2020.102364
2. Acheth, N., van Weert, A., Birkl, M., van Leeuwen, T. G., Aalders, M. C. G., & van Dam, A. (2021). The compatibility of immunolabeling with STR profiling. Forensic Science International-Genetics, 52, 102485. doi:10.1016/j.fsigen.2021.102485
3. Adolfsson, E., Qvick, A., Green, H., Kling, D., Gunnarsson, C., Jemsson, J., & Green, A. (2021). Technical in-depth comparison of two massive parallel DNA-sequencing methods for formalin-fixed paraffin-embedded tissue from victims of sudden cardiac death. Forensic Science International-Genetics, 53, 102522. doi:10.1016/j.fsigen.2021.102522
4. Agostini, V., Bailo, P., Chiti, E., Lasarello, P., Gentile, G., Primignani, P., ... Piccinini, A. (2020). Ocular swabs on exhumed bodies: An alternative to the collection of "classical" tissue samples in forensic genetics. Forensic Science International-Genetics, 44, 102206. doi:10.1016/j.fsigen.2019.102206
5. Agudo, M. M., Annes, R., Roseth, A., Albert, M., Gill, P., & Bleka, O. (2022). A comprehensive characterization of MPS-STR stutter artefacts. Forensic Science International-Genetics, 60, 102728. doi:10.1016/j.fsigen.2022.102728

https://strbase.nist.gov/pub_pres/FSI-Genetics-439articles-2019to2022-alphabetical-by-author.pdf



ISFG 2019 Proceedings

- **Published in December 2019**
- *FSI Genetics Supplement Series*, Volume 7
- **914 pages freely available online**
- https://www.fsigeneticssup.com/current
- **347 articles** + 1 editorial + 1 corrigendum

The ISFG 2022 Proceedings (volume 8 of *FSI Genetics Supplement Series*) should be **published in December 2022**
(currently 126 articles will be included)

Topics Covered: Forensic Biology and DNA Typing

1. Introduction
    1. Books, Special Issues, and Review Articles of Note
    2. Guidance Documents (SWGDAM, OSAC, ASB, NIFS, ENFSI, UK Forensic Science Regulator)
2. Advancements in Current Practices *(Practitioner Focused)*
    1. Rapid DNA Analysis
    2. Use of DNA Databases (Investigative Genetic Genealogy, Privacy and Ethical Issues, SAKs)
    3. Forensic Biology and Body Fluid Identification
    4. DNA Collection and Extraction
    5. DNA Typing
    6. DNA Interpretation at the Source or Sub-Source Level (Probabilistic Genotyping Software)
    7. DNA Interpretation at the Activity Level (DNA Transfer)
3. Emerging Technologies, Research Studies, and Other Topics *(Researcher Focused)*
    1. Next-Generation Sequencing
    2. DNA Phenotyping (Ancestry, Appearance, Age Predictions)
    3. Lineage Markers (Y-chromosome, mtDNA, X-chromosome)
    4. New Markers and Approaches (Microhaplotypes, InDels, Proteomics, Human Microbiome)
    5. Kinship Analysis, Human Identification, and Disaster Victim Identification
    6. Non-Human DNA Testing and Wildlife Forensics

Investigative Genetic Genealogy Review Article

Forensic Science International: Genetics 52 (2021) 102474

Contents lists available at ScienceDirect

Forensic Science International: Genetics

journal homepage: www.elsevier.com/locate/fsigen

Review article

Investigative genetic genealogy: Current methods, knowledge and practice

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ARTICLE INFO

Keywords:
Genetic genealogy
SNP microarrays
Whole-genome-sequencing
Familial searching
Identity by descent
Forensic DNA analysis
Crime investigation

ABSTRACT

Investigative genetic genealogy (IGG) has emerged as a new, rapidly growing field of forensic science. We describe the process whereby dense SNP data, commonly comprising more than half a million markers, are employed to infer distant relationships. By distant we refer to degrees of relatedness exceeding that of first cousins. We review how methods of relationship matching and SNP analysis on an enlarged scale are used in a forensic setting to identify a suspect in a criminal investigation or a missing person. There is currently a strong need in forensic genetics not only to understand the underlying models to infer relatedness but also to fully explore the DNA technologies and data used in IGG. This review brings together many of the topics and examines their effectiveness and operational limits, while suggesting future directions for their forensic validation. We further investigated the methods used by the major direct-to-consumer (DTC) genetic ancestry testing companies as well as submitting a questionnaire where providers of forensic genetic genealogy summarized their operation/services. Although most of the DTC market, and genetic genealogy in general, has undisclosed, proprietary algorithms we review the current knowledge where information has been discussed and published more openly.

Highlights

- Comprehensive review of investigative genetic genealogy from a forensic perspective
- Background outlined for the DNA methodology and long-range familial searching process
- Survey of current direct-to-consumer testing companies connected to investigative genetic genealogy
- Overview of DNA technologies focusing on high-density SNP genotyping

147 references cited with 7 supplemental files

Summary of Recent Advances

- **Aiding** Investigations
  - Phenotyping and Ancestry Testing (VISAGE and beyond)
  - Investigative Genetic Genealogy (GEDmatch and growing commercial support)
- **Improving** Methods
  - DNA recovery, extraction, quantitation, amplification chemistry, new kits
  - Process mapping, standards and guidance documents
- **Speeding and Strengthening** Analysis
  - Rapid DNA
  - Massively Parallel Sequencing
- **Innovating** Interpretation
  - Probabilistic genotyping software for DNA mixtures
  - Activity level evaluations using DNA transfer studies

*These advances are **reported in the scientific literature and summarized in this INTERPOL review** so that we can, as Isaac Newton famously stated, "stand on the shoulders of giants" to see further*

Forensics@NIST 2022 (happening this week)

https://www.nist.gov/agenda/forensicsnist-2022

(Free) Virtual Meeting
>1625 registrants from 70 countries
55 presentations + 5 workshops
Recordings to be available in two weeks

NIST Forensic Science Efforts

1. Conduct impactful **research**
2. Facilitate **standards** development
3. Assess **foundational** knowledge

DNA Mixture Interpretation
Digital Evidence
Bitemark Analysis
Firearm Examination

Research Focus Areas

Discipline-specific Focus Areas

- ITL Biometrics
- ITL Digital Evidence
- MML Drugs & Toxicology
- PML Firearms & Toolmarks
- MML Forensic Genetics
- MML Trace

Cross-discipline Focus Areas

- MML Quality Assurance
- ITL Statistics

Future Planning Priorities

- Computational Forensic Science
- Forensic Science Data
- Training Officers of the Court

csafe
Center for Statistics and Applications in Forensic Evidence

NIST Center of Excellence

Iowa State · West Virginia University

Thank you for your attention!

John Butler

john.butler@nist.gov

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
U.S. DEPARTMENT OF COMMERCE

https://www.nist.gov/topics/forensic-science

MVPs of Forensic DNA

2021 (480): https://strbase.nist.gov/pub_pres/AAFS2021-W19-Handouts.pdf (pp. 3-35)

2022 (85): https://strbase.nist.gov/pub_pres/AAFS2022-W2-NIST-Forensic-DNA-Activities-FINAL.pdf (pp. 77-84)

Questions?

Informative Forensic DNA Reviews and Research Studies (A-to-Z)

Category Group	Topic(s) Covered	# Articles 480 (2021)	85 (2022)
A	Plain Language Guides to Forensic DNA Analysis	4	2
B	Serology and Body Fluid Identification	24	3
C	Collection and Storage of Biological Material	25	2
D	DNA Extraction/Purification, Differential Extraction	18	2
E	DNA Quantitation, Degraded DNA	10	2
F	PCR Amplification, Inhibition, and Artifacts	13	3
G	Capillary Electrophoresis Separation and Detection	12	2
H	Assessing Sample Suitability & Complexity, Low-Template	7	2
I	Estimating the Number of Contributors	12	4
J	Data Interpretation, Mixture Deconvolution, Interlab Studies	12	4
K	Interpretation: Binary Approaches (CPI, RMP, LR)	11	5
L	Interpretation: Probabilistic Genotyping Software	44	4
M	Report Writing and Technical Review	8	4

Informative Forensic DNA Reviews and Research Studies (A-to-Z)

Category Group	Topic(s) Covered	# Articles 480 (2021)	# Articles 85 (2022)
N	Court Testimony, Communication, Juror Comprehension	22	5
O	Autosomal STR Markers and Kits	29	2
P	Mitochondrial DNA Testing	11	3
Q	Y-Chromosome and X-Chromosome Testing	17	4
R	DNA Databases and Investigative Genetic Genealogy	14	3
S	Statistical Analysis	11	2
T	Population Genetics	11	2
U	DNA Phenotyping (Ancestry, Appearance, Age)	24	2
V	New Technologies (Rapid DNA, Massively Parallel Sequencing)	35	5
W	DNA Transfer and Activity Level Reporting	57	8
X	Non-Human DNA Testing	15	2
Y	Method Validation, Quality Control, and Human Factors	23	5
Z	General Forensic Science Topics	11	3

Testing the Current 26 MVP "A-to-Z" Categories
with the 2019-2022 INTERPOL Review

Starting with 4,087 articles

Scopus & Web of Science "forensic DNA" searches
January 2019 to March 2022 (with some additions)

Removed duplicates
and **sorted**
into 26 categories
MVP "A to Z"
+ 6 additional ones

1,884 articles

version
May 16, 2022

MVP	# articles
A	9
B	56
C	116
D	100
E	27
F	38
G	5
H	3
I	10
J	20
K	6
L	63
M	2

MVP	# articles
N	18
O	49
P	95
Q	117+25
R	77
S	54
T	147
U	172
V	105+32
W	57
X	126
Y	22
Z	18

Additional Categories

Human Remains ID (DVI)
92
Microbial & Viral DNA
59
Microhaplotypes/InDels
53
Proteomics
15
Sexual Assault Policy
33
Other Applications
48

(+12 unsorted)

Guidance Documents – United States

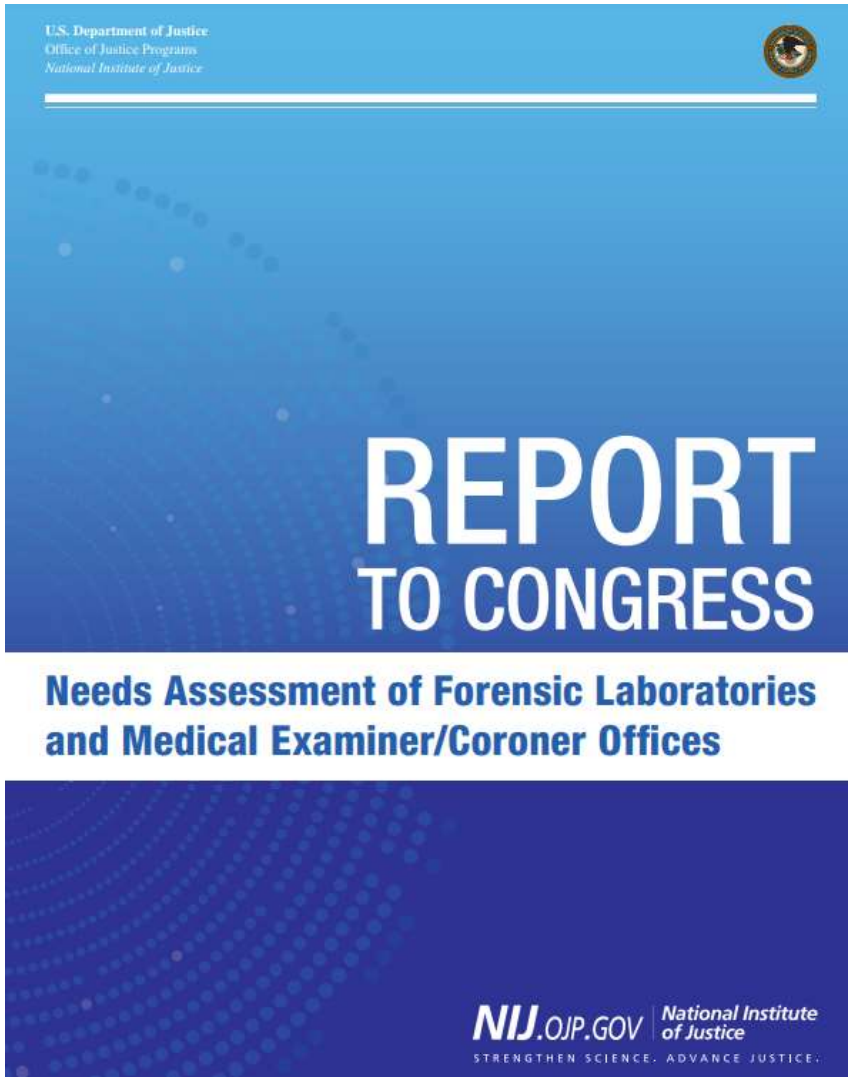
DOJ Uniform Language for Testimony and Reports (ULTRs)

Approved ULTR for the Forensic DNA Discipline – Autosomal DNA with Probabilistic Genotyping (effective 3.18.19)

Approved ULTR for the Forensic DNA Discipline – Mitochondrial DNA (effective 3.18.19)

Approved ULTR for the Forensic DNA Discipline – Y-STR DNA (effective 3.18.19)

https://www.justice.gov/olp/uniform-language-testimony-and-reports



December 2019, 200 pages
https://www.justice.gov/olp/page/file/1228306/download

Guidance Documents – United States

UNITED STATES DEPARTMENT OF JUSTICE
INTERIM POLICY
FORENSIC GENETIC GENEALOGICAL DNA ANALYSIS AND SEARCHING

I. Purpose and Scope[1]

The purpose of this interim policy is to promote the reasoned exercise of investigative, scientific, and prosecutorial discretion in cases that involve forensic genetic genealogical DNA analysis and searching ('FGGS').[2] It provides guidance to Department agencies when formulating a thoughtful and collaborative approach to important interdisciplinary decisions in cases that utilize this investigative technique. Collaboration between investigators, laboratory personnel, and prosecutors is important because the decision to pursue FGGS may affect privacy interests, the consumption of forensic samples, and law enforcement's ability to solve violent crime.

UNITED STATES DEPARTMENT OF JUSTICE
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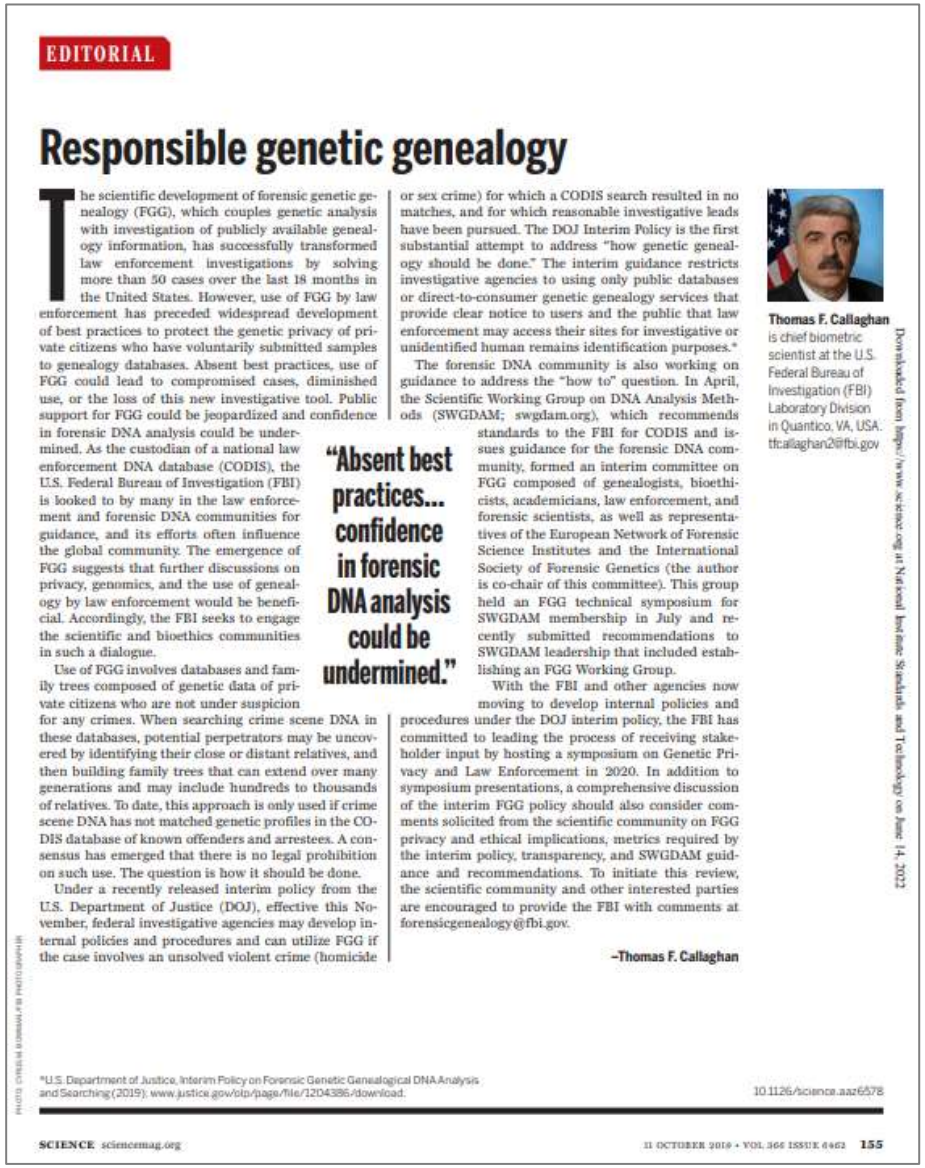
Approved: 09.02.2019 Effective: 11.01.2019

https://www.justice.gov/olp/page/file/1204386/download



EDITORIAL

Responsible genetic genealogy

The scientific development of forensic genetic genealogy (FGG), which couples genetic analysis with investigation of publicly available genealogy information, has successfully transformed law enforcement investigations by solving more than 50 cases over the last 18 months in the United States. However, use of FGG by law enforcement has preceded widespread development of best practices to protect the genetic privacy of private citizens who have voluntarily submitted samples to genealogy databases. Absent best practices, use of FGG could lead to compromised cases, diminished use, or the loss of this new investigative tool. Public support for FGG could be jeopardized and confidence in forensic DNA analysis could be undermined. As the custodian of a national law enforcement DNA database (CODIS), the U.S. Federal Bureau of Investigation (FBI) is looked to by many in the law enforcement and forensic DNA communities for guidance, and its efforts often influence the global community. The emergence of FGG suggests that further discussions on privacy, genomics, and the use of genealogy by law enforcement would be beneficial. Accordingly, the FBI seeks to engage the scientific and bioethics communities in such a dialogue.

Use of FGG involves databases and family trees composed of genetic data of private citizens who are not under suspicion for any crimes. When searching crime scene DNA in these databases, potential perpetrators may be uncovered by identifying their close or distant relatives, and then building family trees that can extend over many generations and may include hundreds to thousands of relatives. To date, this approach is only used if crime scene DNA has not matched genetic profiles in the CODIS database of known offenders and arrestees. A consensus has emerged that there is no legal prohibition on such use. The question is how it should be done.

Under a recently released interim policy from the U.S. Department of Justice (DOJ), effective this November, federal investigative agencies may develop internal policies and procedures and can utilize FGG if the case involves an unsolved violent crime (homicide or sex crime) for which a CODIS search resulted in no matches, and for which reasonable investigative leads have been pursued. The DOJ Interim Policy is the first substantial attempt to address "how genetic genealogy should be done." The interim guidance restricts investigative agencies to using only public databases or direct-to-consumer genetic genealogy services that provide clear notice to users and the public that law enforcement may access their sites for investigative or unidentified human remains identification purposes.*

The forensic DNA community is also working on guidance to address the "how to" question. In April, the Scientific Working Group on DNA Analysis Methods (SWGDAM; swgdam.org), which recommends standards to the FBI for CODIS and issues guidance for the forensic DNA community, formed an interim committee on FGG composed of genealogists, bioethicists, academicians, law enforcement, and forensic scientists, as well as representatives of the European Network of Forensic Science Institutes and the International Society of Forensic Genetics (the author is co-chair of this committee). This group held an FGG technical symposium for SWGDAM membership in July and recently submitted recommendations to SWGDAM leadership that included establishing an FGG Working Group.

> "Absent best practices... confidence in forensic DNA analysis could be undermined."

With the FBI and other agencies now moving to develop internal policies and procedures under the DOJ interim policy, the FBI has committed to leading the process of receiving stakeholder input by hosting a symposium on Genetic Privacy and Law Enforcement in 2020. In addition to symposium presentations, a comprehensive discussion of the interim FGG policy should also consider comments solicited from the scientific community on FGG privacy and ethical implications, metrics required by the interim policy, transparency, and SWGDAM guidance and recommendations. To initiate this review, the scientific community and other interested parties are encouraged to provide the FBI with comments at forensicgenealogy@fbi.gov.

–Thomas F. Callaghan

Thomas F. Callaghan is chief biometric scientist at the U.S. Federal Bureau of Investigation (FBI) Laboratory Division in Quantico, VA, USA. tfcallaghan2@fbi.gov

*U.S. Department of Justice, Interim Policy on Forensic Genetic Genealogical DNA Analysis and Searching (2019); www.justice.gov/olp/page/file/1204386/download.

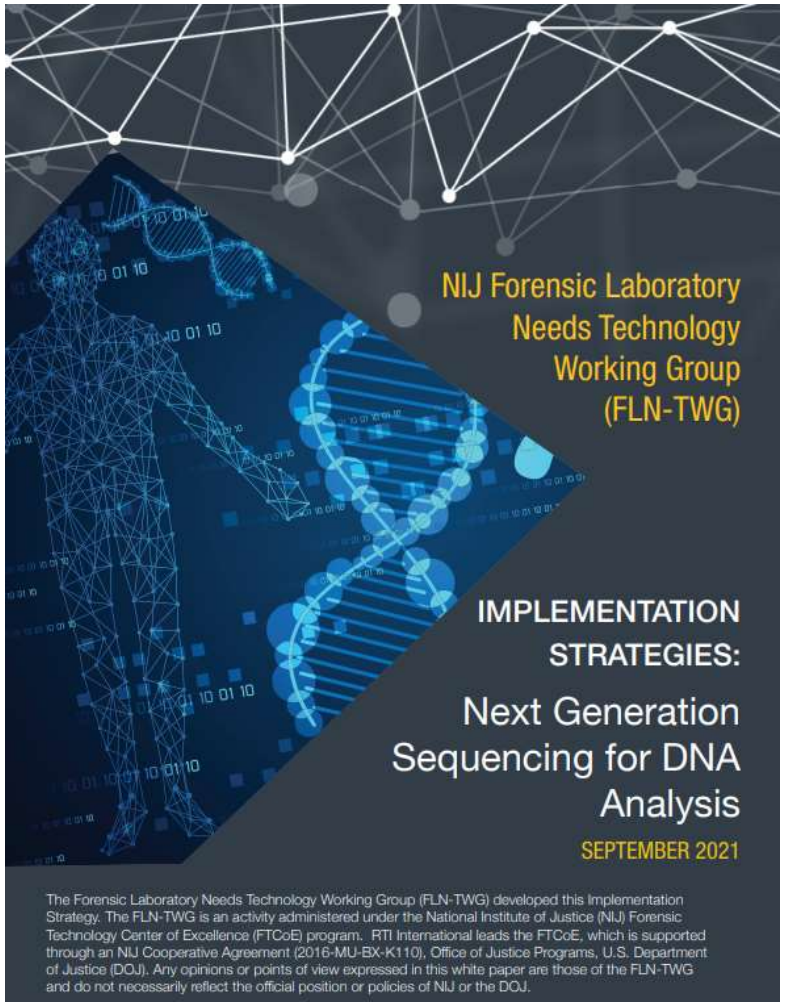
10.1126/science.aaz6578

Callaghan, T.F. (2019) Responsible genetic genealogy. *Science* 365: 155.

Guidance Documents – United States

NIJ FLN-TWG

(Forensic Laboratory Needs Technology Working Group)



https://forensiccoe.org/fln-twg-next-generation-sequencing/ (29 pages)

Forensic Technology
CENTER OF EXCELLENCE
A program of the National Institute of Justice

Human Factors Sourcebook

- https://forensiccoe.org/human_factors_forensic_science_sourcebook/

Publication of six articles in *Forensic Science International: Synergy*, March 2022

1) **Overview of special issue: Human factors in forensic science practice sourcebook**
2) **The need for research-based tools for personnel selection and assessment in the forensic sciences**
3) **The benefits of errors during training**
4) **Challenges to reasoning in forensic science decisions**
5) **Stressors in forensic organizations: Risks and solutions**
6) **Describing communication during a forensic investigation using the Pebbles on a Scale metaphor**

Guidance Documents – United States

Organization of Scientific Area Committees for Forensic Science (OSAC)

1. OSAC 2020-N-0007, *Best Practice Recommendations for the Management and Use of Quality Assurance DNA Elimination Databases in Forensic DNA Analysis* (added April 6, 2021, to OSAC website and sent to ASB for further development and publication).
2. OSAC 2020-S-0004, *Standard for Interpreting, Comparing and Reporting DNA Test Results Associated with Failed Controls and Contamination Events* (added June 1, 2021, to OSAC website and sent to ASB for further development and publication).

Academy Standards Board (ASB)

1. ANSI/ASB Standard 020, *Standard for Validation Studies of DNA Mixtures, and Development and Verification of a Laboratory's Mixture Interpretation Protocol*, First Edition, 2018 (added to OSAC Registry May 12, 2020).
2. ANSI/ASB Standard 040, *Standard for Forensic DNA Interpretation and Comparison Protocols*, First Edition, 2019 (added to OSAC Registry May 12, 2020).
3. ANSI/ASB Standard 022, *Standard for Forensic DNA Analysis Training Programs*, First Edition, 2019 (added to OSAC Registry September 1, 2020).
4. ANSI/ASB Standard 018, *Standard for Validation of Probabilistic Genotyping Systems*, First Edition, 2020 (added to OSAC Registry May 4, 2021).
5. ANSI/ASB Standard 023, *Standard for Training in Forensic DNA Isolation and Purification Methods*, First Edition, 2020 (added to OSAC Registry August 3, 2021).
6. ANSI/ASB Standard 110, *Standards for Training in Forensic Serological Methods*, First Edition, 2020 (added to OSAC Registry August 3, 2021).
7. ANSI/ASB Standard 115, *Standard for Training in Forensic Short Tandem Repeat Typing Methods using Amplification, DNA Separation, and Allele Detection*, First Edition, 2020 (added to OSAC Registry August 3, 2021).
8. ANSI/ASB Standard 116, *Standard for Training in Forensic DNA Quantification Methods*, First Edition, 2020 (added to OSAC Registry August 3, 2021).

Guidance Documents – Australia and Europe

Australian National Institute of Forensic Science (NIFS)

1. Case Record Review in Forensic Biology (September 2019)
2. Empirical Study Design in Forensic Science - A Guideline to Forensic Fundamentals (September 2019)
3. Transitioning Technology from the Laboratory to the Field - Process and Considerations for the Forensic Sciences (December 2019)

https://www.anzpaa.org.au/forensic-science/our-work/products/publications

European Network of Forensic Science Institutes (ENFSI) DNA Working Group

1. DNA Database Management Review and Recommendations (April 2019)
2. Guideline for the Training of Staff in Forensic DNA Laboratories (March 2022)

ISFG DNA Commissions

https://www.isfg.org/Publications/DNA+Commission

Provide recommendations and considerations to enable interconnectivity and advance the quality of forensic DNA evidence

- Autosomal STRs and allele nomenclature
  - Bär et al. 1994 allelic ladders & partial repeats (e.g., 9.3)
  - Bär et al. 1997 motif choice & repeat nomenclature
  - Parson et al. 2016 8 considerations with sequence data
- mtDNA
  - Carracedo et al. 2000 guidelines on QC, nomenclature, heteroplasmy, and interpretation
  - Parson et al. 2014 16 recommendations on sequencing, quality control, interpretation, and databases
- Y-STRs
  - Gill et al. 2001 locus & allele nomenclature, allelic ladders
  - Gusmão et la. 2006 repeat nomenclature, new loci
  - **Roewer et al. 2020** statistics and report information
- X-STRs
  - Tillmar et al. 2017 10 recommendations on use of X-STRs in kinship analyses, linkage, and statistical calculations
- DNA mixture interpretation and assessing evidence
  - Gill et al. 2006 nine recommendations on mixture interpretation (e.g., LR vs. CPI)
  - Gill et al. 2012 allele drop-in and drop-out using probabilistic methods
  - **Gill et al. 2018** formulation of propositions; investigator and evaluator roles
  - **Gill et al. 2020** activity level propositions
- Other topics
  - *DNA Polymorphisms*: Brinkmann et al. 1989, 1992, Bär et al. 1992
  - *Disaster Victim Identification*: Prinz et al. 2007 12 recommendations
  - *Biostatistics in Paternity Testing*: Gjertson et al. 2007
  - *Non-human DNA*: Linacre et al. 2011 13 recommendations
  - *STRidER*: Bodner et al. 2016 quality control of autosomal STR allele
  - *Software Validation*: Coble et al. 2016 16 recommendations and expectations

Current (Active) DNA Commissions

1. STR nomenclature with DNA sequencing information (building on STRAND efforts): *K. Gettings*
2. Phenotyping (building on VISAGE efforts): *M. Kayser*