DNA in Sexual Assault Cases Part 1: An Introductory

SAFEta.org
The Ultimate Source for Sexual Assault Forensic Examiner Technical Assistance

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May 11, 2023

This project was supported by Grant No. 15JOVW-21-GK-02194-MUMU awarded by the Office on Violence Against Women, U.S. Department of Justice. The opinions, findings, conclusions, and recommendations expressed in this presentation are those of the author(s) and do not necessarily reflect the views of the Department of Justice, Office on Violence Against Women.

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Today's Host

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Acknowledgement & Disclosures

- This presentation was made possible in part by funding provided by an award from the Office On Violence Against Women, U.S. Department of Justice Grant No. 15JOVW-21-GK-02194-MUMU
- The planners, presenters, and content reviewers of this course disclose no conflicts of interest.
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Today's Presenter

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Today's Presenters

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Disclosure

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Acknowledgements

Utah Bureau of Forensic Services (UBFS)

Learning Outcomes

At the conclusion of this webinar, attendees will have an increased knowledge of:

- *The history of forensic DNA and implications of use, specifically in sexual assault cases.*
- *Definitions of forensic DNA terminology such as STR DNA, Y-STR DNA, major profile, minor profile, CODIS, trace DNA, and CODIS-eligible DNA profiles.*
- *The general laboratory steps of DNA analysis: extraction, quantitation, normalization, amplification, DNA separation and detection, and interpretation.*
- *Methods to recognize and evaluate best practice recommendations in evidence collection techniques in sexual assault cases to optimize DNA analysis findings through presentations of case studies.*

Chat Discussion

What is your top learning outcome for today's webinar?

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Sexual Assault Medical Forensic Examinations

Why do we do what we do?

- Healthcare
- Trauma-informed
- Patient/Survivor focused
- Require expertise in clinical judgment

What about the "BOX"?

Forensic Evidence Collectors

Sexual Assault Nurse Examiners
Forensic Healthcare Professionals

Forensic Evidence Analysts/Specialists

Forensic scientists

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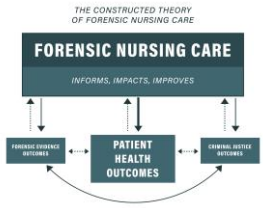
The big picture . . .



Valentine, J.L., Sekula, K., & Lynch, V.A. (2020)

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Forensic DNA

- 1984 – Alec Jeffreys (genetic/DNA fingerprinting)

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https://www.google.com/search?q=forensic+DNA&source=lnms&tbm=isch&sa=X&ved=2ahUKEwjqiKiUzpv4AhUEXMIDHfRDABMQ_AUoAnoECAEQBA&biw=1200&bih=639#imgrc=QSF4jnfIuajUkM

Definitions (1)

- Trace/Touch DNA
- Short tandem repeat (STR) DNA
- Y-STR DNA

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Definitions (2)

- Serology
- Y-screening
- DNA extraction
- Quantitation

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Definitions (3)

- CODIS Eligibility
  - Case scenario / Evidence
  - Profile
- CODIS hit

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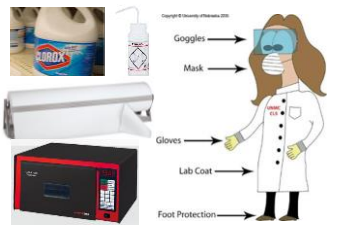
Laboratory Guidelines

PPE

Clean techniques

Avoid cross contamination

Separation of lab space



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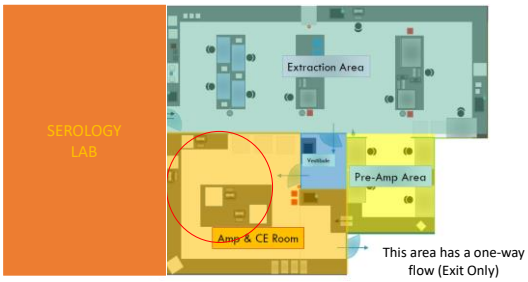
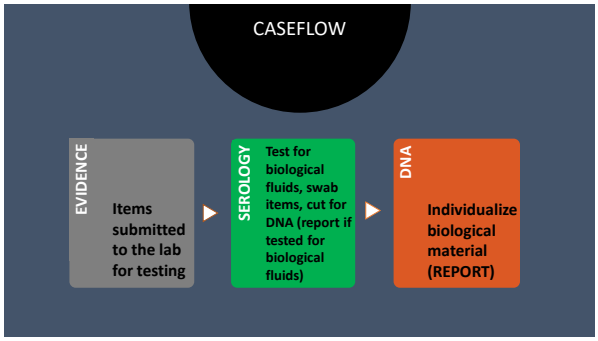
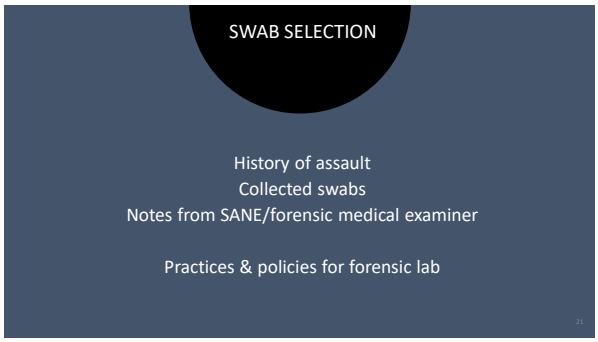

SEROLOGY LAB
Extraction Area
Vestibule
Pre-Amp Area
Amp & CE Room
This area has a one-way flow (Exit Only)


CASEFLOW
EVIDENCE
Items submitted to the lab for testing
SEROLOGY
Test for biological fluids, swab items, cut for DNA (report if tested for biological fluids)
DNA
Individualize biological material (REPORT)


SWAB SELECTION
History of assault
Collected swabs
Notes from SANE/forensic medical examiner
Practices & policies for forensic lab

SWAB SELECTION

SEROLOGY

The approach used will be determined by each laboratory

- Screen every sample in the kit or test a subset
- May use serological testing, Y-screening, or case documentation to screen samples prior to determining which samples will be taken for DNA analysis or employ a direct to DNA approach

All swabs vs subset

Serology testing results

Y-screening results

Case scenario and nurse's notes

Typically, only half of each sample will be used, saving half for future testing

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DNA WORKFLOW

- Full serological testing
- Straight to DNA

(Optional step)

- Manual vs robotic methods
- Many types

- Human DNA
- Male DNA

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DNA WORKFLOW

- PCR
- Copy specific areas for testing
- Attach fluorescent tags

- Separate based on size and dye color

- Troubleshoot
- Determine profiles

- Number of contributors
- Comparing to reference standards
- Statistical weights

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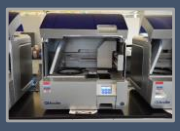
EXTRACTION

PURPOSE: break open cells to get DNA into solution; remove inhibitors, cell debris, and proteins - purifies the DNA that is present.



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QUANTITATION

PURPOSE: estimate the amount of human DNA and male DNA present in each sample; determine if there is inhibition; estimate male:female DNA ratio

Determine:
- if and how to proceed with each sample
- type of testing may provide comparable results

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AMPLIFICATION

PURPOSE:
1. Make copies of specific areas of the DNA for testing
2. Attach fluorescent tags to allow for detection of the resulting DNA fragments based on size

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STRs – SHORT TANDEM REPEATS

Length-based differences at specific locations on the DNA used to establish ***identity***

TCCCAAGCTCTTCCTCTTCCCTAGATCAATACAGACAGAAGACAGGTGGATAGATAGAT AGATAGATAGATAGATAGATAGATAGATAGATAGATATCATTGAAAGACAAAACA GAGATGGATGATAGATACATGCTTACAGATGCACAC

It does NOT:

- Predict phenotype
- Predict disease

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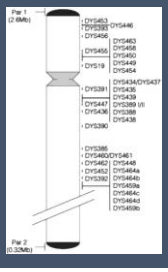
Y-STRs

Y-STR analysis targets locations which are all found on the Y-chromosome.

Only males have a Y-chromosome, and it is inherited as a unit from father to son to grandson – therefore, it is not unique to an individual, but shared among male members of a paternal line.

Useful in extreme mixture cases with an abundance of female DNA and a small amount of male DNA from the individual of interest.



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CAPILLARY ELECTROPHORESIS

PURPOSE:

- separate and detect DNA fragments based on size and location
- raw profile data is generated that can be used for interpretation

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PROFILE INTERPRETATION & COMPARISON

- Single-source or mixture?
- Number of contributors?
- Estimate the ratio of the individual contributors and consider all possible genotype combinations
- Assumed contributors?
  - Importance of reference standards
- Comparison to reference standards
- Statistical calculations

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Trace/Touch DNA Considerations

Small amount of DNA material

Challenges:

- Often result in low-level or partial profiles and complex mixtures
- Result in "*not comparable*" or "*inconclusive*" profiles
- DNA transfer
  - Primary
  - Secondary

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TRACE DNA CONSIDERATIONS

- Background DNA
- Contamination
- Elimination standards
- Understand limitations of interpretations

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PROBABILISTIC GENOTYPING

Probabilistic genotyping refers to the use of biological modeling, statistical theory, computer algorithms, and probability distributions to calculate likelihood ratios and infer genotypes of a DNA profile.

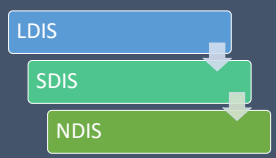
It is an advanced approach to the statistical analysis of DNA mixtures developed in response to the increased complexity of DNA samples submitted to DNA laboratories.

- a tool to assist DNA analysts to draw conclusions from complex and low-level mixtures which are currently deemed *"not comparable"* or *"inconclusive"*
- provides a more meaningful statistic in the form of a likelihood ratio (LR)

CODIS

Combined **D**NA **I**ndex **S**ystem

Blends forensic science and computer technology into a tool for linking violent crimes. It enables federal, state, and local forensic laboratories to exchange and compare DNA profiles electronically, thereby linking serial violent crimes to each other and to known offenders.



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FBI CODIS

There are strict rules governing the profiles which can be entered into CODIS; based on ***sample type*** and ***profile results***

- ***Sample Types:*** convicted offenders, arrestees, forensic (casework)

✓ Forensic samples are considered crime scene evidence:
- must be from evidence directly linked to the case
- must be from the putative perpetrator
- cannot be taken directly from the suspect

- ***Profile Results:*** must meet minimum CODIS Core Loci requirements

✓ As of January 1, 2017, there are 20 CODIS Core Loci (updated from 13)
- at least 8 of the original 13 core loci, **and**
- a match rarity of at least 1 in 10 million

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FBI CODIS

- There are no names or other personal identifiers of the offenders, arrestees, or detainees stored in the CODIS software.
- Sample remains in the database and is constantly searched as new profiles are added; only removed by administrator if new case information deems the sample ineligible.
- "HIT": A match between two (or more) DNA profiles (*case-to-case* or *case-to- offender*) that provides law enforcement with an **investigative lead**.

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VALIDATIONS

- What are validations? Why are they necessary?
  - Define the scope, reliability, and limitations of instruments, software, and laboratory methods
  - Necessary for not only DNA analysts, but also investigators, attorneys, judges, and potential jurors to understand the capabilities and limitations of DNA evidence.
- Types of validations:
  - 1. Developmental validations
  - 2. Internal validations
- Both are required by accreditation standards specific to forensic DNA testing

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STANDARDS & GUIDELINES

- FBI QAS – Quality Assurance Standards
- OSAC – Organization of Scientific Area Committees
- ASB – Academy Standards Board
- SWGDAM – Scientific Working Group on DNA Analysis Methods
- ENSFI - European Network of Forensic Science Institutes
- FSR – Forensic Science Regulator

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DNA evidence collection in sexual assault cases

- History
- History of SAKs – Marty Goddard
- Changes/updates:
  - Swab technique
  - Types of swabs
  - Wetting solutions
  - Other techniques
  - Length of time of evidence deposition (time between assault and evidence collection)

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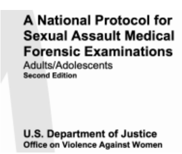
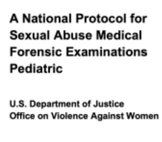
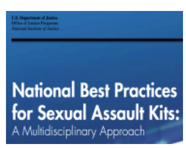
DNA Evidence Collection - Best Practices


A National Protocol for Sexual Assault Medical Forensic Examinations
Adults/Adolescents
Second Edition
U.S. Department of Justice
Office on Violence Against Women

https://www.ncjrs.gov/pdffiles1/ovw/241903.pdf


A National Protocol for Sexual Abuse Medical Forensic Examinations
Pediatric
U.S. Department of Justice
Office on Violence Against Women
April 2016

https://www.justice.gov/ovw/file/846856/download


National Best Practices for Sexual Assault Kits:
A Multidisciplinary Approach

https://www.ncjrs.gov/pdffiles1/nij/250384.pdf

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DNA Evidence Collection

National Best Practices

https://www.ncjrs.gov/pdffiles1/nij/250384.pdf

RECOMMENDATION 8:

Examiners should concentrate the collection of evidentiary samples by using no more than two swabs per collection area so as not to dilute the biological sample.

EXHIBIT 3: RECOMMENDED TIME FRAMES FOR EVIDENCE COLLECTION

Type of Assault	Collection Time
Vaginal	Up to 120 hours (5 days)
Anal	Up to 72 hours (3 days)
Oral	Up to 24 hours (1 day)
Bite marks/saliva on skin	Up to 96 hours (4 days)
Unknown	Collect respective samples within the time frames listed above

Note: For the references used to formulate this exhibit, see Appendix C. See also Scientific Working Group on DNA Analysis Methods, *SWGDAM Recommendations for the Efficient DNA Processing of Sexual Assault Evidence Kits* (Quantico, VA: Federal Bureau of Investigation, December 2016); http://media.wix.com/ugd/4344b0_4daf2bb5512b4e2582f895c4a133a0ed.pdf.

Skin (from bite wounds or oral contact)[c]	Use two lightly moistened swabs, from each affected area, packaged per jurisdictional policy.[d]	Same in children.
Skin (for touch DNA)	Use two lightly moistened swabs across the affected area (as in cases of strangulation), packaged per jurisdictional policy.[e]	Same in children.

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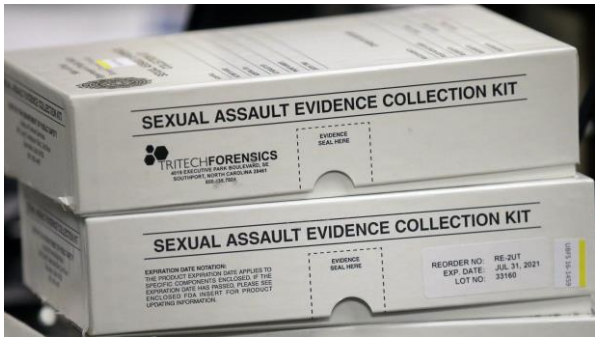
DNA Evidence Collection

- Avoid cross-contamination
  - Masks and gloves



Case Study

Case Study

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Case Study

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BLOOM

https://www.youtube.com/watch?v=QR4osIQxK5s

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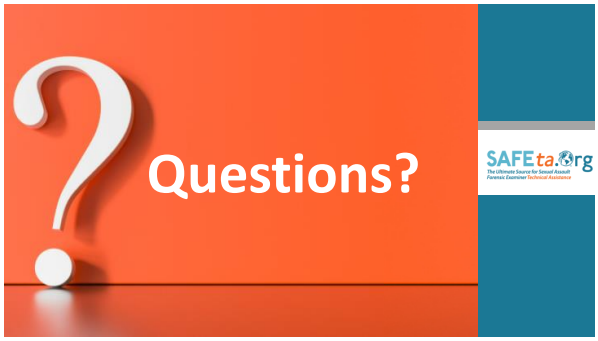

Upcoming SAFEta Webinar

DNA in Sexual Assault Cases Part 2: Current Sexual Assault Kit Research and Advancing DNA

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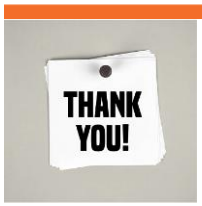
Research. Educate. Lead.



Thank you for joining us today!!