DNA in Criminal Sexual Assault Investigation

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Joliet Forensic Science Laboratory
Analytical Requests

Provide links between victim, suspect, and the crime scene by analyzing the physical evidence

• Common requests
  – CSA kit, clothing, bedding

• Unique requests
  – Products of conception (POC)
  – Criminal parentage

• Not all requests are acceptable
Types of Evidence Submitted

• Sexual assault kit containing:
  – Body swabs
  – Underwear
  – Hairs
  – Fingernail samples
Types of Evidence Submitted

- Sexual assault kit
- Clothing
Types of Evidence Submitted

- Sexual assault kit
- Clothing
- Bedding
Types of Evidence Submitted

- Sexual assault kit
- Clothing
- Bedding
- "Touch" swabs
Types of Evidence Submitted

- Sexual assault kit
- Clothing
- Bedding
- “Touch” swabs
- Miscellaneous stains / items
Types of Evidence Submitted

- Sexual assault kit
- Clothing
- Bedding
- “Touch” swabs
- Miscellaneous stains / items
- Weapons
Types of Analysis Performed

- Biological fluid screening
- Non-fluid sample collections
- DNA analysis
Case Approach for Criminal Sexual Assaults

Kit (including reference standard)

Undergarments

Other items
Case Approach for Criminal Sexual Assaults

• No testing of non-probative samples

• Approval to consume

• Profiling decision point
  – Standard versus male DNA only
Biological Fluid Screening

- Visualization of stains
Biological Fluid Screening

- Visualization of stains
- Preliminary testing

Test for semen (prostate fluid)

Test for semen (acid phosphatase)

Test for saliva
Results Reported: Biological Fluid Testing

Preliminary tests
– Fluids are “indicated”

No semen indicated

Semen indicated

Saliva indicated
Biological Fluid Screening

- Visualization of stains
- Preliminary testing
- Confirmatory testing
Biological Fluid Screening

- Visualization of stains
- Preliminary testing
- Confirmatory testing

Sperm cell
Results Reported: Biological Fluid Testing

Confirmatory testing
- Fluids are “identified”

Semen identified
Biological Fluid Screening

- Visualization of stains
- Preliminary testing
- Confirmatory testing
- Collection of samples for DNA testing
The DNA Analytical Process

Extraction

The spot containing the material is cut away from the rest of the object.

This piece is cut into even smaller pieces and placed in a tube.

Through a process of chemicals and heat, unwanted components are eliminated.

The pure DNA is suspended in a liquid.
Extraction

• Sampling plan for kit swabs
  – No swabs consumed

• Differential extraction
  – Sperm and non-sperm fractions

• Non-differential extraction
  – Mixed DNA
The DNA Analytical Process

Extraction

Quantification

Total amount of human DNA including how much of that DNA is male
The DNA Analytical Process

- Extraction
- Quantification
- Amplification (PCR)
  - Polymerase Chain Reaction (PCR)
  - Short Tandem Repeat (STR) sites
    - Variety of chromosomes
    - Just the Y chromosome (Y-STRs)
The DNA Analytical Process

- Extraction
- Quantification
- Amplification (PCR)
- Detection
Detection

Electropherogram
Detection

Electropherogram

Locus
Detection

Electropherogram

Locus

Alleles
The DNA Analytical Process

- Extraction
- Quantification
- Amplification (PCR)
- Detection
- Profiling and Comparison
Profiling and Comparison
Profiling and Comparison

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![Genetic Profiling Diagram](image-url)
Profiling and Comparison

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Results Reported: DNA

• Number of contributors
  – Single-source
  – Mixtures
    • Resolved
    • Unresolved

• Comparison to reference standards
  – Inclusion
  – Exclusion
  – Inconclusive
Multiple contributors

Resolved mixture

Unresolved mixture
The DNA Analytical Process

- Extraction
- Quantification
- Amplification (PCR)
- Detection
- Profiling and Comparison
- Statistical Weight
# Statistical Evaluation

<table>
<thead>
<tr>
<th>Locus</th>
<th>Victim Genotype</th>
<th>Suspect Genotype</th>
<th>Evidence Stain</th>
<th>Frequency (white pop.)</th>
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<tr>
<td>Total for 5 loci</td>
<td>NO MATCH</td>
<td>MATCH</td>
<td></td>
<td>4.9x10^-10</td>
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When frequency was calculated for remaining 8 core loci, final frequency was 1 in 69 quadrillion.
The DNA Analytical Process

Extraction

Quantification

Amplification (PCR)

Detection

Profiling and Comparison

Statistical Weight

CODIS
CODIS (The DNA Index)

- Database for autosomal STR profiles
- No Y-STR haplotypes
CODIS (The DNA Index)

- Profiles are searched statewide against:
  - Other sample profiles
  - Convicted felons
  - Suspects from other cases

- Eligible profiles are searched nationally against:
  - Other sample profiles
  - Convicted felons
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