DNA and Sexual Assault Evidence

Sarah Atterbury, Forensic Scientist
Amy Smith, Forensic Scientist
DNA Section
WSP Crime Laboratory -- Seattle
2203 Airport Way South, Suite 250
206.262.6020
DNA and Sexual Assault Evidence

- The Crime Lab
- The DNA Section
- Working a Sexual Assault Case
- Evidence Handling/Collection
- DNA Contamination Prevention
- Enemies of Biological Evidence
- CODIS
- Thanks to teamwork!
The WSP Crime Lab

Funded by the State Legislature

Managed by Washington State Patrol within the Forensic Laboratory Services Bureau

- Toxicology Lab
- Crime Lab

Provides forensic services to law enforcement agencies across the state
The WSP Crime Lab

• 4 Full Service Labs
  – Seattle (206)262-6020
  – Tacoma (253)536-4280
  – Marysville (360)651-6503
  – Spokane (509)625-5401

• 3 Limited Service Labs
  – Vancouver (360)993-3800
  – Kennewick (509)734-7022
  – Olympia (360)705-5988
The WSP Crime Lab

Services include:

- Firearms/Toolmarks
- Arson/Explosives
- Drugs/Clandestine Labs
- Microanalysis (hairs/fibers)
- DNA
- Latent Fingerprints
- Questioned Documents
Cases are submitted by law enforcement agencies

Prioritized according to court dates, offense, and/or whether or not there is a possible suspect
The DNA Section

Offenses include:

– Crimes against people
  • Homicide
  • Assault
  • Sexual assault

– Property crimes
  • Burglary
Locard’s Principle
Whenever two objects come into contact there is always a transfer of material. The methods of detection may not be sensitive enough to demonstrate this or the decay rate may be so rapid that all evidence of transfer has vanished after a given time. Nonetheless, the transfer has taken place.
Working a Sexual Assault Case

Communication with Detective

- Scenario
- What potential evidence is available?
- How long before SAK collected?
- Oral, anal, vaginal penetration?
  - Beware of the victim’s story!
- When was last consensual sex?
- Did suspect wear a condom? Ejaculate?
- Other unusual circumstances?
Working a Sexual Assault Case--
Evidence Examination

Evaluation of Medical Swabs  Evaluation of Clothing
Examination of SAK

- What are we looking for?
  - Semen
    - Oral, anal, vaginal, perineal swabs
    - Dried secretions/skin swabs
    - Underpants
  - Saliva
    - Dried secretions/skin swabs
  - Cellular Material/Hairs
    - Fingernail swabs
Working a Sexual Assault Case--Evidence Examination

Evidence Examination

- Blood ID
  - Phenolphthalin
  - Takayama
- Semen ID
  - Acid Phosphatase
  - Microscopic
  - P30
- Saliva ID
  - Amylase
- Cellular Material
  - Fingernails
  - Wearer DNA
Semen Search--Acid Phosphatase

Acid phosphatase (AP) is an enzyme found in elevated levels in semen and in lower levels in other body fluids, such as vaginal secretions.

AP testing can be used to target possible semen stained areas on swabs, underpants, clothes, bed sheets, etc.
Sexual Assault Case--Semen

Process of AP mapping
1. A moistened piece of filter paper is placed over the selected area.
2. Pressure is used to facilitate the transfer of body fluids to the paper.
3. The paper is marked for orientation, then transferred to a fume hood.
4. The paper is sprayed with the Fast Blue reagent.
5. A purple color develops in the presence of acid phosphatase.
Sexual Assault Case--Semen

Semen Search--Acid Phosphatase
Sexual Assault Case--Semen

Semen Search--Acid Phosphatase

Positive = purple color

Conclusion:
Indications of semen detected. Further testing required
A portion of the sample in question (swab, clothing, bed sheet, etc.) is removed and placed into a tube for further testing.
Sexual Assault Case--Semen

Semen ID--Spermatozoa Search
Microscopic Examination
Christmas Tree Stain--brightfield

Epithelial Cell
Spermatozoa
Sexual Assault Case--Semen

Spermatozoa Search
Microscopic Examination
Christmas Tree Stain--phase

Conclusion:
Semen Identified.
→ DNA extraction
Sexual Assault Case--
Semen

Prostate Specific Antigen
(PSA, p30)

PSA or p30 is a protein used to identify semen.

The test used is similar to a pregnancy test--in the presence of the protein, two pink lines will form on the card.

The p30 test is employed in the absence of sperm.
Sexual Assault Case--Semen

Prostate Specific Antigen

Positive = two lines
Negative = one line

Conclusion: Semen detected
Amylase is an enzyme found in elevated levels in saliva and in lower levels in other body fluids.

**NEW** – RSID Cards – specific for amylase
Sexual Assault Case--Saliva

Conclusion:
Elevated levels of amylase were detected. Results usually associated with saliva, however other bodily fluids cannot be eliminated.

Positive for Amylase
Phenolphthalein is a presumptive test for the presence of blood.

– Hemoglobin catalyzes the reaction that results in a color change to pink.
– It is a very sensitive test.
Sexual Assault Case--Blood

Phenolphthalin

Positive = Pink color

Conclusion: Indication of blood detected.
Sexual Assault Case--
Blood

Takayama

Takayama is a confirmatory test for blood.

- In the presence of blood, microscopic red crystals are formed.
- It is a very specific test.

**New – Hematrace Cards -
Specific for Human hemoglobin.**
Positive = crystal formation

Conclusion: Blood was identified.
Sexual Assault Case--Cellular Material

Skin cells are constantly being sloughed from the body and can be suspended within bodily fluids. Increased activity and/or friction increases the chance of cellular deposition.

Fingernail swabs and clothing items are excellent sources for cellular material.
Sexual Assault Case--
Cellular Material

Fingernail Swabs -
(old: Fingernail clippings/scrapings)

Possible foreign skin cells
Sexual Assault Case--Cellular Material

Clothing

Possible skin cells from wearer
Sexual Assault Case--
Other Evidence

Other sexual assault evidence
• Clothing (body fluids, signs of force, time lapse)
• Hairs (old: plucked)
• Condoms (sperm on the inside, female epithelial cells on the outside)
• Tampons
• Diapers
• Trauma on victim’s body
• Anything odd/unusual?
Once the biological material has been established, isolate the DNA.

Semen

Saliva

Blood

Cellular Material

DNA
DNA extraction procedures:

- Standard extraction
- Differential extraction

Two DNA extraction procedures

DNA is chemically isolated and purified

Differential extraction separates the sperm cells from epithelial cells.
Sexual Assault Case--DNA Quantitation

A technique that allows the scientist to evaluate how much human DNA was obtained during the extraction process and to determine the quantity to amplify.
PCR is a method of DNA manipulation that results in the chemical amplification of very specific DNA sequences. PCR acts to make many “copies” of these DNA regions (‘molecular xeroxing’). Millions of copies can result from only a few copies of DNA. This is great for old, degraded or minimal amounts of sample.
The Polymerase Chain Reaction

20-30 cycles

Denature
Anneal
Extend

Cycles 1 2 3 4 5

10^9
**Sexual Assault Case**

**DNA Amplification (PCR)**

| Profiller Plus kit amplifies 10 areas of the DNA | COfiler kit amplifies 7 areas of the DNA |

Together, the kits amplify 13 regions of DNA. For quality control, two overlapping areas and a gender determination site (amelogenin).
Sexual Assault Case--DNA Amplification (PCR)

This instrument acts like a molecular photocopier.
Sexual Assault Case--
DNA Detection

Capillary Electrophoresis ABI 310 Instrument

- Sample injected into capillary
- DNA fragments are separated by size
- Data is generated and is categorized by software

**New – AB 3130 – four samples run at the same time**
Once a case file is completed, it is given to another scientist who will review the case file and determine if the results obtained from the testing performed supports the conclusions reported.

This is a quality control measure to insure that the conclusions reported are complete and accurate.
Evidence Handling--Collection

If at all possible collect the entire item (clothing, knife, etc.)

Collection of stain if entire item cannot be collected

Collect the entire stain by using a slightly moistened sterile swab or use clean scissors or scalpel blade to remove it

Collection of substrate control
Collect an unstained area near the stain removed using the same procedure
Evidence Handling--Collection

Remember:
Use sterile swabs
and / or clean utensils.
Evidence Handling--
Collection of References

Oral swabs --
not a recommended reference for SA victims

Use a sterile swab and rub the inside of cheek area.
Air dry and store frozen.
Evidence Handling--
Collection of References

Blood Sample

Collect and store in the refrigerator
Remember:
Change your
gloves
frequently.

That means between each item.
Instead of using a gauze pad to collect a sample use a sterile swab.

Swab – keep the sample concentrated.
Instead of using tape to collect a sample use a sterile swab.

Swab – keep the sample concentrated
Use sterile instruments when collecting evidence.
• Make sure the item is completely dry before packaging
• Place each item in its own labeled package
• Do not overfill the package
• Do not seal items in plastic
  • Plastic can be used to transport wet items to a drying area, but should not be used for long term storage.
Evidence Handling--
Packaging

Condoms

Condom with liquid - the liquid should be allowed to dry before packaging and freezing.

Use a sterile swab to collect the liquid, allow to dry, package and label appropriately. Package the condom as instructed above.
Evidence Handling--Storage

- Stains, swabs and condoms – Freeze
- Stains on glass, metal, plastic or leather - DO NOT FREEZE --

Store these items on a shelf in a cool, dry, dark place.
Evidence Handling--Summary

- Dry thoroughly
- Package items loosely and separately in paper bags
- Document and label!
- Store in cool place
Good sterile techniques begin with you.

The quality of the results obtained by the scientists in the laboratory depends on the quality of the evidence collected and received.
Evidence Considerations

Consider the length of time between assault and report of assault / evidence collection.

Seminal fluids and constituents only stay in or on the body for so long.

Ask yourself--

“What’s the best evidence?”
If the event is reported days / weeks after occurrence and / or the victim has bathed, clothing evidence (incl. bed sheets, etc.) and signs of trauma may be the only or best evidence of sexual assault.
Sexual Assault Case--
Evidence Considerations

Your documentation / photodocumentation and communication with the investigator for the proper evidence collection are the key components of a sexual assault investigation.
DNA Contamination: 
Is There A Reason To Be Paranoid??
Contamination Prevention--
Non-Case Related

To prevent contamination

1) AVOID COUGHING OR SNEEZING ON ITEMS
   IF YOU HAVE A COLD, USE A MASK

2) ALWAYS WEAR DISPOSABLE GLOVES
   THEY WILL ALSO PROTECT YOU FROM DISEASE
Contamination Prevention--Case Related

To prevent contamination

1) ALWAYS CHANGE GLOVES BETWEEN ITEMS

2) DO NOT PACKAGE SEPARATE ITEMS IN THE SAME PACKAGE.

3) MAKE SURE THAT EACH ITEM IS CLEARLY MARKED WITH THE APPROPRIATE IDENTIFIERS.
Enemies of Biological Evidence

- UV light (sunlight)
- Heat
- High humidity/moisture
- Bacteria
• Pilot project begun by the FBI in 1990.
• The WSP Crime Lab system was one of fourteen state/local labs asked to participate.
• Allows the crime lab to search a database of DNA profiles of convicted offenders on state and national levels.
• Also possible to search crime scene evidence profiles to link cases via DNA.
**Washington--CODIS**
**As of December 2008**

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<tr>
<th>Statistical Information</th>
<th>State Total</th>
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<td>Current Backlog</td>
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Current samples collected are buccal swabs transferred to FTA paper
• An essential part of the evidence collection, preservation and analysis is communication.

• The SANE nurse and investigator must communicate with each other about the collection of evidence to make sure the appropriate items are collected.

• The forensic scientist must communicate with the investigator and prosecutor to determine the best evidence to examine.
Teamwork

Thanks to the efforts of Detectives, Sexual Assault Nurse Examiners, and Forensic Scientists…

KEEP UP THE GOOD WORK!!!
Case Study

• **Case scenario:**
  – Victim is 56-year-old woman, sexually assaulted by stranger in her home, after her husband left for work.
  – Suspect wore a mask during attack so victim could not ID him.
  – SAK, bedding, and clothing collected from Victim.
Body Fluid Testing Results

- Semen (p30+) detected on Vaginal and Anal swabs
- Amylase (not elevated) detected on Breast swabs (victim stated suspect licked her)
DNA Results:

• Breast swabs: partial male DNA profile (searched profile against CODIS and HIT to an offender profile)

• Vaginal and Anal swabs: male DNA detected at Quantifiler stage but no profile obtained. Both samples were further tested for Y-STR’s which also matched developed suspect.
Case Results:

• Suspect plead guilty to Rape 1 with a sentence range of 20 years to life.
• Suspect was currently serving time for another sexual assault with same scenario.
WSP Crime Lab – Seattle
Phone number 206.262.6020
Fax number 206.262.6033
Sarah Atterbury, Amy Smith

Email us at: first.last@wsp.wa.gov
Questions