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Importance of DNA Profiling

- DNA profiles helps solve more crime
- DNA databases
  - Speed up investigations
  - Reduce recidivism
- Technology in the labs is increasing
- Capturing the DNA from crime scene is becoming more critical

Green River Killer

The Problem

- Murder/Suspected Rape Case
  - Garment submerged – recovered within 10 hours
  - Failed DNA swab test
- Murder Case – Gang Related Shooting
  - Suspect sweat or saliva on fabric
  - Swab yield mixture
  - Need full profile to move case forward

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The Problem

"Sexual assault samples are among the most difficult sample types encountered by forensic DNA laboratories, frequently suffering from multiple challenges including small quantity of male DNA, relatively high quantity of female DNA and presence of PCR inhibitors."

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National Forensics Data

- Approximately 5.6 Million violent crimes, rapes, murders, robberies, assaults and property crimes in the US in 2010
- 185,000 unsolved homicides between 1985 and 2010

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Random vs. Deliberate

- Other industries the target cells/material is randomly dispersed
- In forensics the DNA material is deposited by a specific act (i.e. crime)
- Investigation process narrows down the points of deposit so that the DNA material can be collected

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What is wet vacuum sampling?

- Dispensing a sterile collection solution onto a sample surface under pressure
- Simultaneously collecting the solution from the surface with vacuum force
- Isolating the collection solution and surface particulate in a collection bottle

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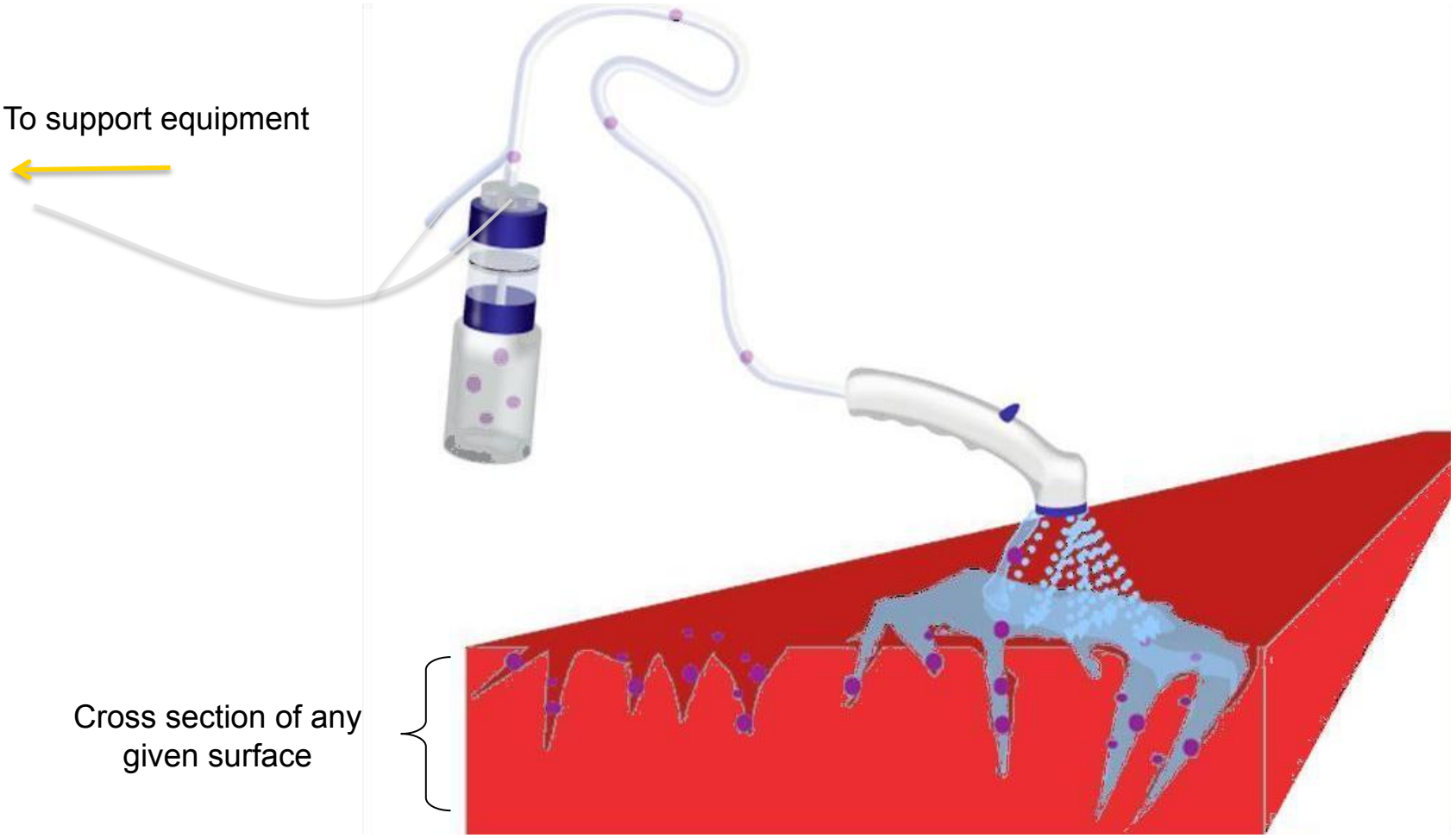
How The M-Vac Works



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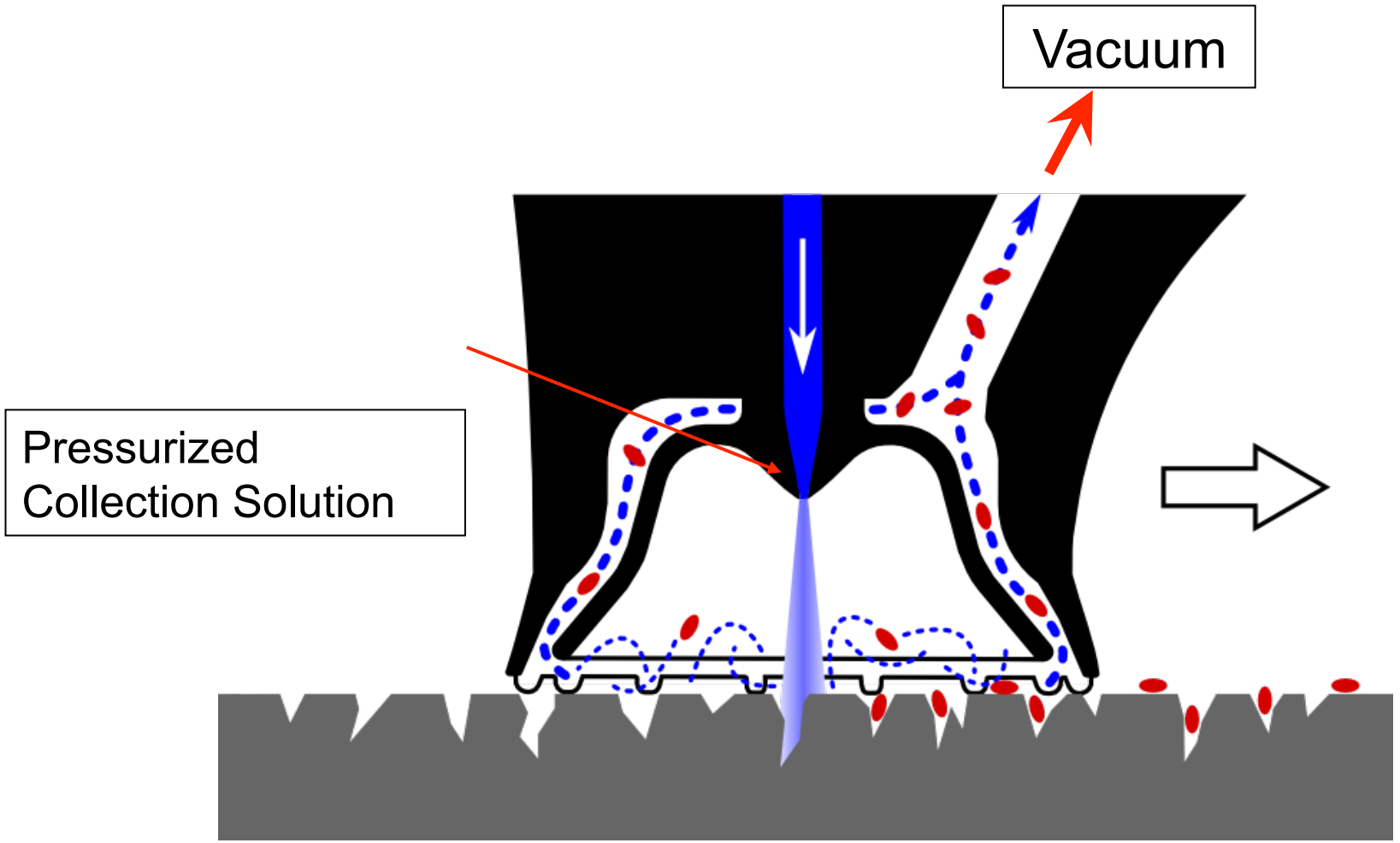
Sampling Method



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Summary of Sorenson Forensics Validation

Quality of DNA Profile Results:

- **The M-Vac procedure provided DNA of quality suitable to obtain excellent DNA profile results and of excellent quality.**
- **No DNA inhibitors or sample degradation attributable to the M-Vac was detected.**
- **The results obtained from traditional sampling methods often did not yield sufficient DNA to obtain profile results of equivalent quality from those obtained from the M-Vac samplings.**
- **The M-Vac recovered up to 200X more DNA material than the double swab method.**

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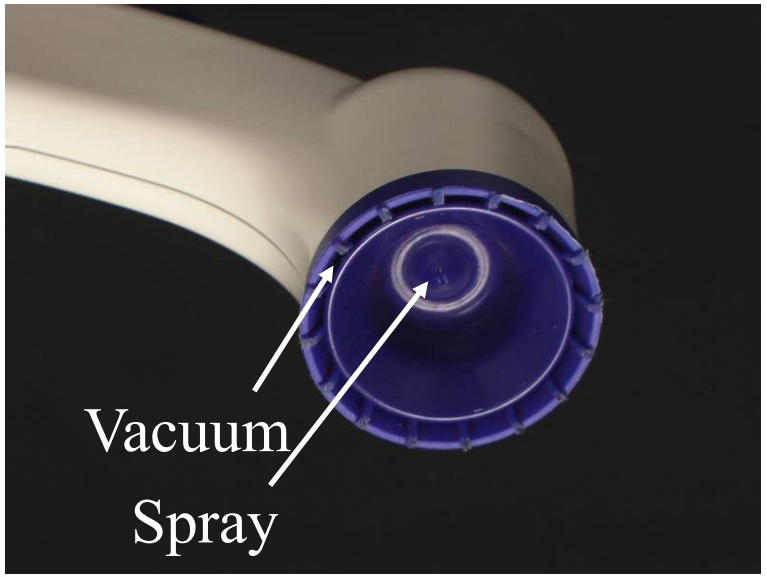
M-Vac System

SEC

SRS

M-Vac & Sampling Head (MS Kit)

Sample Collection Bottle



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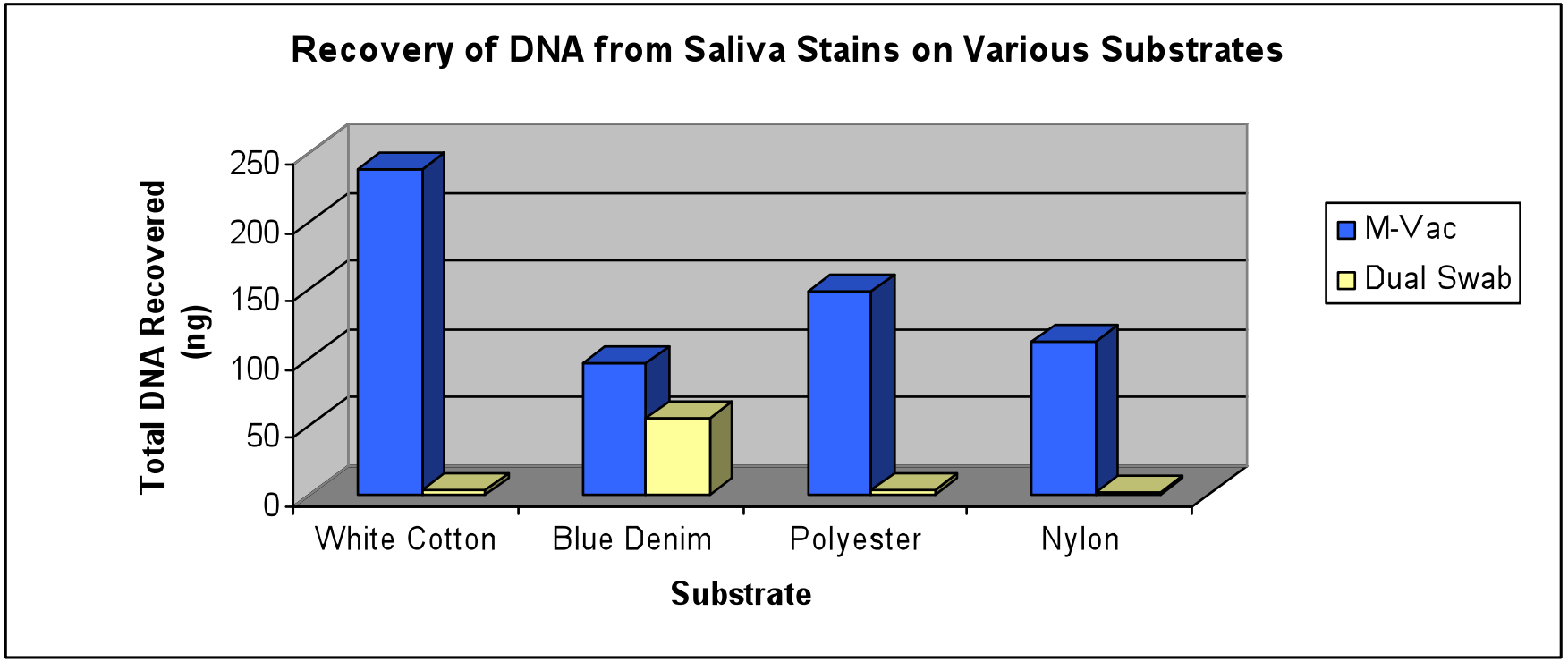
Recovery of DNA



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Boston University Data

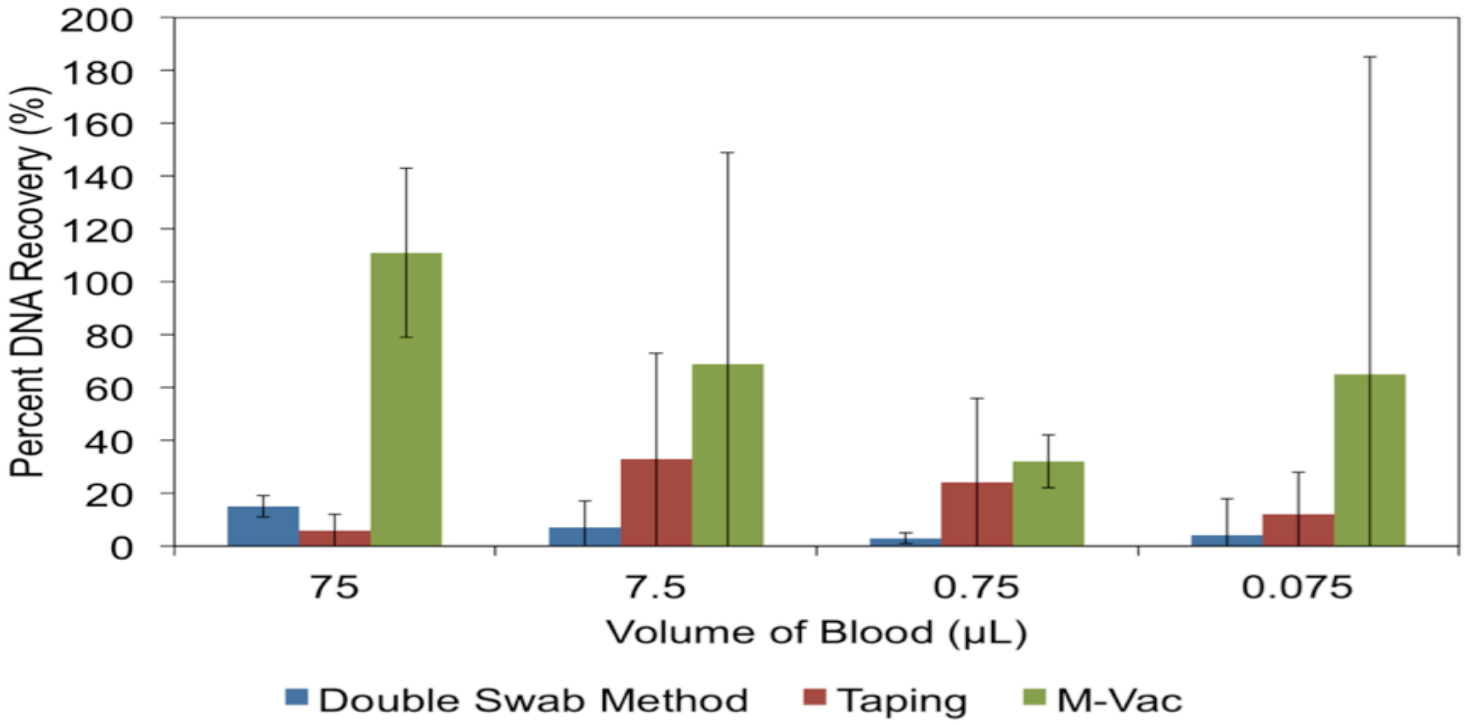

Figure 8. Percent DNA recovery of blood (0.075 – 75 µL) using various collection methods on denim with error bars representing the 2SD calculated using the theory of propagation of random error.

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UC Davis - Biological Evidence Collection Methods

- "Traditional" methods to collect biological evidence include swabbing, cutting, and tape lifting
- Disadvantages:
  - Non-visible biological stains
    - Where to sample?
  - Large Surface Areas
    - Multiple samples require a lot of time
    - Cost to extract and quantify
    - Random collections may "miss" the evidence

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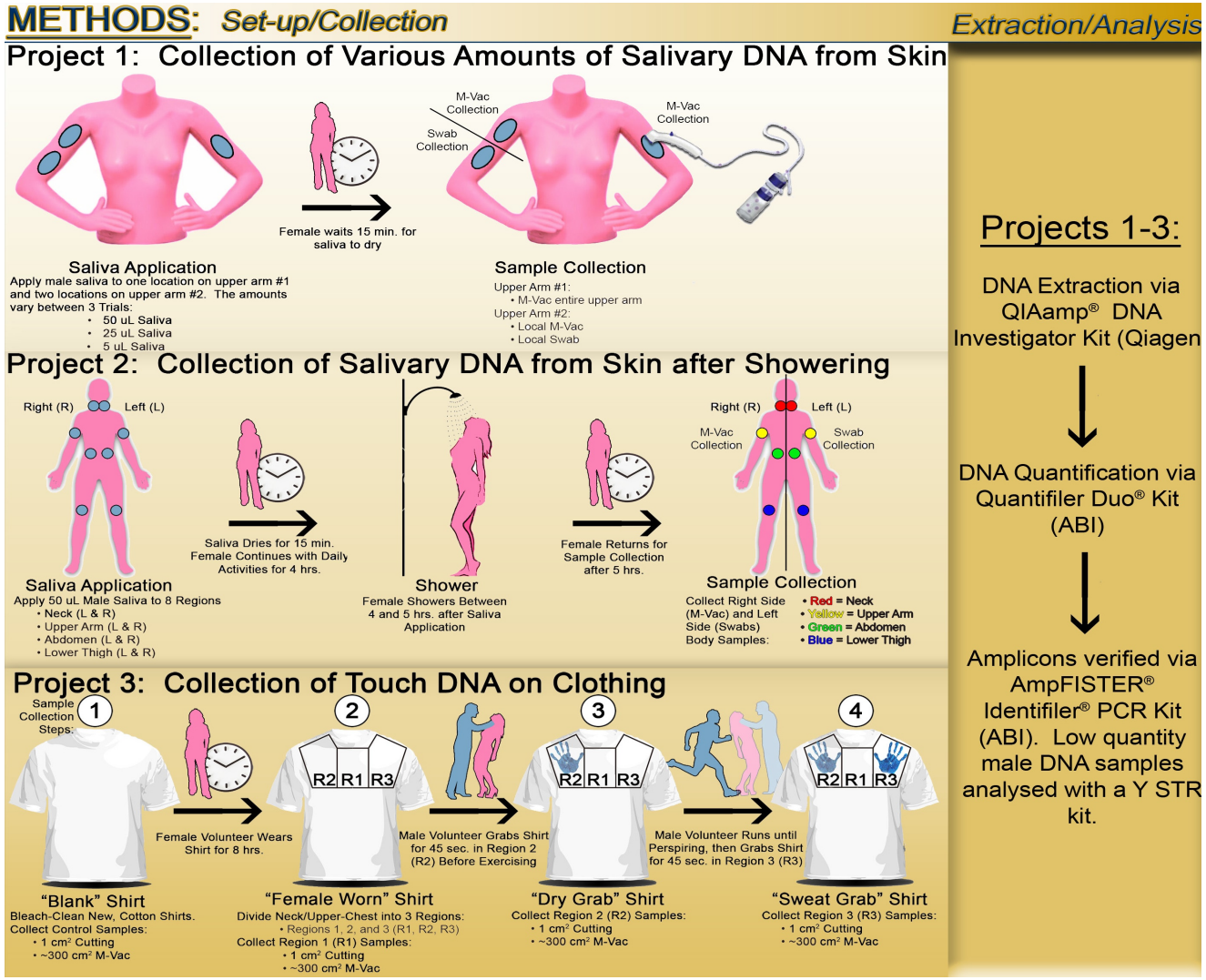
UC Davis Project



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Conclusions

- Project 1:
  - Local M-Vac is more effective at collecting salivary DNA from female skin than standard double swab technique
  - Full arm M-Vac yields sufficient male DNA for STR analysis
- Project 2:
  - Successful recovery of male salivary DNA after showering
  - M-Vac may be more effective when saliva location is unknown
- Project 3:
  - M-Vac collected significantly more DNA compared to cuttings
  - More touch DNA is recovered if the contributor has sweaty hands
  - M-Vac allows for more effective sampling from large surface areas

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Filtrate Data

Sample	Average Quant	Total DNA (ng)	Sample Method
#1 Filter	2.92E-01	52.56	M-Vac of Positive
#2 Filter	2.82E-03	0.51	M-Vac of Blank
#3 Filter	1.62E-01	29.16	M-Vac of Swabbed Positive
#4 Filter	7.46E-03	1.34	Swab of Positive
#5 Filter	N/A	0.00	Swab of Blank
1A	N/A	0.00	M-Vac of Positive Filtrate
2A	N/A	0.00	M-Vac of Blank Filtrate
3A	N/A	0.00	M-Vac of Swabbed Positive Filtrate

Concentration Filter Used .45µ

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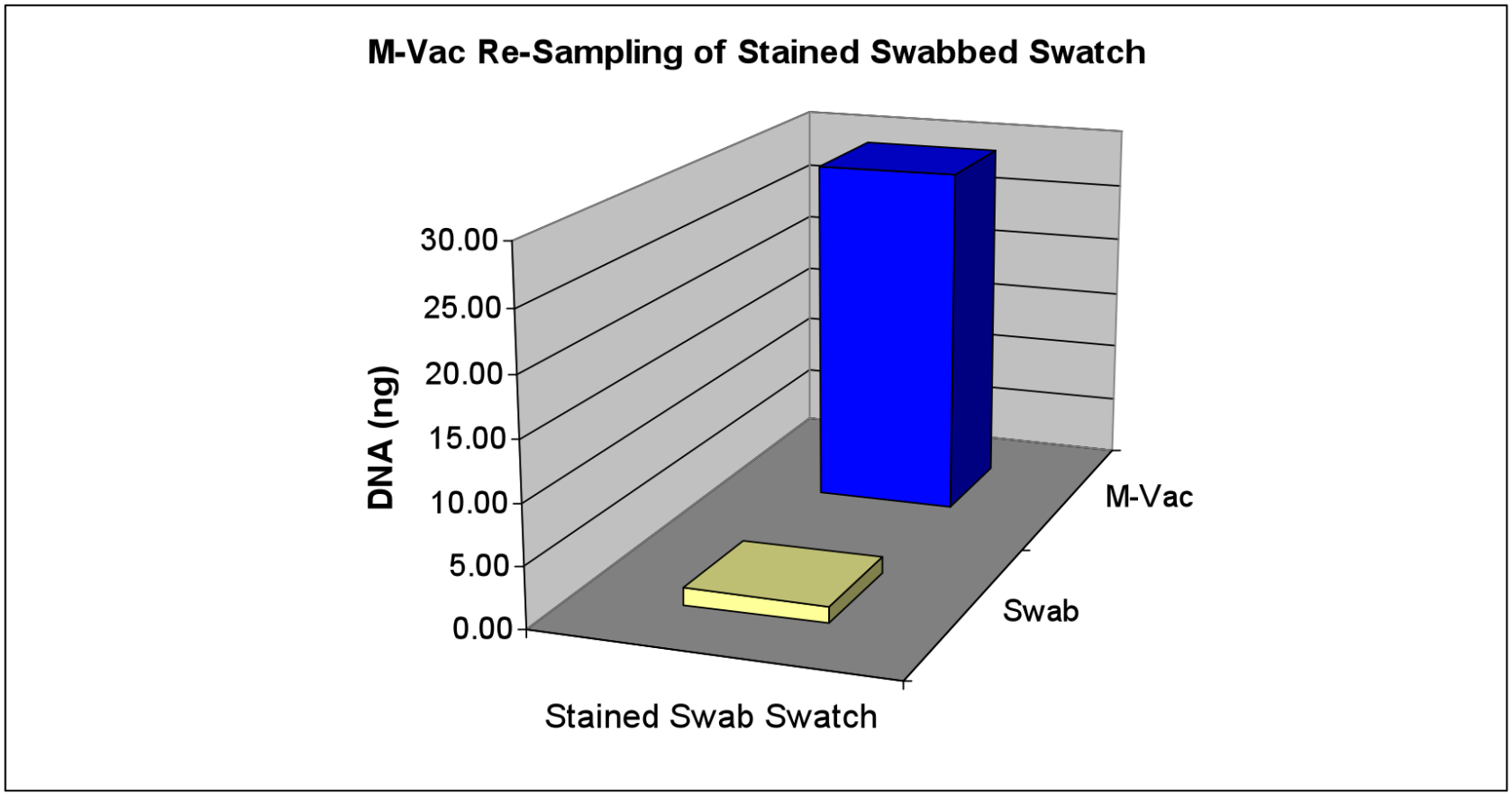
Filtrate Data



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Types of Surfaces

- White cotton fabric
- Blue denim fabric
- Nylon fabric
- Polyester fabric
- Ceramic Tile
- Cutting board
- Conveyor belt
- Stainless steel
- Polypropylene
- Carpet
- Animal hide
- Corkboard
- Human skin

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Who's Using It?

- US
  - Salt Lake Area Agencies
  - NY, FL, AZ, CO, CA, TN
  - Research – UC Davis, IUPUI, Cedar Crest, OK, Boston U, Cal State LA
  - Private Labs - Sorenson Forensics, DNA Labs International, SERI
- International
  - Active or Testing – SAPS, China, GCC, UK, Australia, Russia, Mexico, Canada

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When is M-Vac Used?

- Porous surfaces
  - Fabrics
  - Rock
  - Carpet
  - Brick
  - Bedding
- Non-porous surface
  - Large areas
- Touch DNA
- Failure of traditional method

Case #1

Krystal Lynn Beslanowitch - 1995

Yahoo News – “Without the efforts of Wasatch County Sheriff Todd Bonner, the case would have been forgotten long ago. For Bonner, however, it was personal. As the original investigator in the bludgeoning death of the teenage prostitute in 1995, he couldn't let it go.

"It was haunting me my whole career," Bonner told The Associated Press on Friday. "It doesn't matter that she was a street girl. This is a 17-year-old girl — a human being. I could care less what she did for a living. She was doing what she had to survive."

The body of Krystal Lynn Beslanowitch was found Dec. 6, 1995, along the Provo River near Midway. Her head had been crushed with a granite river rock.

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Full “touch DNA” profile collected from river rock

"There are many officers, analysts and agencies that need to be thanked for their part in solving the Beslanowitch homicide. *Without a doubt, the M-Vac System is the major tool that allowed us to make critical DNA connections in this case.*” Sheriff Todd Bonner

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Additional Cases

- Case #2 - Attempted burglary backpack
  - Touch DNA
  - Former employee attempted to grab payroll
  - Sample backpack
- Case #3 - Forcible rape homicide
  - Touch DNA
  - Swab not definitive
  - Sampled girls blouse

Additional Cases

- Case #4 - Rape/Homicide
  - Body submerged for 8-10 hrs
  - Sampled underwear for touch DNA & semen

- Case #5 - Gang-related Shooting
  - Sweatshirt discarded away from scene
  - Swabbing yielded mixture
  - M-Vac sampled neck area of hoodie – full profile

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Additional Cases

- Case #6 - Homicide
  - Fabric used to smother victim
  - Swab sample not definitive (Y-STR)
  - Sampled around perimeter of victim bio-stain
  - M-Vac produced full profile of suspect

- Case #7 – Accused Sexual Assault
  - Swab inconclusive
  - M-Vac revealed 1 major, 2 minor donors (up to 6 donors) - NOT accused

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Success Rates

- Silver Bullet? No.
- 50%+ of evidence re-sampled with M-Vac came back with at least partial profile
- Agencies using system are getting results
- Mindset of new capability X+Y+Z
- Training
- Understanding of where appropriate

Value

- Increased DNA Collection
  - Touch DNA
  - Scalability & sensitivity
  - Rough and porous surfaces
  - Unlock cold cases
- Law Enforcement/Legal
- Society
- Victims and Families

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Summary

- DNA collection is key
- New technology platform
- Unprecedented DNA recovery
- Increased sensitivity and scalability
- Potential to solve more cases

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Questions?

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