Battle of the Collection Methods:
Wet Vacuum vs. Wet Swab

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"Comparison of the M-Vac® Wet-Vacuum-Based Collection Method to a Wet-Swabbing Method for DNA Recovery on Diluted Bloodstained Substrates"

Itunu Alao and Mallika Chari

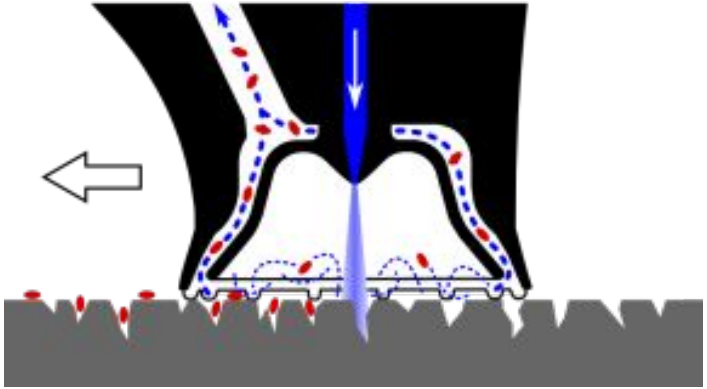
Background information

Wet Swabbing Method

1. Rub the swab onto the stain to transfer the particles
2. DNA extraction to collect the DNA for purifying and quantifying

Wet Vacuuming Method

1. Collection solution sprayed onto the surface while simultaneously being vacuumed off
2. Collect any residual liquid by only using vacuum force
3. Transfer solution into sterile collection bottle with filter



Why does this work?
The vacuum force and spray creates a “mini hurricane”, loosening the DNA that can then be collected and concentrated onto a filter.

Wet-swabbing

Advantages

- Convenient
- Simple
- Time-efficient
- Inexpensive
- Can be utilized in crevasses

Disadvantages

- Does not perform well on porous and absorbent surfaces

Wet-vacuum

Advantages

- Ability to expand the area of sampling
- Allows for better retrieval of DNA hidden within fibers or crevasses of absorbent and or porous items
- Increase in amount of biological material

Disadvantages

- Can recover more DNA which can unnecessarily increase to complexity of the DNA mixture
- Difficult for target sampling
- Expensive ($43,000-45,000)
- Bulky/ Inconvenient

Previous Studies vs McLamb et. al.'s Study

Where wet vacuum had a greater DNA yield than other collection methods …

- On denim, carpet, bricks, laminated wood, cotton t-shirts

Where wet vacuum and other collection methods had similar DNA yield …

- On tiles, glass, skin

How this study expanded upon these previous results …

- Used 22 different substrates
- Deposited blood on each
- Tested wet-vacuum method in two different ways:
  - Just wet-vacuum
  - Wet-vacuum AFTER wet swabbing

McLamb et al.

Purpose:

1. Compare DNA recovery between the wet-vacuum and conventional wet-swabbing
2. Explore the wet-vacuum ability to recover potentially uncollected DNA from previously swabbed substrates
3. Determine the efficiency of the collection techniques when using the same extraction method

Results:

- In 20 of the 22 substrates tested, the wet-vacuum method resulted in greater nDNA yield than the wet-swab method
- Following wet-swabbing, the wet-vacuum method recovered additional DNA that was, at minimum, equivalent to the initial swabbing, and maximally 46-fold more
- When utilizing the same DNA isolation protocol there was slight increase in DNA yields for the wet-vacuum samples

McLamb et. al (continued)

Advantages

- Despite having two different extraction methods for the wet-vacuum and wet swab …
  - Able to determine that only the collection method had an effect on DNA yield
    - Tested collection methods with the same extraction technique to ensure that the only factor affecting DNA yield was collection method

Disadvantages

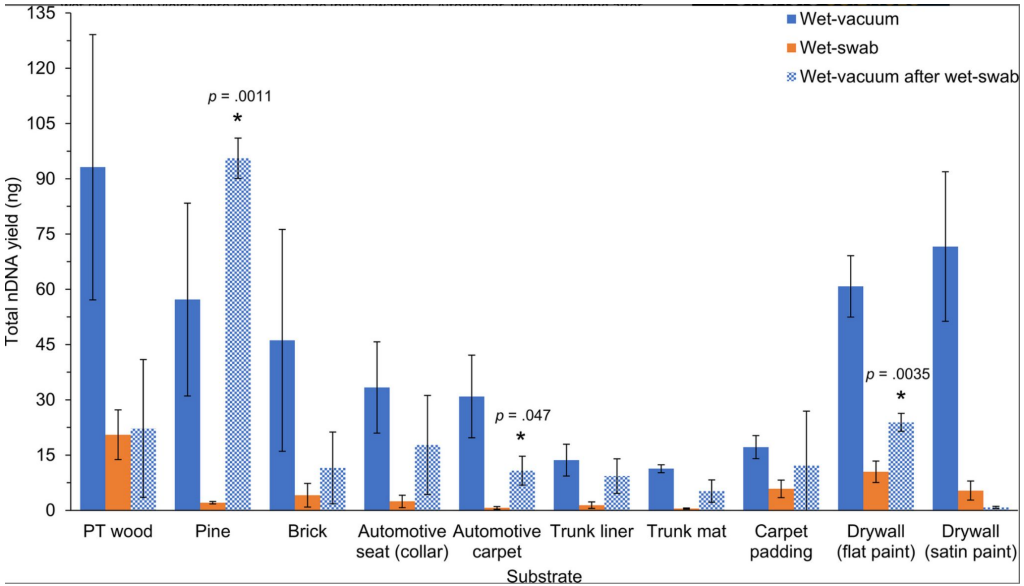
- Didn't know how much DNA was lost during the wet-vacuum filtration

Because this study only tested diluted bloodstains …

- Didn't test water-insoluble stains and the residue recovery from them
- Didn't test trace evidence recovery (ie: hair, fibers, etc.)

Application to Forensic cases

- Performs well on porous surfaces
  - “ In total, wet-vacuuming recovered more nDNA on 18 porous substrates compared to wet-swabbing, eight of which were significantly greater”
- Wet vacuuming may be helpful when retesting evidence
  - Following wet swabbing of 10 substrates, “ for nine substrates, the wet-vacuum recovered additional DNA that was, at minimum, equivalent to the initial swabbing, and maximally 46-fold more”



Cold Case

1995 Murder Case

- 17 year old girl, Krystal Beslanowitch was beaten to death with a rock
- Wet-vacuum was utilized to collect “touch DNA” from skin cells on the rock
- In 2013, match from touch DNA led police to Joseph Micheal Simpson who was convicted for the murder

Recent Case

Water Soaked Clothing

- Female child found submerged in water; had been there for ~10 hours; signs of sexual trauma
- Initial examination → no semen, blood from underwear presumed to be the victim's
- M-Vac examination → underwear processed for touch DNA, obtained a minimal amount of male DNA
  - 6000:1 = female:male ratio
  - Still able to develop a partial profile

Suggestions for further research or implementations

- Research should be conducted to improve wet-vacuuming and expand its forensic applications
- Wet-vacuum should be utilized when conventional methods yield poor DNA results
- Cell retention of wet-vacuum filters
- Price of wet-vacuum can be a limiting factor for wide implementation

Sources

Better than 'CSI': High-tech DNA vacuum cracks cold case. Al Jazeera America. (n.d.). Retrieved November 11, 2021, from http://america.aljazeera.com/watch/shows/techknow/blog/2014/2/18/better-than-csi-hightechdnavacuumcrackscoldcase.html.

Hellwig, D. (2018). *Water Soaked Clothing - Touch DNA and Body Fluids*. Sorenson Forensics. https://www.m-vac.com/images/pdfs/casesummary-m-vac1.pdf

Graham Williams Head of Criminal Justice and Forensic Science. (2021, October 6). *The science that could revolutionise time measurements in forensic investigations.* The Conversation. Retrieved November 11, 2021, from https://theconversation.com/the-science-that-could-revolutionise-time-measurements-in-forensic-investigations-92319.

McLamb, J. M., Adams, L. D., & Kavlick, M. F. (2020). Comparison of the M-Vac® Wet-Vacuum-Based Collection Method to a Wet-Swabbing Method for DNA Recovery on Diluted Bloodstained Substrates. Journal of Forensic Sciences, 65(6), 1828–1834. https://doi.org/10.1111/1556-4029.14508

Mitra, S. (2021, September 8). *Krystal Beslanowitch Murder: Where is Joseph Michael Simpson now?* The Cinemaholic. Retrieved November 11, 2021, from https://thecinemaholic.com/krystal-beslanowitch-murder-where-is-joseph-michael-simpson-now/.