Turning Unsearchable Mixtures into Actionable Intelligence for Reliable DNA Evidence

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Cybergenetics

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Disclosure

- The views and opinions expressed in this presentation are those of the presenters & authors and do not represent any official views or opinions of the American Academy of Forensic Sciences.

- Some of the authors are employed by Cybergenetics.

- We show the TrueAllele® evidence interpretation technology developed by Cybergenetics.

- Burglary
- Thefts
- Car Break-Ins
- Weapons Possession

DNA Investigative Process

- BodeHITS Process
- Enables DNA use in high-volume, low-level crime
- Batch testing provides speed and cost efficiency
- Regional database sharing links profiles across jurisdictions

- Trade-off
  - High-volume low-level crimes result in samples that are deemed non-searchable mixtures (NSM)

RapidHit Investigative Process

- Enables the 90-minute processing of single-source samples, producing DNA profiles for uploading and searching of the BodeHITS Database for regional sharing matches
- It allows us to answer investigative questions in real-time

Investigative Hurdle

Searchable vs. Non-searchable

✓ **Searchable** Profiles = Match or No match
✓ **Non-searchable** Mixtures = Stalled investigation

POLICE LINE DO NOT CROSS

A New Question was asked
- Is there more we can do with the NSM Data on a monthly basis?

MontCo and Cybergenetics Collaboration

Established TrueAllele Investigative Database (TAID) → Allow us to re-evaluate the NSMs → Started with two years of high-volume low-level crime data → Developed associations between evidence and reference samples

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TrueAllele® Technology

Separates data into contributor genotypes
   uses all data, no thresholds, 10 contributors
Represents uncertainty using probability
   accurate: preserves identification information
   unbiased: doesn't know suspect profile

Reports likelihood ratio match statistic
   change in genotype probability, error rates
Automated computer workflow frees people
   no calibration, learns from evidence data

Number of Contributors

	1	2	3	4	5	6	7
1	93	16	1				
2	132	156	77	18	3		
3	24	132	168	79	30	3	
4	3	17	81	84	73	22	
5	1		2	22	60	25	6
6				1	5	13	7
7							3

TrueAllele Database

Genotype matching database
    uploads all genotypes
    automated match server

Connects separated genotypes
    evidence to evidence
    evidence to reference

LR connection strength
    records DNA matches

TrueAllele + LIMS = TAID

TrueAllele Identification Database (TAID)
    uploads all contributor genotypes
    preserves DNA match information
    records all strong LR connections
   annotates with LIMS information

- Reduces human effort ten-fold
- Passes cost saving on to investigator
- Enables affordable volume crime DNA

Evidence to Evidence

	A	B	C	D	E	F	G
Collected		14-Nov-22					
Door Handle		1					
Gear Shifter		15					
Steering Wheel		23					
log(LR) range	4 - 10	4 - 11	4 - 9	5 - 11	4 - 11	4 - 9	5 - 7
# Matches	9	39	7	4	9	6	4
Collected	31-May-21		6-Jan-23	13-Feb-23	16-Feb-23	22-Mar-23	2-Oct-23
Door Handle			3				
Gear Shifter	3		2	4	3	4	2
Ski Mask	3						
Steering Wheel	3		2		3	2	2
Tire Iron				3			

Evidence to Reference

				R			
			Collected	**10-Jan-23**			
			Suspect	18 Y/O Male			
			log(LR) range	**4 - 30**			
			# Matches	**18**			

	A	B	C	D	E	F	G
log(LR) range	23 - 27	4 - 9	17 - 30	18 - 30	16 - 30	18 - 20	16 - 21
# Matches	3	3	3	2	3	2	2
	A	**B**	**C**	**D**	**E**	**F**	**G**
Collected	**31-May-21**	**14-Nov-22**	**6-Jan-23**	**13-Feb-23**	**16-Feb-23**	**22-Mar-23**	**2-Oct-23**
Door Handle			1				
Gear Shifter	1	1	1	2	1	1	1
Ski Mask	1						
Steering Wheel	1	2	1		1	1	1
Tire Iron					1		
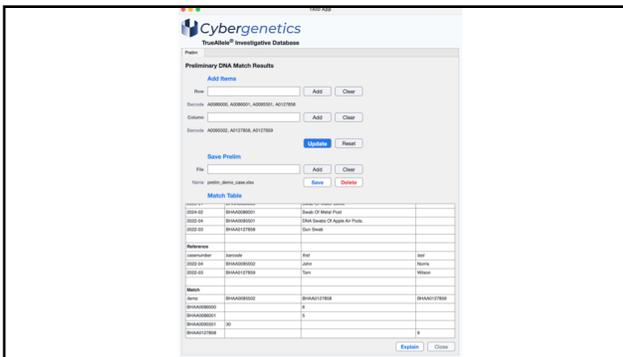
From Mixtures to Clarity

Montgomery Bode data to Cybergenetics
  100 DNA items / month
  60% evidence, 40% reference
  ➡ **60% *unsearchable mixtures* <u>unused</u>**

TrueAllele ID information improvement
  1.32 evidence matches / item
  98% of evidence is informative
  ➡ **72% *unsearchable mixtures* <u>matched</u>**

Case Example

- Juvenile male "HB" criminal trajectory

HB was the suspect in numerous vehicle thefts/break-ins, but wasn't linked because of NSMs.

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- A father and his two children were carjacked by two suspects. One was masked, and the other was identified and arrested.

- The two years of DNA were evaluated by TAID, resulting in matches in seven cases, identifying HB, one of whom was the masked perpetrator in the carjacking.
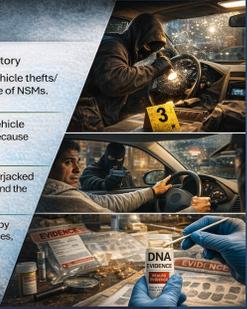
Montgomery County TAID

- Local PDs and Prosecutors have seen the revival of stalled cases

- Associations are given on a monthly basis, between cases in the same jurisdiction and across jurisdictions

  - Evidence-Evidence
  - Evidence-Reference

- We realized that NSMs don't mean non-useable
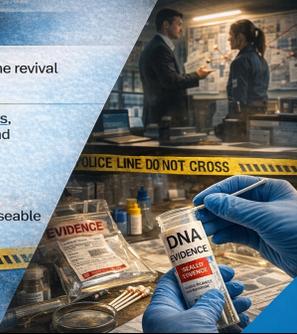
Montgomery County TAID

Where do we go from here?

- Continue to prioritize DNA recovery and analysis on volume crimes

- Support intervention before escalation occurs

- DNA shouldn't just close cases—It should change trajectories of early offenders

More TAID information

http://www.cybgen.com/information

- Courses
- Newsletters
- Newsroom
- Presentations
- Publications
- Reliability
- Webinars

http://www.youtube.com/user/TrueAllele
TrueAllele YouTube channel

You Tube

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