**Solving Cold Cases by
TrueAllele® Analysis of DNA Evidence**

**Finding Closure: The Science, Law and Politics
of Cold Case Investigations
October, 2014
Pittsburgh, PA**

**Mark W Perlin, PhD, MD, PhD
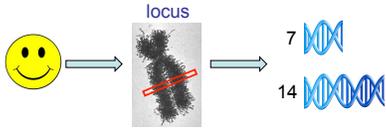Cybergenetics, Pittsburgh, PA**

Cybergenetics

Cybergenetics © 2003-2014

Genotype

10, 12
13, 16
15, 15
29, 32
18, 23
15, 18
 7, 14
20, 22
9, 9.3
14, 18

• list of numbers
• no personal information
• anonymous data
• good only for matching
• unrelated to disease
• no genetic predispositions
• bar code for identification
• connects people to crimes

DNA biology

Cell

Nucleus

Chromosome
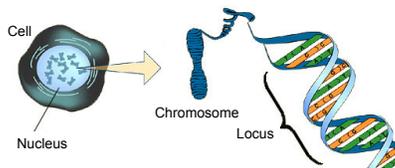
Locus

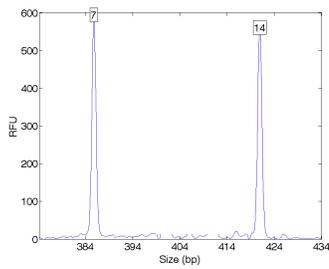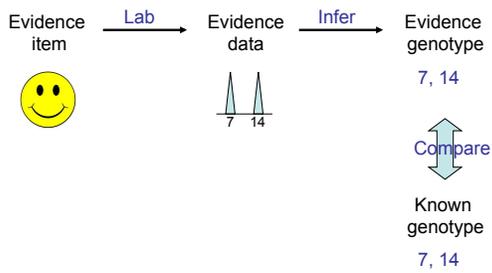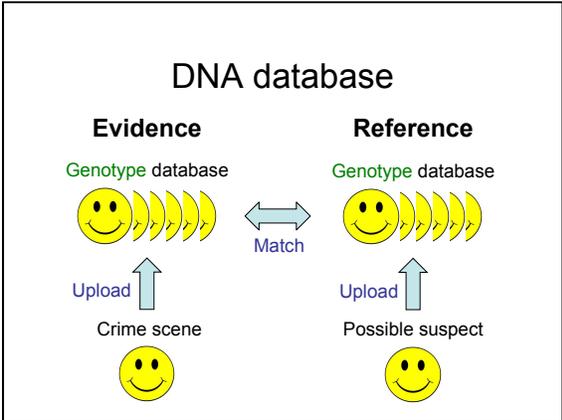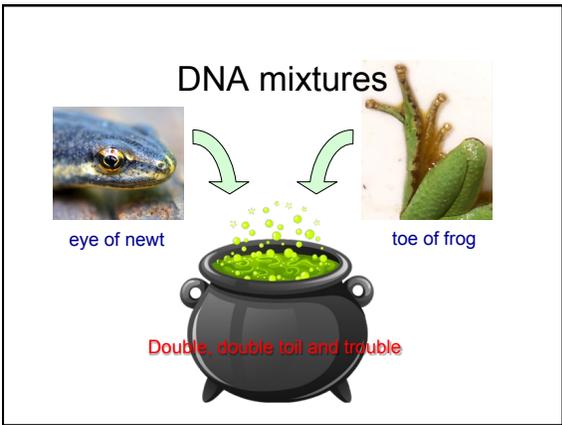
One person, one genotype

DNA data

One or two allele peaks at a locus

DNA identification pathway

DNA database

Evidence   **Reference**

Genotype database   Genotype database

Match

Upload   Upload

Crime scene   Possible suspect

DNA mixtures

eye of newt   toe of frog

Double, double toil and trouble

Two people, two genotypes

locus

7

14

10

12

DNA mixture data

Peak heights and pattern at a locus

DNA pathway broken

Most mixture interpretation methods and software cannot separate mixtures into contributor genotypes
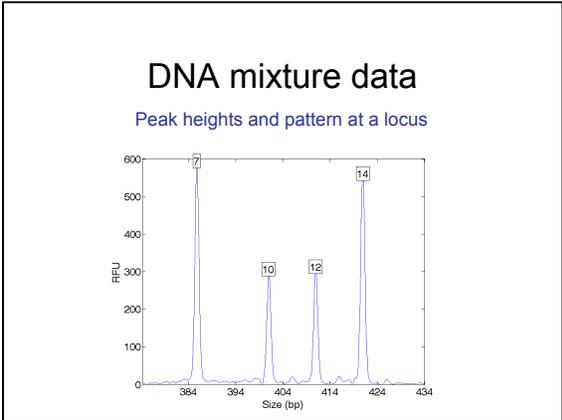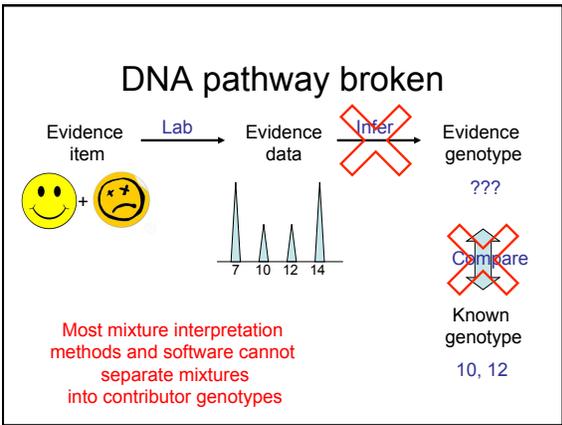
DNA Mixture Crisis

375 cases/year x 4 years = 1,500 cases
320 M in US / 8 M in VA = 40 factor
1,500 cases x 40 factor = 60,000 inconclusive

1,000 cases/year x 4 years = 4,000 cases
320 M in US / 8 M in NY = 40 factor
4,000 cases x 40 factor = 160,000 inconclusive

+ under reporting of DNA match statistics

DNA evidence data in 100,000 cases
Collected, analyzed & paid for – but unused

TrueAllele® Casework

ViewStation   **Database**   **Interpret/Match**
User Client   **Server**   **Expansion**

Visual User Interface   Parallel Processing Computers
VUIer™ Software

TrueAllele separates mixtures

Resolves mixture data into minor & major contributors

25% 75%

Cybergenetics
DNA pathway restored

Evidence   Lab   Evidence   Infer   Evidence
item   data   genotype

10, 10 @   5%
10, 12 @ 90%
10, 14 @   5%

7 10 12 14

Compare

Computer separation of mixtures
into contributor genotypes
restores single-source simplicity

Known
genotype

10, 12

Southampton rapist

Stranger rape on New Year's Eve

DNA rape kit evidence

A trace amount of semen detected on vaginal swabs was submitted for DNA profiling

The DNA profile contained limited information. A speculative search was done of the National DNA Database. The search found 13 profiles, 1 in the Hampshire area.

Due to the low level and incomplete nature of the DNA profile, it is not suitable for routine statistical evaluation.

TrueAllele uses all the data

Quantitative peak heights at locus D21S11
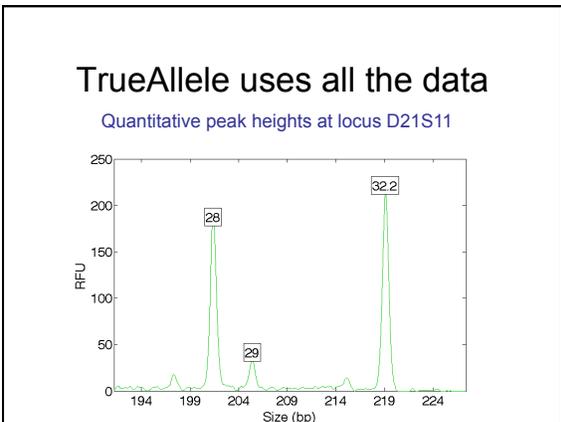
Alternatives use less of the data

Over threshold, peaks are labeled as allele events

All-or-none allele peaks, each given equal status

Threshold

Under threshold, alleles vanish
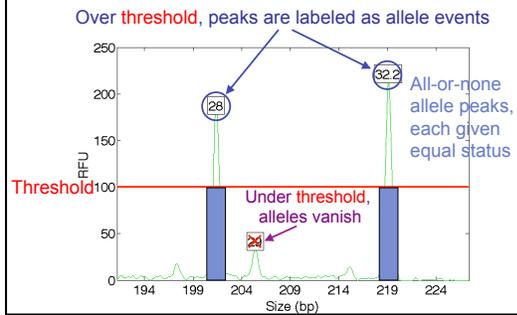
How the TrueAllele computer thinks

Consider every possible genotype solution

Explain the peak pattern

One person's allele pair

Better explanation has a higher likelihood

Another person's allele pair
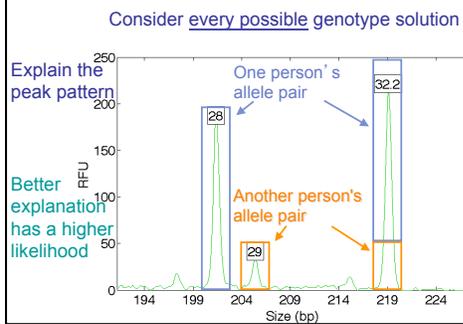
Separated evidence genotype

Objective genotype determined solely from the DNA data. Never sees a comparison reference.

one contributor, at one locus

12% 14% 12% 2% 4% 13% 2% 21%

27,29 28,29 29,29 28,30 29,30 29,31.2 28,32.2 29,32.2

Allele Pair

DNA match information

How much more does the suspect match the evidence than a random person?

Match information at 10 loci
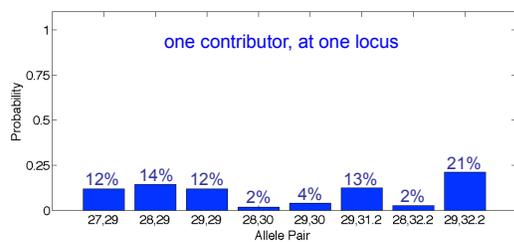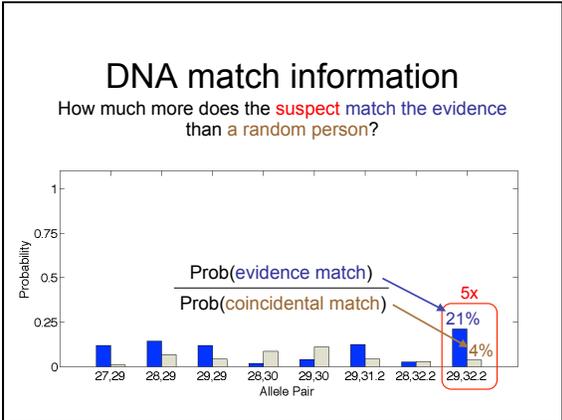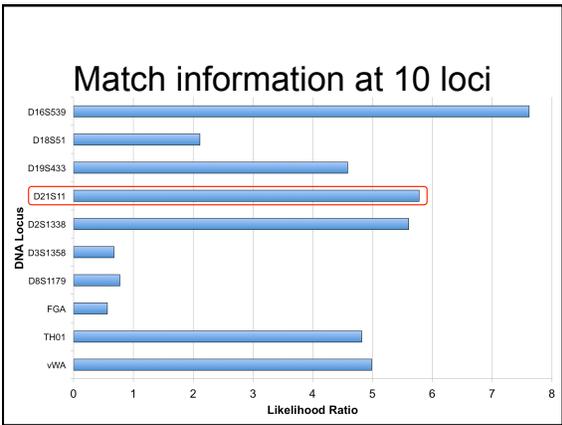
Is the suspect in the evidence?

A match between the **vaginal swabs** and **Stuart Ashley Burton** is 17 thousand times more probable than coincidence.

Mr. Burton pleaded guilty to the rape committed on January 1, 2014. He was sentenced to 12 years in prison.

Separating database hits

Burton
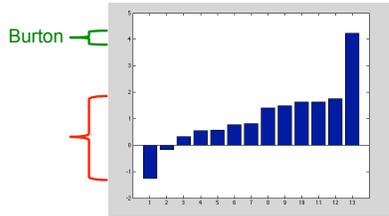
Separating hits statistically

non-contributor distribution

1 in a thousand

1 in a million

Burton
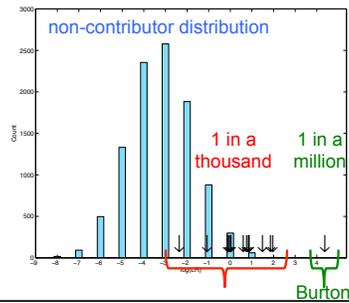
TrueAllele validation papers

Perlin MW, Sinelnikov A. An information gap in DNA evidence interpretation. *PLoS ONE*. 2009;4(12):e8327.

Ballantyne J, Hanson EK, Perlin MW. DNA mixture genotyping by probabilistic computer interpretation of binomially-sampled laser captured cell populations: Combining quantitative data for greater identification information. *Science & Justice*. 2013;53(2):103-14.

Perlin MW, Hornyak J, Sugimoto G, Miller K. TrueAllele® genotype identification on DNA mixtures containing up to five unknown contributors. *Journal of Forensic Sciences*. 2015;*in press*.

Greenspoon SA, Schiermeier-Wood L, Jenkins BC. Establishing the limits of TrueAllele® Casework: a validation study. *Journal of Forensic Sciences*. 2015;*in press*.

Perlin MW, Legler MM, Spencer CE, Smith JL, Allan WP, Belrose JL, Duceman BW. Validating TrueAllele® DNA mixture interpretation. *Journal of Forensic Sciences*. 2011;56(6):1430-47.

Perlin MW, Belrose JL, Duceman BW. New York State TrueAllele® Casework validation study. *Journal of Forensic Sciences*. 2013;58(6):1458-66.

Perlin MW, Dormer K, Hornyak J, Schiermeier-Wood L, Greenspoon S. TrueAllele® Casework on Virginia DNA mixture evidence: computer and manual interpretation in 72 reported criminal cases. *PLOS ONE*. 2014;(9)3:e92837.

MIX05: Unreliable statistics

National Institute of Standards and Technology
Two Contributor Mixture Data, Known Victim

Some Differences in Reporting Statistics

		Case1		
LabID	Kits Used	Caucasians	African Americans	Hispanics
90	ProPlus/Cofiler	1.18E+15	2.13E+14	3.09E+15
34	ProPlus/Cofiler	2.40E+11	7.66E+09	9.80E+10
33	ProPlus/Cofiler	2.94E+08	1.12E+09	1.74E+09
6	ProPlus/Cofiler	40,000,000	3,500,000	280,000,000
9	ProPlus/Cofiler	1.14E+07	1.97E+07	1.54E+08
79	ProPlus/Cofiler	930,000	47,900	1,350,000
16	ProPlus/Cofiler	434,600	31,710	399,100

213 trillion (14)

31 thousand (4)

Remember that these labs are interpreting the same MIX05 electropherograms

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MIX13: False inclusions

MIX13 Case 5 Outcomes with Suspect C
(whose genotypes were not present in the mixture)

# Labs	Report Conclusions	Reasons given
6	Exclude Suspect C	detailed genotype checks (ID+); TrueAllele negative LR (ID+); assumed major/minor and suspects did not fit (ID+); 3 labs noted Penta E missing allele 15 (PP16HS)
3	Inconclusive with C only (A & B included)	All these labs used PP16HS
21	Inconclusive for A, B, and C	
70	**Include** & provide CPI statistics	*All over the road…*

Range of CPI stats for Caucasian population:
FBI allele frequencies: **1 in 9** to **1 in 344,000**

TrueAllele preserves information

Simple two person mixture, 10% minor contributor

TrueAllele

Software using thresholds and drop parameters

Pennsylvania precedent

Appeal from the Judgment of Sentence of June 1, 2009
In the Court of Common Pleas of Indiana County
Criminal Division at No(s): CP-32-CR-0001170-2007

BEFORE: PANELLA, SHOGAN, and COLVILLE[*], JJ.

OPINION BY PANELLA, J.   FILED: FEBRUARY 15, 2012

Appellant, Kevin James Foley, appeals from the judgment of sentence entered on June 1, 2009, by the Honorable William J. Martin, President Judge of the Court of Common Pleas of Indiana County, Criminal Division. After careful review, we affirm.

• • •

Because Foley has failed to establish the existence of a legitimate dispute over Dr. Perlin's methodology, he has failed to show that Dr. Perlin's testimony constituted "novel" scientific evidence. *See Betz*, 998 A.2d at 972. Therefore, we find that the trial court's decision to admit the testimony was not an abuse of discretion. Absent a legitimate dispute, there is no reason to "impede admissibility of evidence that will aid the trier of fact in the search for truth." *Id.*
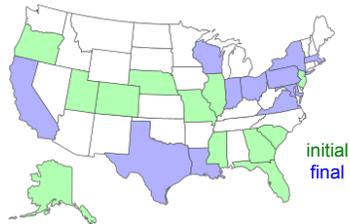

Used in local rape cases

Pittsburgh Post-Gazette

Man sentenced to 75-150 years for rape

April 17, 2014 11:43 PM
By Paula Reed Ward / Pittsburgh Post-Gazette

Skundrich was developed as a suspect after a DNA match was made in the national database in 2010. He went to trial in January and was found guilty of five counts of involuntary deviate sexual intercourse, as well as multiple counts of sexual assault, indecent assault, terroristic threats, simple assault and false imprisonment.

At trial, a DNA expert said the probability of the sample collected from the victim coming from Skundrich was 4.04 quadrillion times more likely than coincidence, Ms. Necessary said.

TrueAllele computer, over **quadrillion**
Laboratory review, under a **million**
(Billion-fold loss of information)

TrueAllele in Allegheny County

25 cases, 20 reports
4 trials, 1 exoneration

Crime	Evidence	Defendant	Outcome	Sentence
rape	clothing	Ralph Skundrich	guilty	75 years
murder	gun, hat	Leland Davis	guilty	23 years
rape	clothing	Akaninyene Akan	guilty	32 years
murder	shotgun shells	James Yeckel, Jr.	guilty plea	25 years
murder	fingernail	Anthony Morgan	stipulation	life
weapons	gun	Thomas Doswell	guilty plea	1 year
drugs	gun	Derek McKissick & Steve Morgan	2 guilty pleas	2 1/2 years
murder	door handle, shirt sleeves	Calvin Kane	guilty plea	20 years

TrueAllele in the United States

Laboratory systems or case reports in 23 states

initial
final

Cold case homicide in Canada

New DNA skills may solve Hamilton killing
The Hamilton Spectator, July 29, 2013

John Paul Page, age 29

Cybergenetics examined DNA data from the Hamilton stabbing scene, separating out genetic profiles of the killers.

But the crime lab "is not permitted to enter DNA analysis from other labs" into Canada's national DNA database.

The victim's step-mother is baffled as to why the DNA profile can't be run through the Canadian database. "If we can use it, let's use it," she says, frustrated.

Hamilton police make arrest in 2004 fatal stabbing
Toronto Sun, December 16, 2013

DNA database broken

Evidence

Allele database

Reference

Allele database

Match

Upload

Upload

Crime scene

Possible suspect

Unseparated mixtures

Cybergenetics
DNA database restored

Evidence

Genotype database

Match

Upload

Crime scene

+

Separated genotypes

Reference

Genotype database

Upload

Possible suspect

TrueAllele database workflow

Prevent rape by DNA monitoring

Monitoring helps prevent people from behaving badly.

TrueAllele computing for genetic surveillance to deter rape on campus.

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1. Collect DNA from people

Reference

Genotype database

Upload

University people

2. Collect DNA from all rapes

• rape crime must be reported
• rape kit must be collected
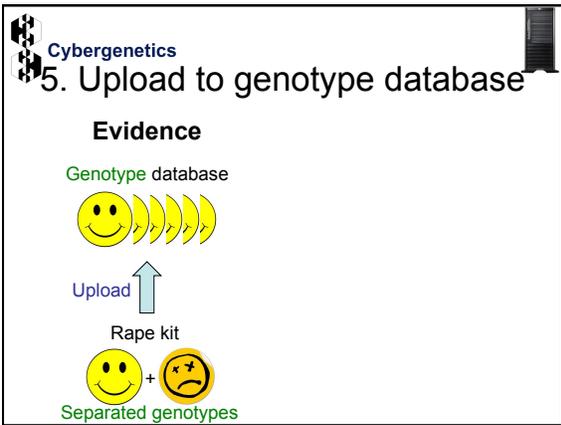• but attacker need not be named

Rape kit
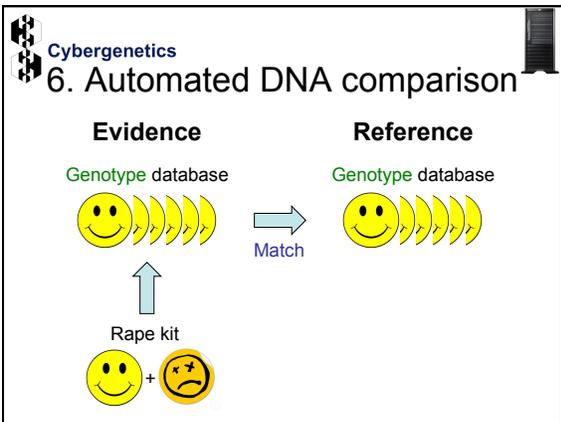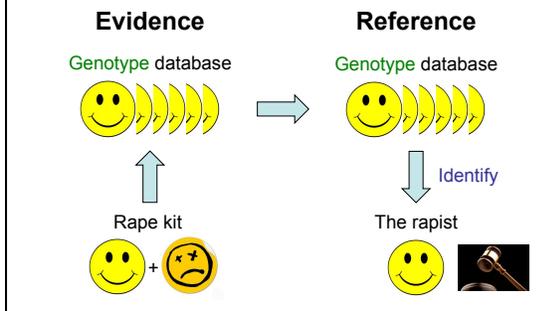

3. Rapidly process rape kits
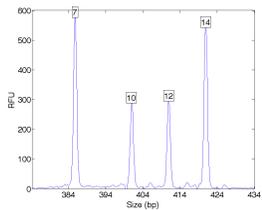
Rape kit
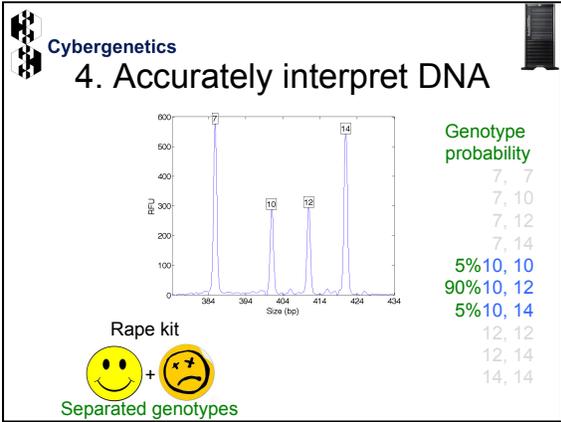
7. Identify and prosecute

Evidence

Genotype database

Rape kit

Reference

Genotype database

Identify

The rapist

How can you help?

"If we can use it, let's use it!"

- victim
- nurse
- investigator
- forensic scientist
- prosecutor
- defense attorney
- general public

More information

http://www.cybgen.com/information

- Courses
- Newsletters
- Newsroom
- Patents
- Presentations
- Publications
- Webinars

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

Cybergenetics

You Tube

perlin@cybgen.com