

ADVANCED ISSUES IN RELATION TO DNA EVIDENCE

Public Defenders Conference
09 and 10 March 2024

Presented by
Jae Gerhard
Independent Forensic Services



INDEPENDENT FORENSIC SERVICES

- Principal Scientist Jae Gerhard
- Review Forensic Biology cases from all Australian jurisdictions & internationally
- Over 20 years' of experience in Australia
- Takes instruction from prosecution and defence



1. BIOLOGICAL FLUID TESTING
2. LIMITATIONS / LACK OF DISCLOSURE IN BIOLOGICAL FLUID TESTING
3. ACCREDITATION / ISO17025
4. STRMIX™ INTERPRETATION FOR COMPLEX SAMPLES
5. TRACE DNA
6. Q & A

TESTING FOR THE PRESENCE OF BIOLOGICAL FLUIDS



EXAMINING FOR BIOLOGICAL EVIDENCE

Can be time consuming

Requires patience and attention to detail

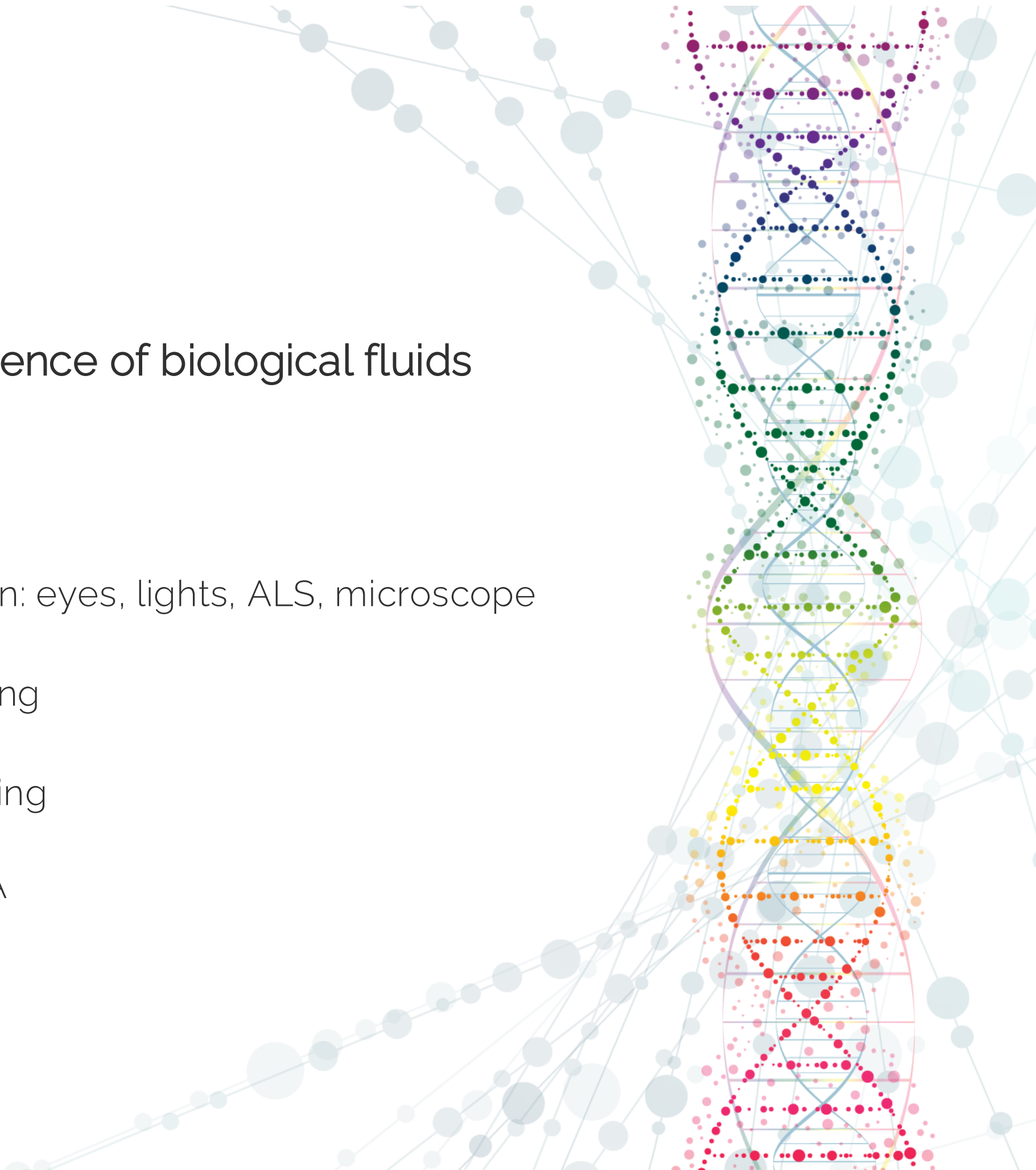
Requires consideration of the case type

EXAMINING FOR BIOLOGICAL EVIDENCE



Testing for the presence of biological fluids

- Occurs in stages:
 - Visual examination: eyes, lights, ALS, microscope
 - Presumptive testing
 - Confirmatory testing
 - Sampling for DNA



TESTING FOR BIOLOGICAL FLUIDS

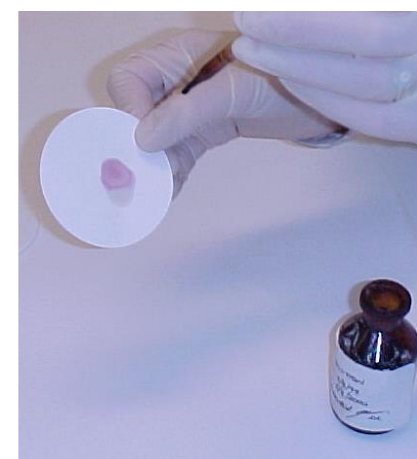
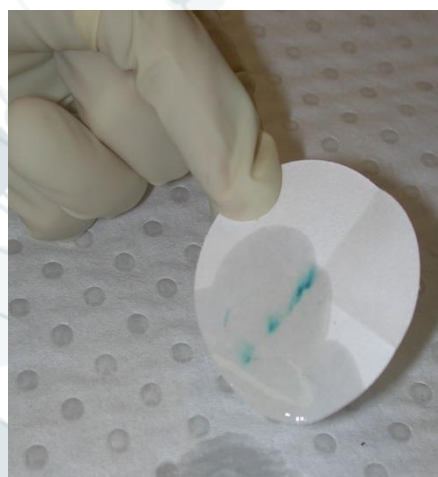
Testing for the presence of biological fluids

- Blood
- Semen
- Saliva
- Limited other tests for urine, faeces and vomitus

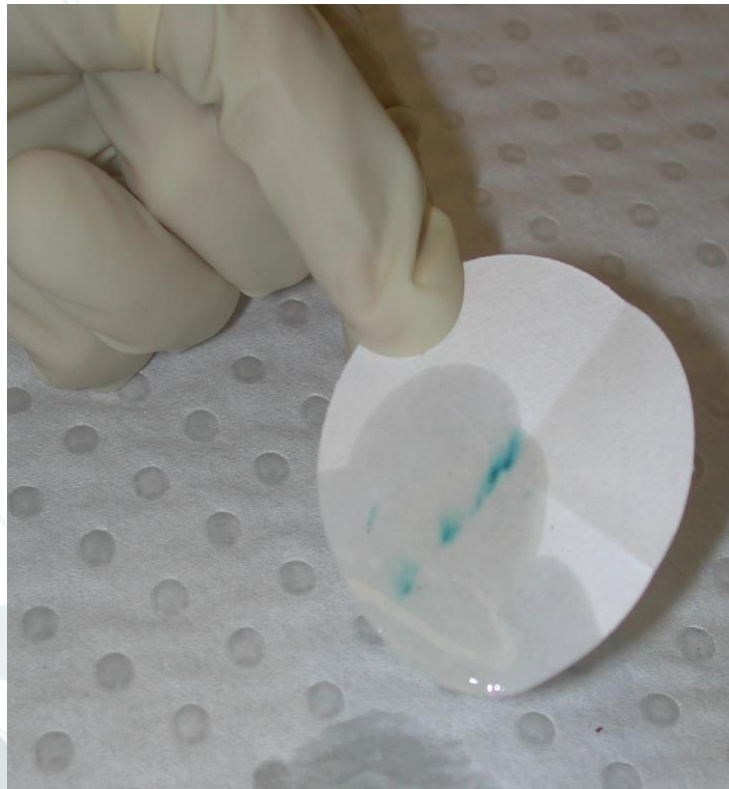
TESTING FOR BIOLOGICAL FLUIDS

Presumptive tests for biological fluids

- Will react with other substances
- Reported as:
 - “presumptive test for semen/saliva/blood was positive”
 - “apparent semen/saliva/blood was detected”



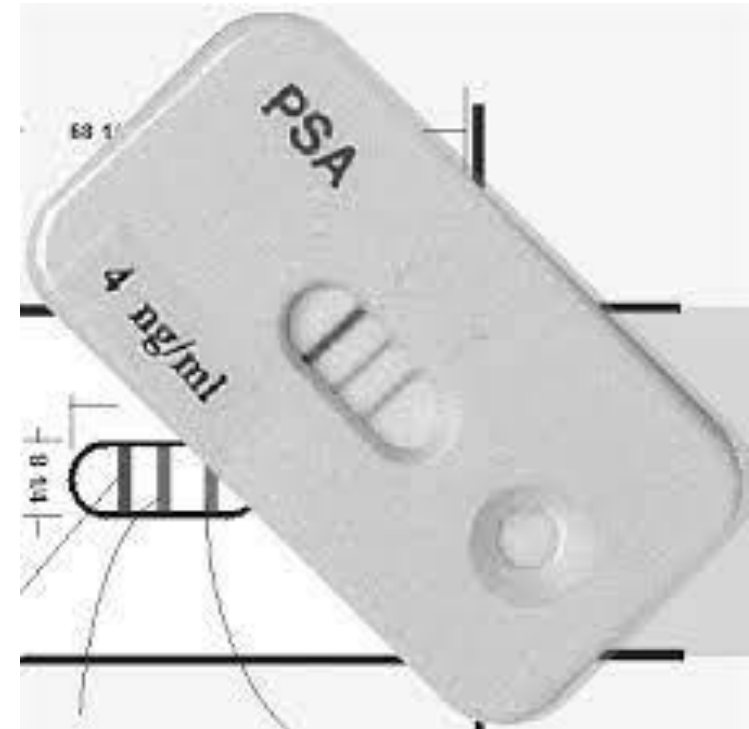
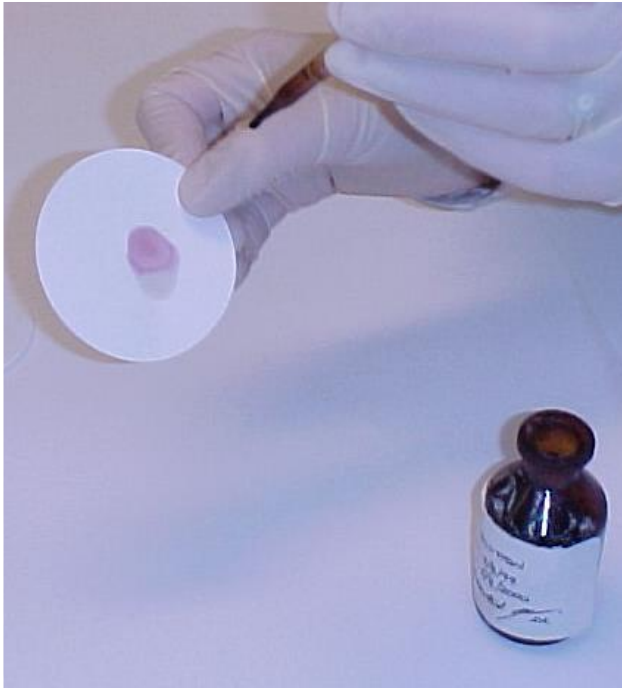
TESTING FOR BLOOD



TESTING FOR SALIVA



TESTING FOR SEMEN



TESTING FOR BIOLOGICAL FLUIDS

Confirmatory tests for biological fluids

- Specific to a biological fluid
- Requires more material. Compromise between test and DNA
- Reported as:
 - “semen/saliva/blood was detected”
 - “confirmatory test for semen/saliva/blood was positive”



TESTING FOR BIOLOGICAL FLUIDS

Do not assume a biological
fluid is present because of
the report

Find out the limitations to
the testing



LACK OF DISCLOSURE

Have you allowed unreliable
evidence into the
courtroom?



LACK OF DISCLOSURE: BIOLOGICAL FLUIDS TESTING

Alleged sexual assault – soiled nappy submitted for examination

Sample	Description	Result
Sample R1	Sample from nappy	A presumptive test for semen produced a positive result. Mixed DNA profile obtained - infant and defendant not excluded.

Failure to declare that infant faecal material can produce a positive result to presumptive semen test.

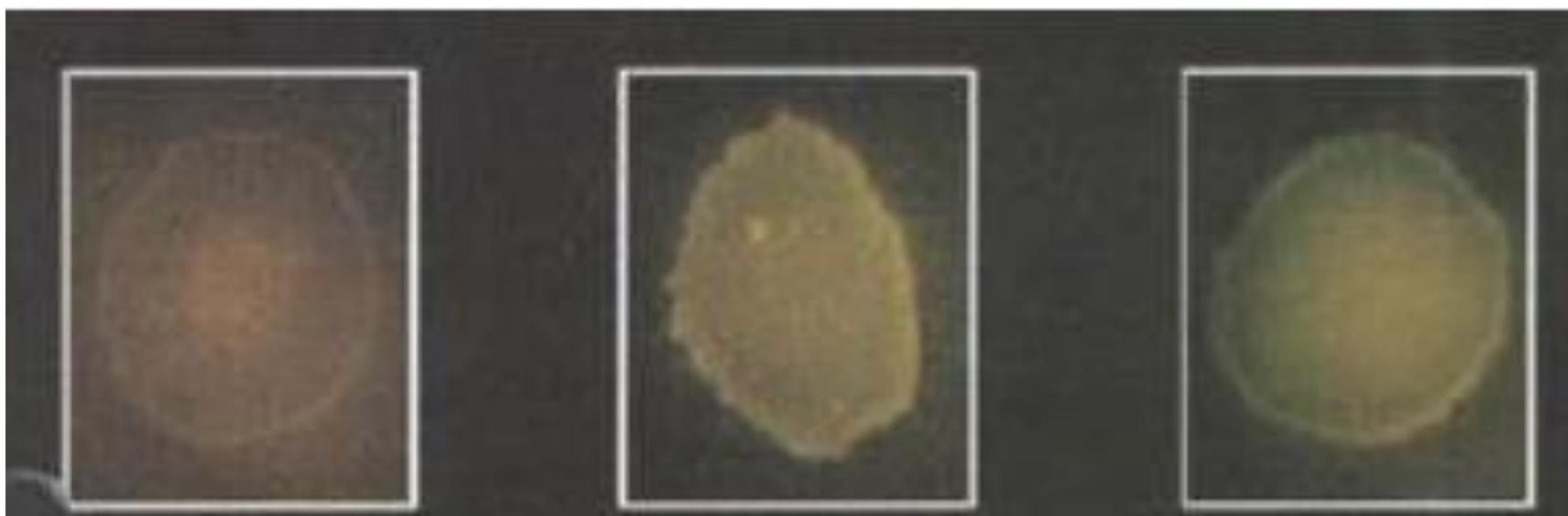
Defendant changes infants nappies.

FAILURE TO DISCLOSE: BIOLOGICAL FLUID TESTING

Alleged sexual assault – girls underwear submitted for examination

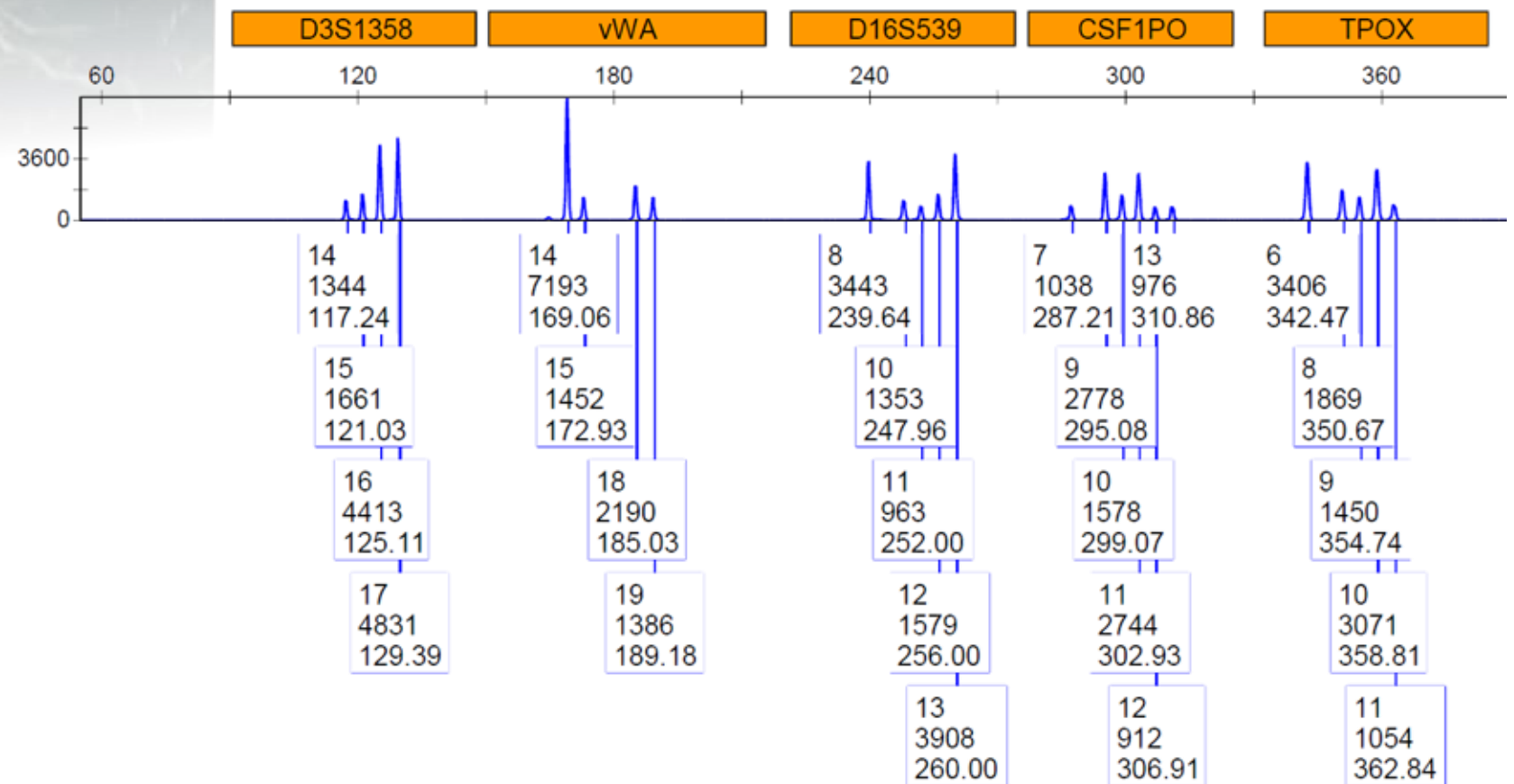
"I conducted an examination of the underwear using forensic light sources. This examination indicated the positive presence of saliva in the crotch area".

Statement of Crime Scene Examiner



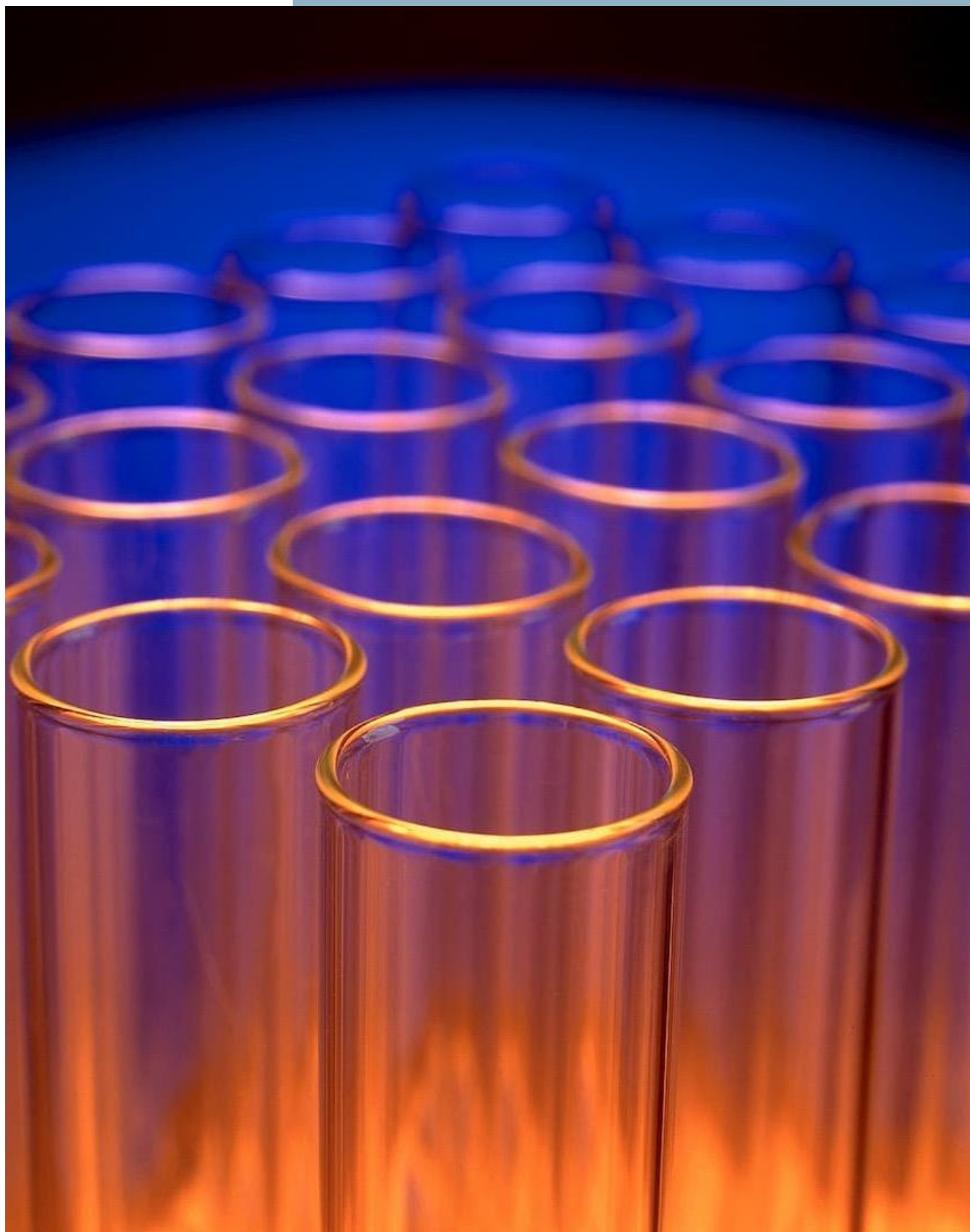
These are semen, saliva and urine.
Which one is which?

LACK OF DISCLOSURE- MOTIVATIONAL BIAS



LACK OF DISCLOSURE

Do you have all of the
information in relation the
the evidence being
presented?



ISO17025 AND LIMITATIONS WITH ACCREDITATION



ACCREDITATION AND ISO17025

All forensic biology laboratories in Australia
accredited by NATA

ISO17025 with Forensic Supplement

"It is not part of NATA's assessment to determine
whether the laboratory is actually operating in
accordance with best practice." *

ACCREDITATION AND ISO17025

Dadley v R
[2021] NSWCCA 267

"DNA doesn't survive very long. Current guidelines I believe up to 12 hours. Looking to extend to 24 hours"
NSWFASS Scientist

FACT: trace DNA can survive in the vagina for up to
43 hours*

Evidence of the scientist in court is not reviewed
under accreditation

* A retrospective study on the transfer, persistence and recovery of sperm and epithelial cells in samples collected in sexual assault casework

Ane Elida Fonneløp^{a,*}, Helen Johannessen^a, Guro Heen^a, Karen Molland^a, Peter Gill^{a,c}

ACCREDITATION AND ISO17025

Alleged sexual assault – complainants clothing tested

Sample	Description	Result
Sample R1	Swab inner waistband of jeans	The DNA profile recovered has the same DNA profile as [POI]. It is greater than 100 billion times more likely that this profile originates from [POI]

Error in reporting – DNA matched the complainant not the POI

ACCREDITATION AND ISO 17025

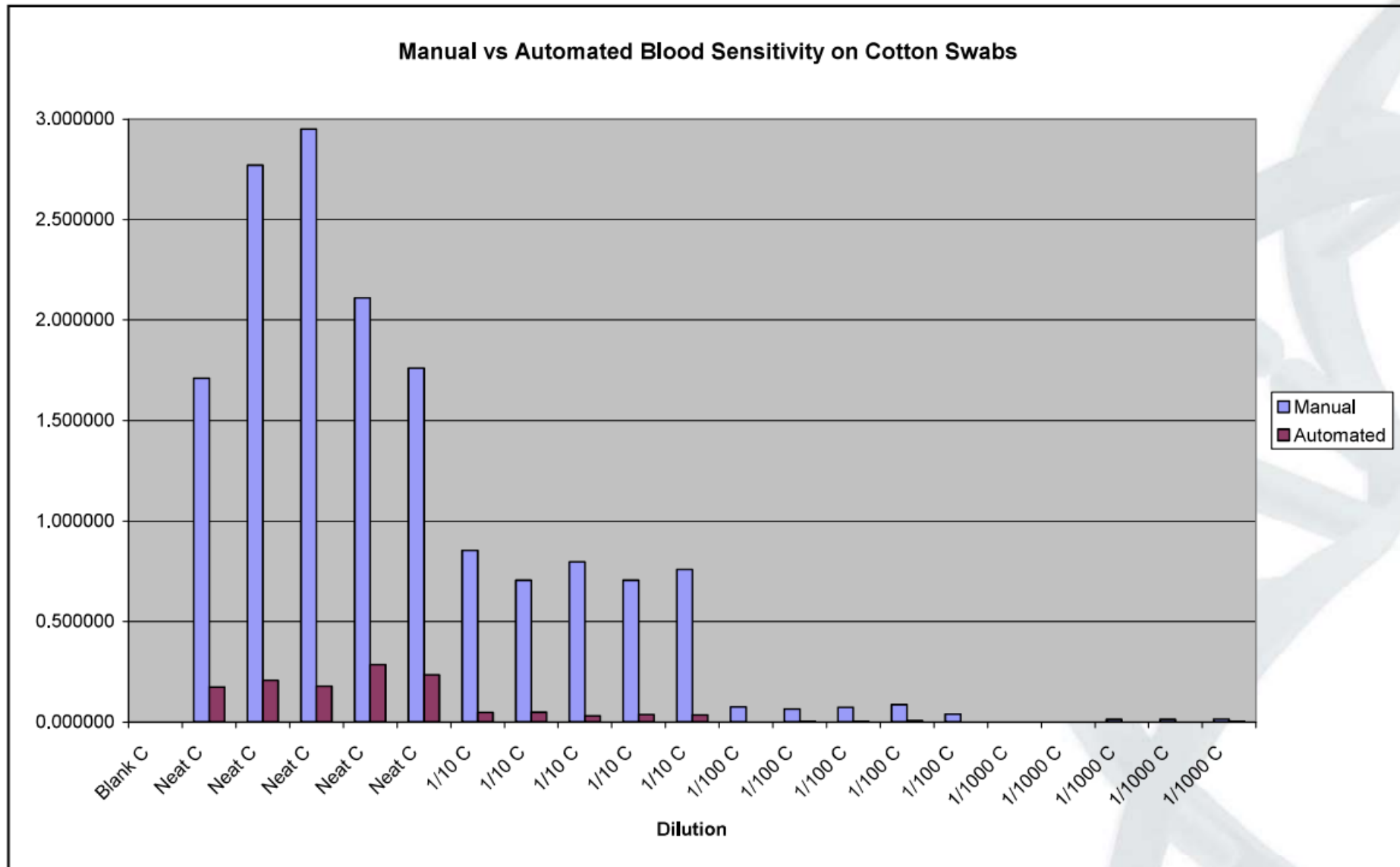


Figure 10. Comparison of sensitivity between the manual and automated DNA IQ™ methods for blood samples on cotton swabs.

ISO/IEC 17025 Application Document

Supplementary Requirements

for accreditation in the field of Forensic Science (including Parentage Testing)

- b) The PCR set-up area must not be in the amplified DNA laboratory and must be physically isolated (eg. within a PCR set-up hood, as a minimum) from the extraction area.

Automated (robotic) systems

- i) Automated workstations that are used to carry out DNA extractions through to PCR set-up may be located in a single room on the same platform.
- ii) The laboratory must demonstrate that all functions of the automated system are protected against sample contamination.
- iii) A positive and negative plate control must be used for each automated extraction run.

5.4 Test and calibration methods and method validation

5.4.1

Laboratories must have documented policies for the interpretation of data for each method of DNA analysis. The basis for concluding that samples have the same or different profiles or that the results of the analysis are inconclusive or uninterpretable must be established.

5.4.2

- a) In instances where there may be only one attempt at typing (eg. due to insufficient sample), it must be ensured that the following have been tested prior to use:
 - DNA Polymerase
 - Kits

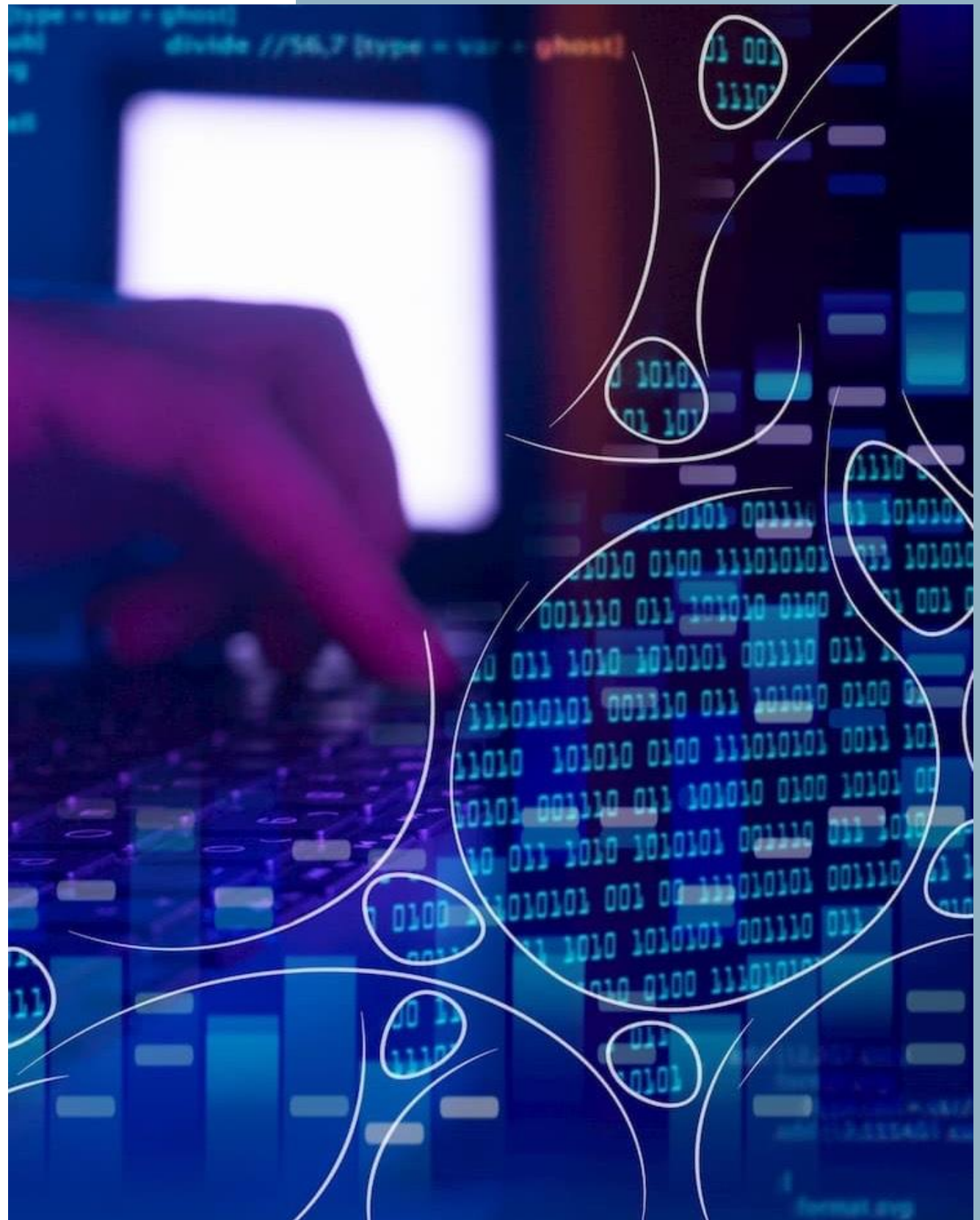
ISO17025 AND LIMITATIONS WITH ACCREDITATION

Don't assume that because
the laboratory is accredited
there won't be mistakes

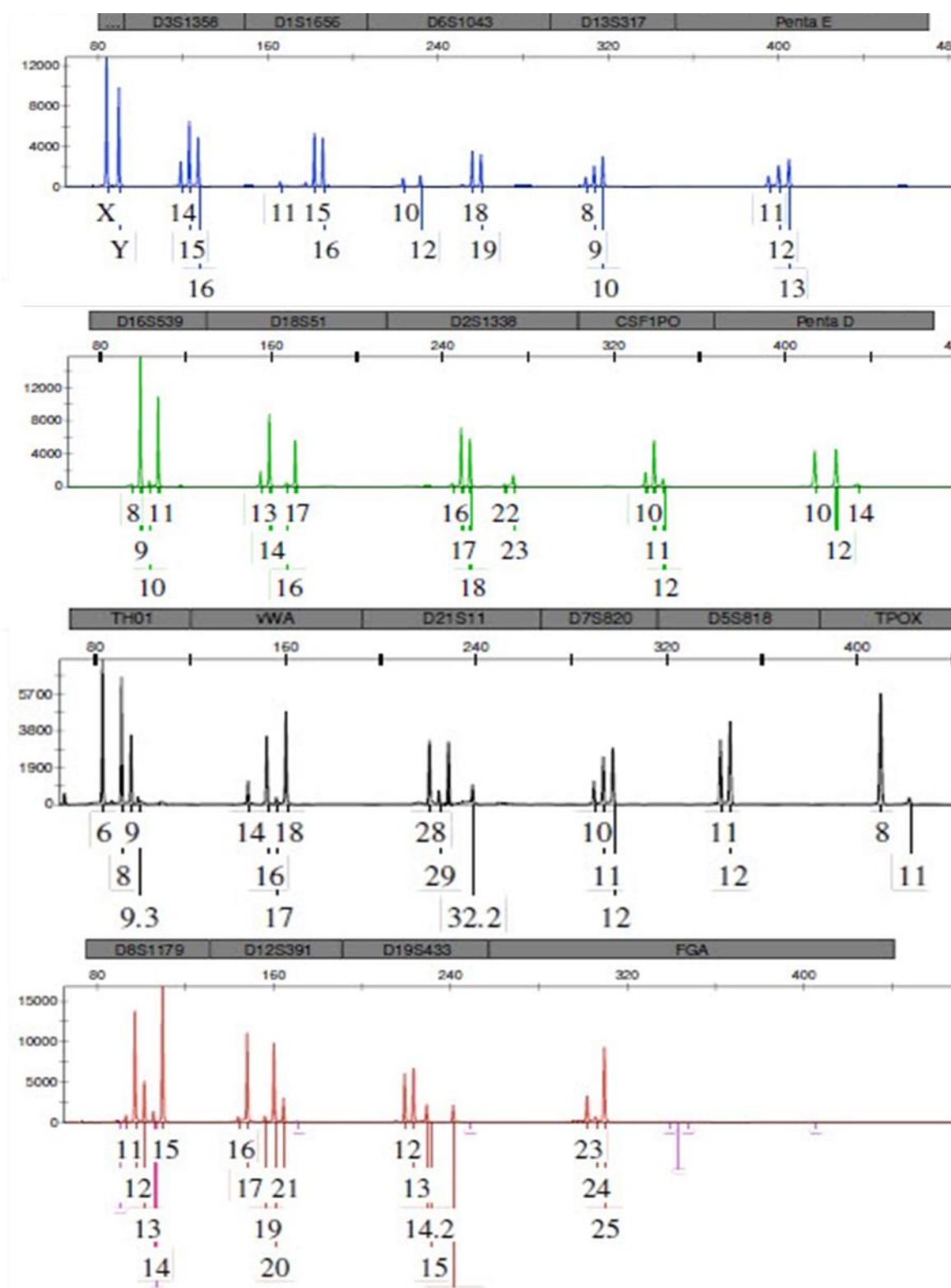


A VERY BRIEF INTRO TO STRMIX

Presented by
Independent Forensic Services



A MIXED DNA PROFILE



DETERMINING COMBINATIONS OF DNA

Contributor 1

14, 15

14, 16

14, 14

15, 15

16, 16

15, 16

15, 16

15, 16

14, 16

14, 15

Contributor 2

15, 16

15, 16

15, 16

14, 16

14, 15

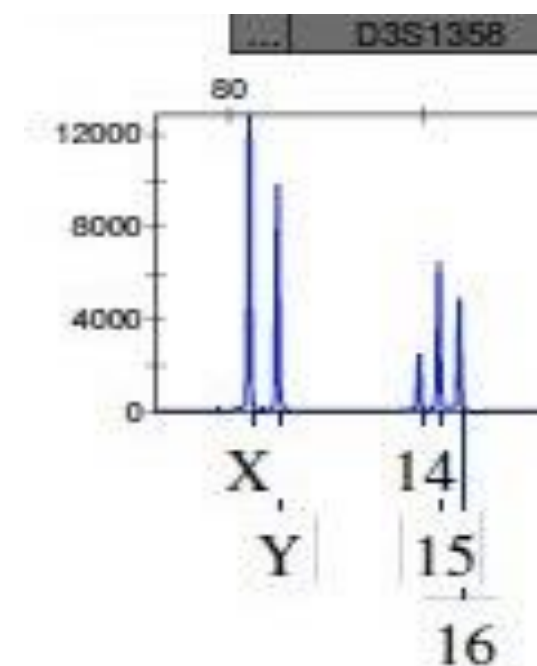
14, 15

14, 16

14, 14

15, 15

16, 16



24 combinations for this
site if 2 contributors

STRMIX™ ASSIGNS WEIGHTINGS TO DNA COMBINATIONS

D3S1358

125

GENOTYPE PROBABILITY DISTRIBUTION

*Reporting row limit has been activated - only the first 10 rows for each locus will be displayed.

LOCUS	CONTRIBUTORS			WEIGHT (HIGHLIGHT ≥ 0.99)
	1 (66%)	2 (25%)	3 (9%)	
D3S1358	17, 18	17, 17	15, 16	9.59087E-1
	17, 18	17, 18	15, 16	1.20599E-2
	17, 18	15, 17	16, 17	7.73871E-3
	17, 18	16, 17	15, 17	5.86575E-3
	17, 18	17, 17	15, 17	4.13838E-3
	17, 18	17, 17	15, 18	3.79409E-3
	17, 18	17, 17	15, 15	2.55474E-3
	17, 18	15, 17	16, 18	1.45509E-3
	17, 18	16, 17	15, 18	1.13573E-3
	17, 18	17, 18	15, 17	3.85650E-4

15
403

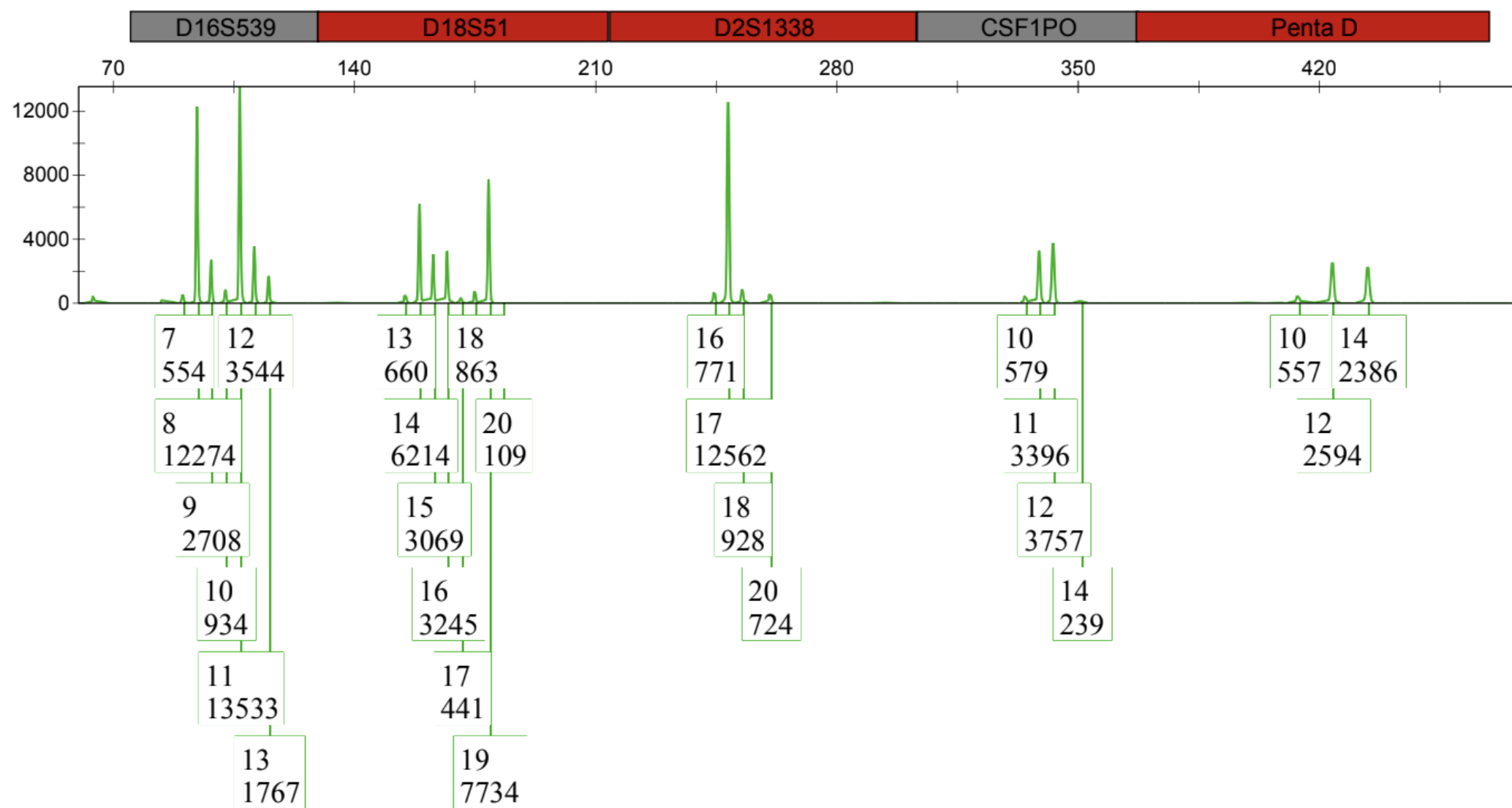
16
639

17
3816

18
2016



HOW MANY CONTRIBUTORS?



STRMIX™ – SUBJECTIVE DETERMINATIONS

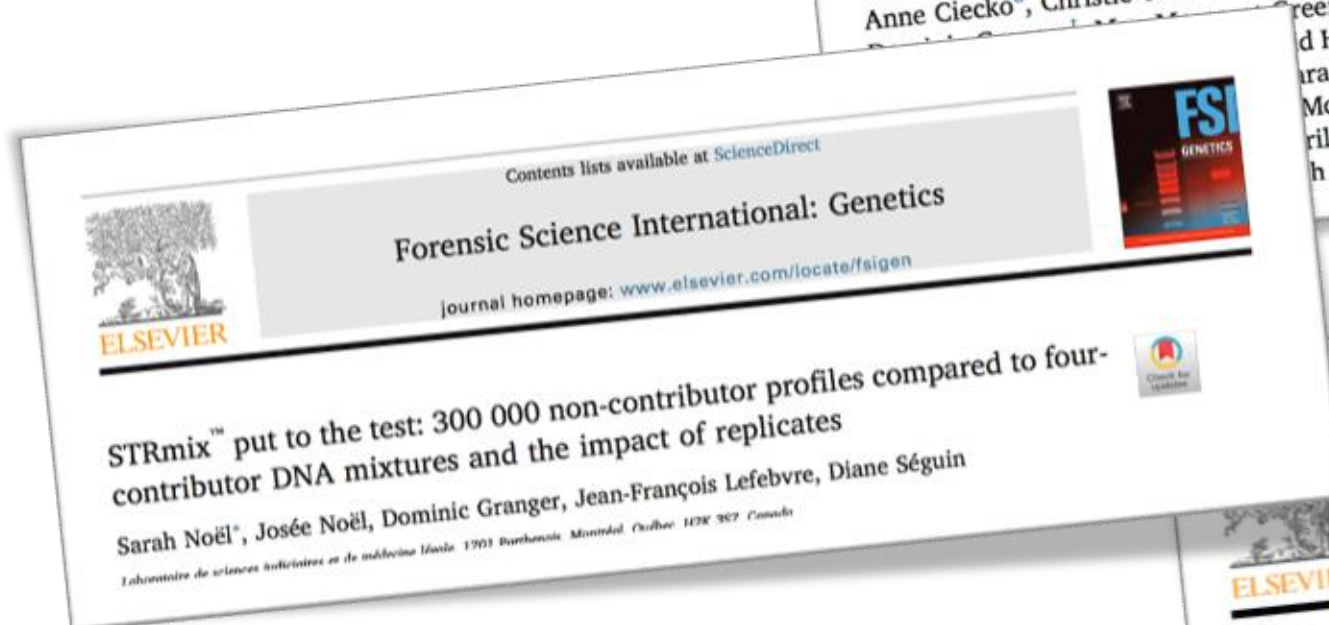
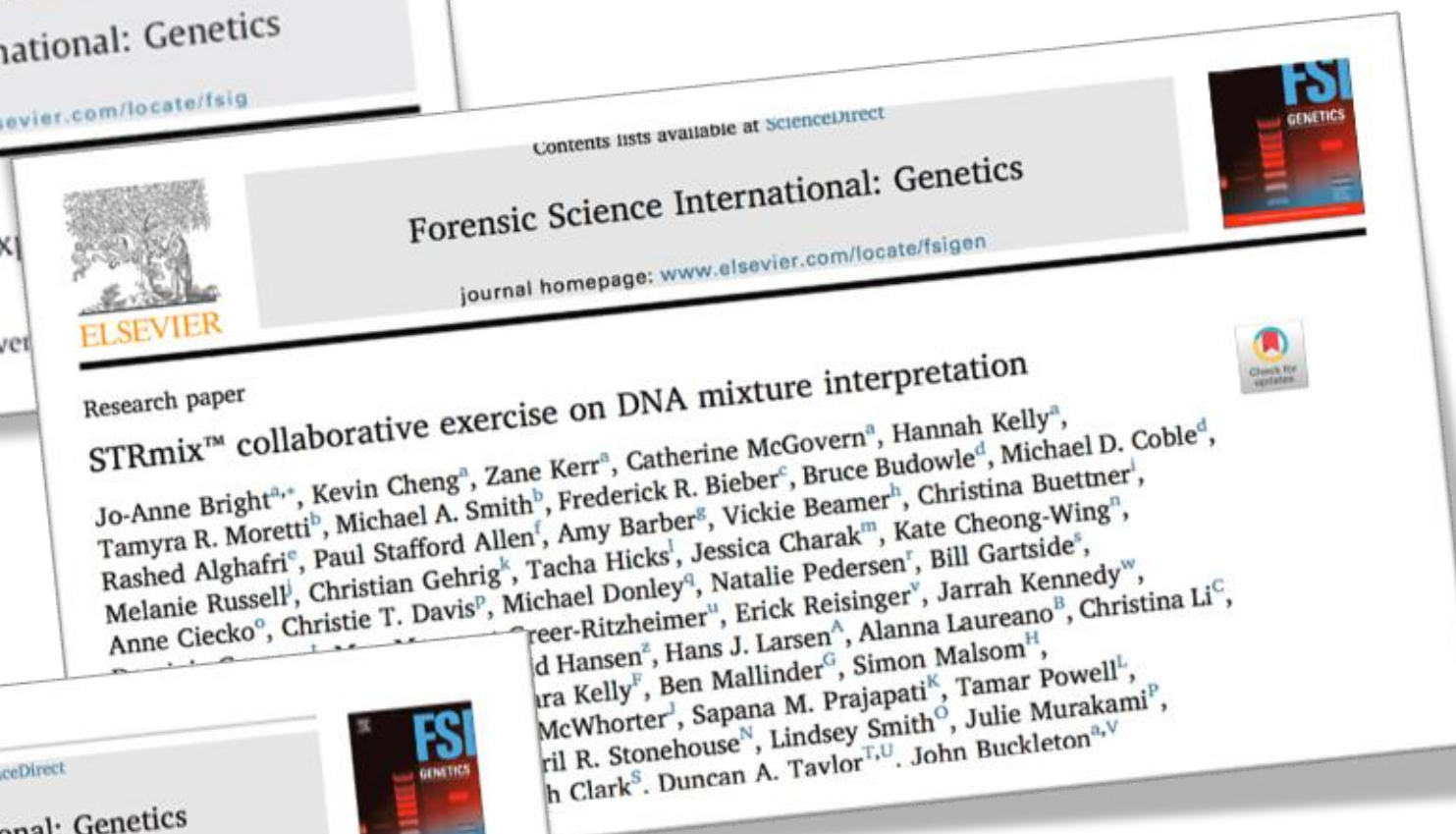
Genotype	Weighting
24,25	20.5%
22,25	4.4%
20,25	7.7%
22,24	3.6%
20,24	9.7%
20,22	4.5%
25,25	1.7%
21,24	0.4%
18,22	11.8%
22,23	1.1%
18,20	5.8%
20,20	1.4%
20,23	2.2%



STRMIX™ – SUBJECTIVE DETERMINATIONS

Sample	Profile Description	Person	Proposition/interpretation	Statistical weighting
Sample 1-1	Mixed profile – 2 contributors	Mr X	1: Mr X is a contributor 2: Mr X is not a contributor	DNA evidence is 100 billion times more likely if Mr X is a contributor
		Mr Z	Excluded	
	Mixed profile – 3 contributors	Mr X	1: Mr X is a contributor 2: Mr X is not a contributor	DNA evidence is 100 billion times more likely if Mr X is a contributor
		Mr Z	1: Mr Z is a contributor 2: Mr Z is not a contributor	DNA evidence is 1.4 million times more likely if Mr Z is a contributor

FALSE INCLUSIONS ARE KNOWN TO OCCUR



FALSE INCLUSIONS ARE KNOWN TO OCCUR

Table 1

Count of adventitious links per profile for experiment 2, a true three person mixture interpreted assuming either three or four contributors.

Profile	1		2		3		4		5		6		7		8		Total counts	
Assumed no. contributors	3	4	3	4	3	4	3	4	3	4	3	4	3	4	3	4	3	4
Ranges of LR_C																		
1-10 ¹	3076	31,464	1209	4057	45	16,956	1	23,582	22	24,433	330	26,303	254	24,781	203	29,685	5140	181,261
10 ¹ -10 ²	960	3036	497	164	32	2717	31	3319	105	3678	287	2850	152	2777	826	3845	2890	22,386
10 ² -10 ³	168	125	123	2	10	196	43	137	120	102	85	123	36	191	301	139	886	1015
10 ³ -10 ⁴	17	2	22	0	3	18	24	1	31	0	15	2	15	22	15	4	142	49
10 ⁴ -10 ⁵	2	1	2	0	1	1	0	0	0	0	0	0	3	4	3	0	11	6
10 ⁵ -10 ⁶	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Total as % of database size	2.9%	23.8%	1.3%	2.9%	0.1%	13.7%	0.1%	18.6%	0.2%	19.4%	0.5%	20.1%	0.3%	19.1%	0.9%	23.1%	9069	204,718

was made. The adventitious match with the highest LR_C (730,000) occurred when Profile 8 was interpreted as a three person mixture. More adventitious matches with high LR_C values (in the order of 10⁵) were obtained for the extreme low level profiles compared to experiment 2.

Forensic Science International: Genetics 9 (2014) 102–110

Contents lists available at ScienceDirect



ELSEVIER

Forensic Science International: Genetics

journal homepage: www.elsevier.com/locate/fsig

Searching mixed DNA profiles directly against profile databases

Jo-Anne Bright^{a,b,*}, Duncan Taylor^c, James Curran^b, John Buckleton^a

^a Institute of Environmental Science and Research Limited, Private Bag 92021, Auckland 1142, New Zealand

^b Department of Statistics, University of Auckland, Private Bag 92019, Auckland 1142, New Zealand

USE OF VERBAL SCALES

Likelihood Ratio	Verbal Equivalent
1	Is neutral
1 - 10	Provides slight support
10 - 100	Provides moderate support
100 - 1,000	Provides strong support
1,000 - 1,000,000	Provides very strong support
Over 1,000,000	Provides extremely strong support

STRMIX™ – FALSE INCLUSIONS

Incomplete 2-person mixture.
Assumed contribution from



 LR = 27 (**supports inclusion**)

 LR = 21 (**supports inclusion**)

 LR = 14 (supports exclusion)

The evidence supports the proposition that all remaining reference DNA profiles did not contribute DNA.

Who is the other contributor?



STRMIX™ – FALSE INCLUSIONS

Major DNA profile matching male A – not the POI

Issues with sharing of alleles between male A and the POI (as well as POI's brother)

No calculations conducted that considered whether all individuals could have contributed together

STRMIX™ – FALSE INCLUSIONS

- Male A – crime scene officer contamination
- At our request lab conducted further calculations
- Determine POI could not have contributed DNA if Male A and/or POI's brother had contributed
- Therefore, demonstrated the reported match to POI was a false inclusion due to sharing of alleles

STRMIX™

Look at the propositions
posed in the statistical
calculation (get help if you
need)

Consider challenging low
LRs if no other supporting
evidence
(LR - <10,000)



TRACE DNA – TRANSFER AND PERSISTENCE



TRACE DNA – TRANSFER AND PERSISTENCE

DNA that cannot be attributed to biological fluid

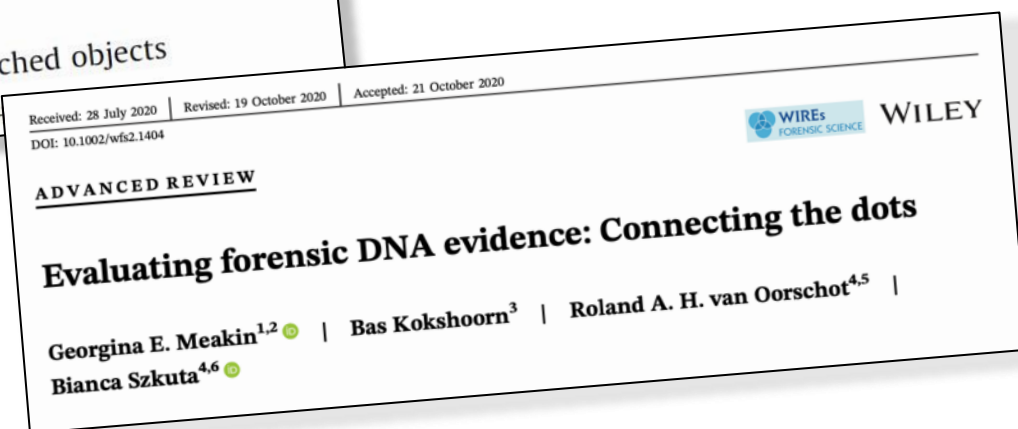
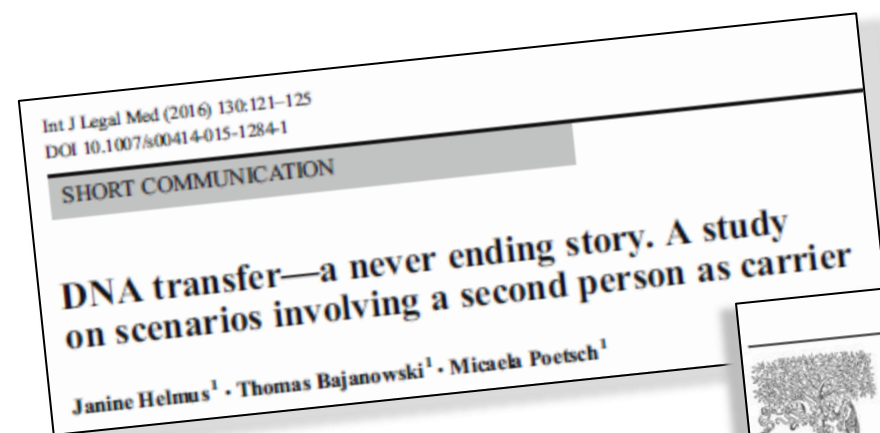
Amount of DNA detected cannot be used to infer
method of deposition

Consider whether DNA evidence is more prejudicial
than probative

CASE EXAMPLE – TRACE DNA

Trace DNA ≠ touching

Seifeddine V R [2021] NSWCCA 214



Probative versus prejudicial

See also rulings of Paulino/Wise/Adams/Fitzgerald

Summary

- Don't rely on the Certificate of Analysis / Statement to give you the full picture of the evidence
Often pertinent information is in the casefile
- Don't make assumptions in relation to the origin of the DNA
Know or find out the limitations to the testing
- Probe the expert for limitations in their evidence
They may not disclose them in their reports

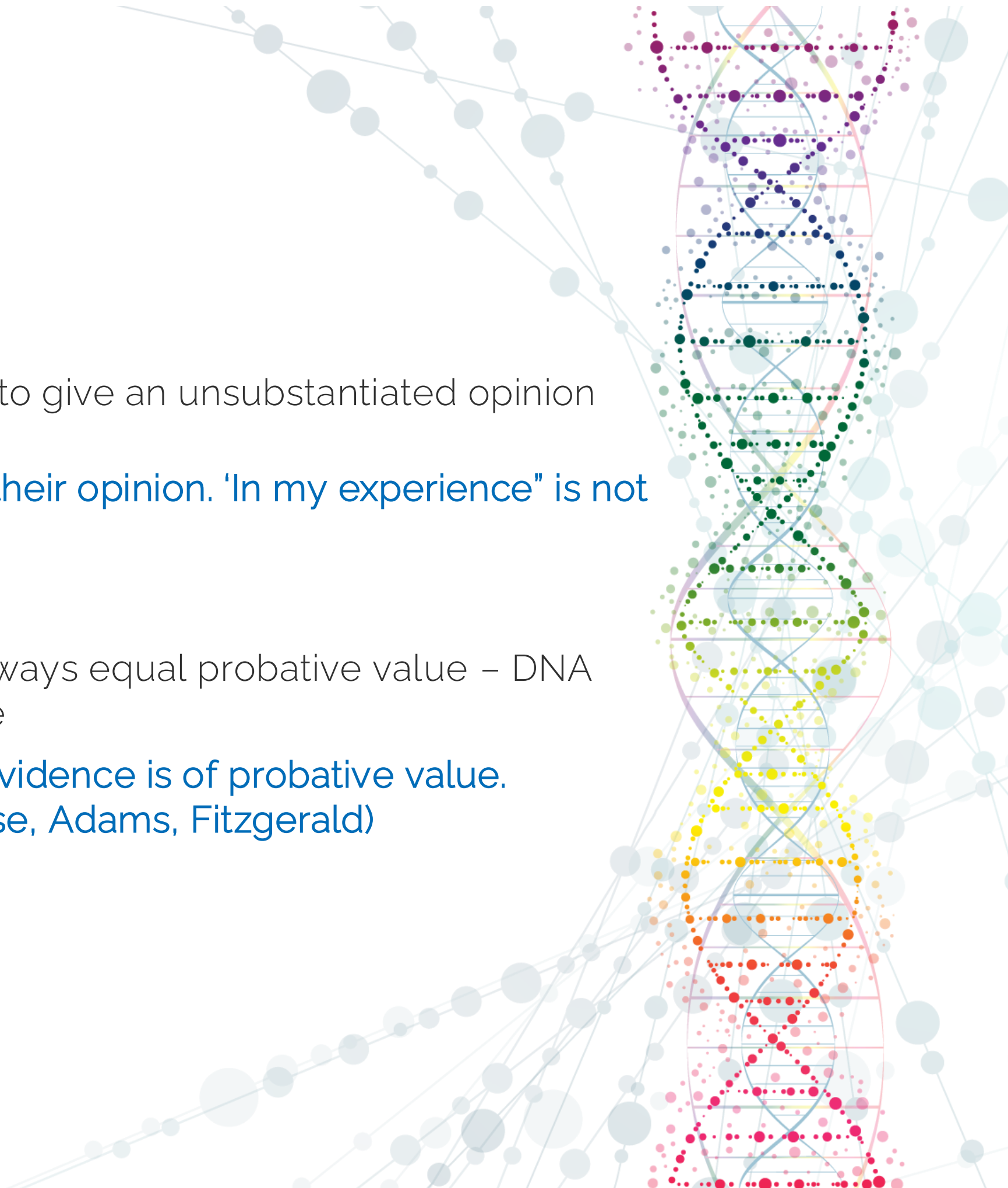
Summary

- Do not allow a scientist to give an unsubstantiated opinion in the witness box.

Request they support their opinion. 'In my experience' is not sufficient

- Large numbers don't always equal probative value – DNA transfer and persistence

Consider whether the evidence is of probative value.
(Seiffidene, Paulino, Wise, Adams, Fitzgerald)





Independent Forensic Services



WWW.INDEPENDENTFORENSICSERVICES.COM.AU



ENQUIRIES@INDEPENDENTFORENSICSERVICES.COM.AU