

# “Solution”: Consensus DNA Profiles

- An allele counted only if seen in 2 reactions

Reaction 1	Reaction 2	Reaction 3	Consensus DNA Profile
10 12	10 12	10 12	10 12
10 12	10	12	10 12
10 12	10 14	12 16	10 12

All would be typed as a 10 12

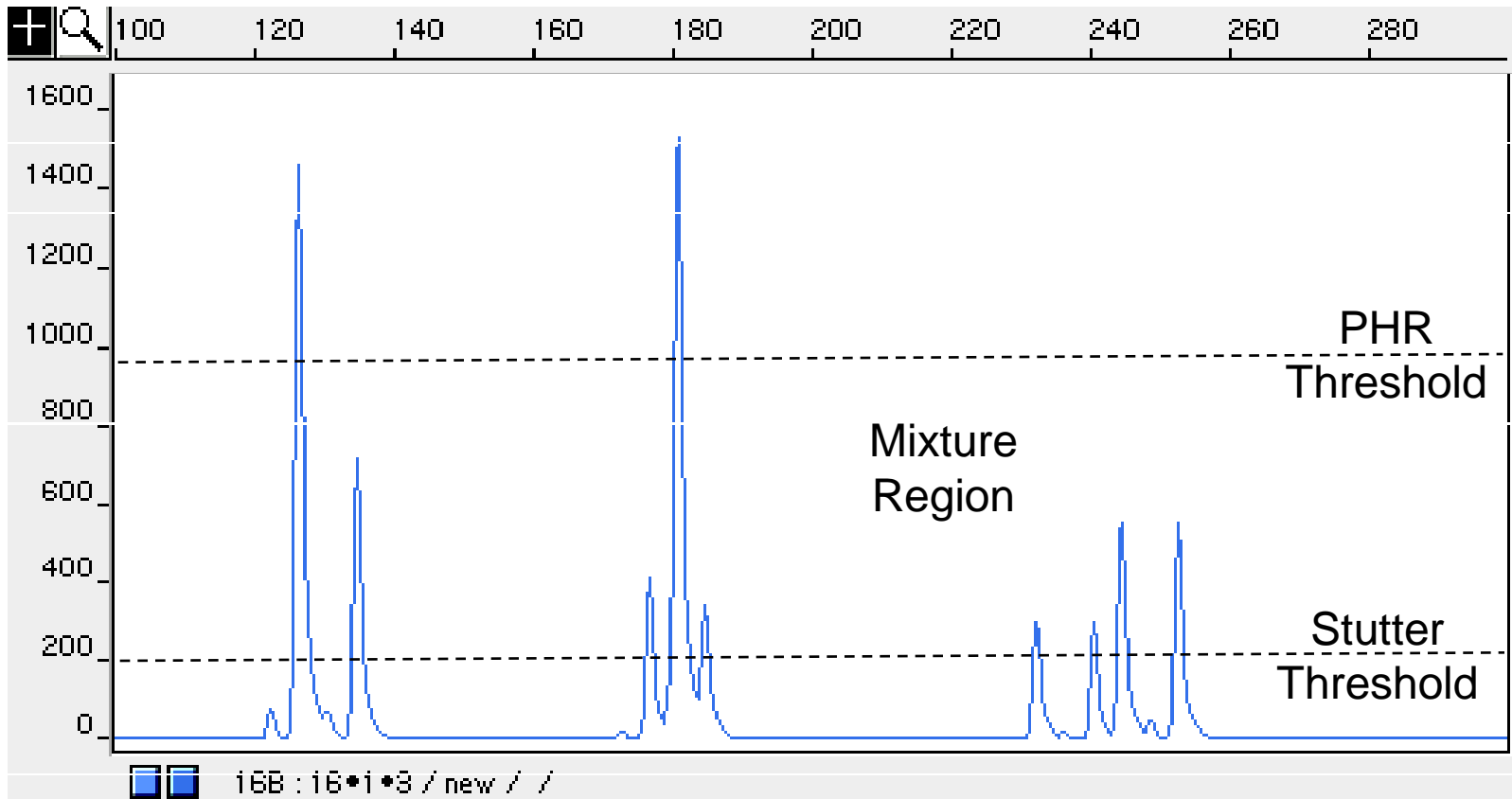
***BUT*** the confidence of the typing being correct is different

Obviously not a good solution

# DNA Typing Issues

- DNA Profile Interpretation
  - Stutter
  - Peak Height Ratio
  - Mixtures
- Low Template DNA (LT-DNA) Analysis
- Mixture Samples
- Case Examples
- 'DNA Only' Cases

# Mixtures: DNA from > 1 Person



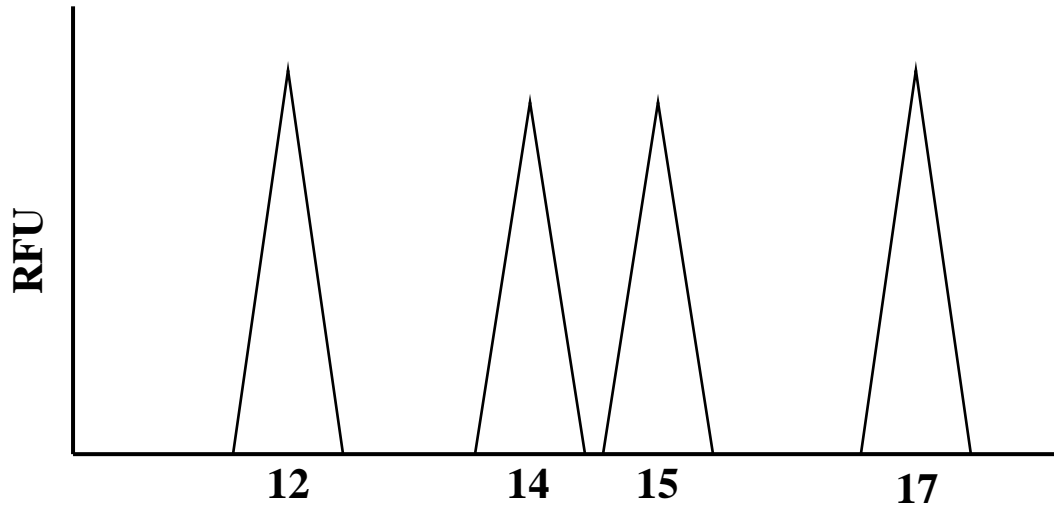
↑  
**Peak Height Ratio  
= 50%**

↑  
**Stutter Position  
Peak = 22%**

↑  
**More than 2 Alleles**

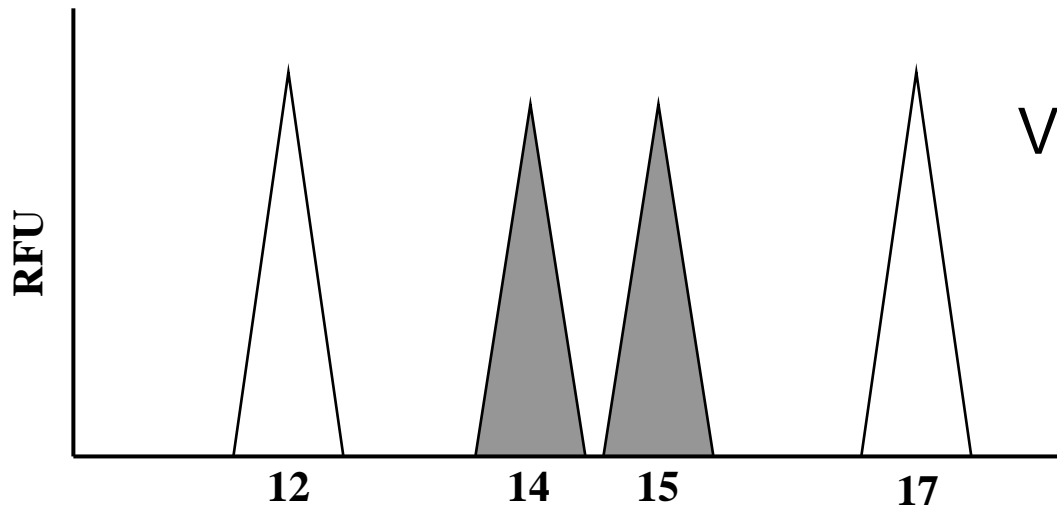
# Mixture Types

## 1. Cannot Resolve Different Contributors



Assume 2 contributors:

- 12 14 + 15 17 *or*
- 12 15 + 14 17 *or*
- 12 17 + 14 15

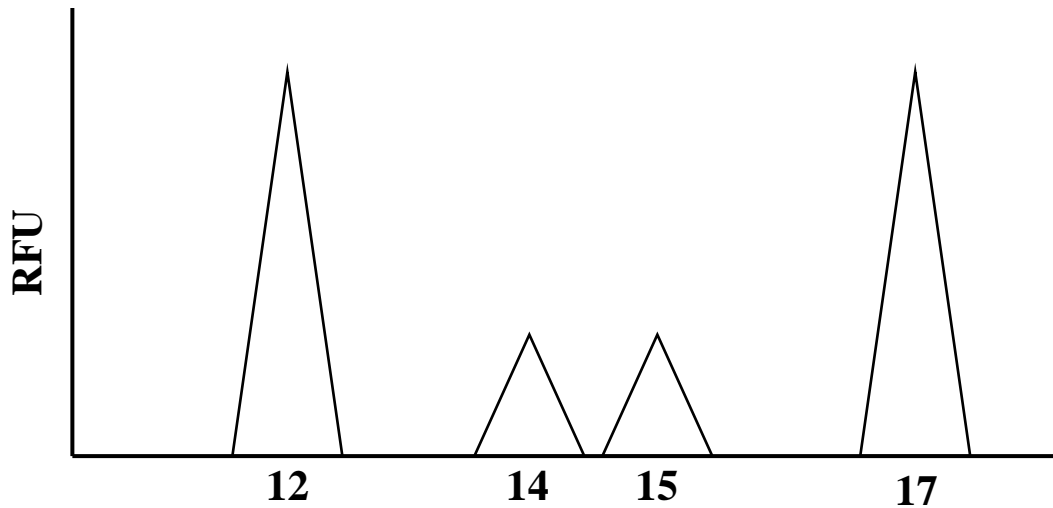


Victim = 14 15:

- Other Contributor = 12 17

# Mixture Types

## 2. Can Resolve Contributors



Focus on this type of mixture

- Major Contributor
- Minor Contributor

utor

utor

# DNA Amounts in Mixture Components

Amount DNA (ng)	Amount DNA (pg)	3:1 Mixture	10:1 Mixture
0.03ng	30pg	0.1pg: 1.2pg	1pg: 9pg

**Cases with this type of mixture**

- Major Contributor
- Minor Contributor

**are potentially problematic**

~10,000 cells  
~100ng



Recommended DNA amount = 0.2 – 2ng (500 – 2000pg)

100pg = 17 cells

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# Low Template DNA Typing

*R v Hoey* [2007] NICC 49 (20 December 2007)

## Setback for LCN DNA

**Omagh Bombing Trial Outcome - LCN DNA is not Reliable as Evidence**

Dec 22, 2007 [Karen Lotter](#)



Moments before the Omagh bomb went off. - [www.wesleyjohnston.com](http://www.wesleyjohnston.com)

When Sean Hoey was freed in Belfast, Northern Ireland after being accused of 29 counts of murder for the Omagh Bombing, the troubles for LCN DNA were just beginning.

Sean Hoey was cleared on 20 December 2007 of 56 charges including the murders of 29 people in the [Omagh bomb attack](#) in Belfast, Northern Ireland, in a case that was essentially built on forensic evidence - in particular DNA.

According to all reports, highly unreliable DNA evidence, chaotic police record-keeping and allegations that police had falsified evidence, undermined the prosecution case against Sean Hoey in the Omagh Bombing trial almost from day one.

Omagh bombing: Sean Hoey found not guilty





# Murdoch v The Queen [2007] NTCCA 1

## Extra DNA found on Falconio case cuffs

November 2, 2005 - 3:54PM



DNA belonging to the director of the Northern Territory's forensic unit was found on handcuffs allegedly used to bind Peter Falconio's girlfriend, a court was told today.

Forensic biologist Carmen Eckhoff admitted the cable tie restraints had been contaminated with DNA from laboratory director Peter Thatcher.

She said she found the DNA when she tested some sections of the restraints in May 2004, three years after Mr Falconio disappeared.

Another section of the cable tie cuffs was later sent to the United Kingdom for further, specialist DNA testing, which found the profile of the accused Bradley John Murdoch, the court was told.



Home-made handcuffs that allegedly bound Joanne Lees' hands behind her back.

## UK FSS LT-DNA analysis of swabs from restraints

## Expert baffled by Falconio evidence DNA contamination

By Amanda Morgan

The director of the Northern Territory's forensic science unit has told a Darwin court he does not know how his DNA contaminated a key piece of evidence in the Peter Falconio murder trial.

Peter Thatcher was called to testify after the court heard his DNA was found on hand restraints that allegedly bound the wrists of Peter Falconio's girlfriend, Joanne Lees.

Dr Thatcher said he did not know how it got there and that, in line with protocol, he believed he was wearing gloves when he handled the ties.

He told the court his DNA could have been transferred by a sneeze or dandruff.



DNA evidence from handcuffs allegedly used on Joanne Lees was contaminated. (Reuters)

# Case Example

## LEAD STORY: King walks free after murder case dropped


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### Deceased woman –

- Prosecution hypothesis: offender is male and punched her in the face in committing the offence
- Swabs taken from her face, both cheeks
- Y STR (male) analysis of left and right cheek swabs
- There were two men of interest, A and B - at different times

Yesterday in the High Court in Napier, Justice Denis Clifford granted a defence application led by co-counsel Peter Williams, QC, to dismiss the charge after Crown prosecutor Russell Collins conceded the case against King was not strong enough.

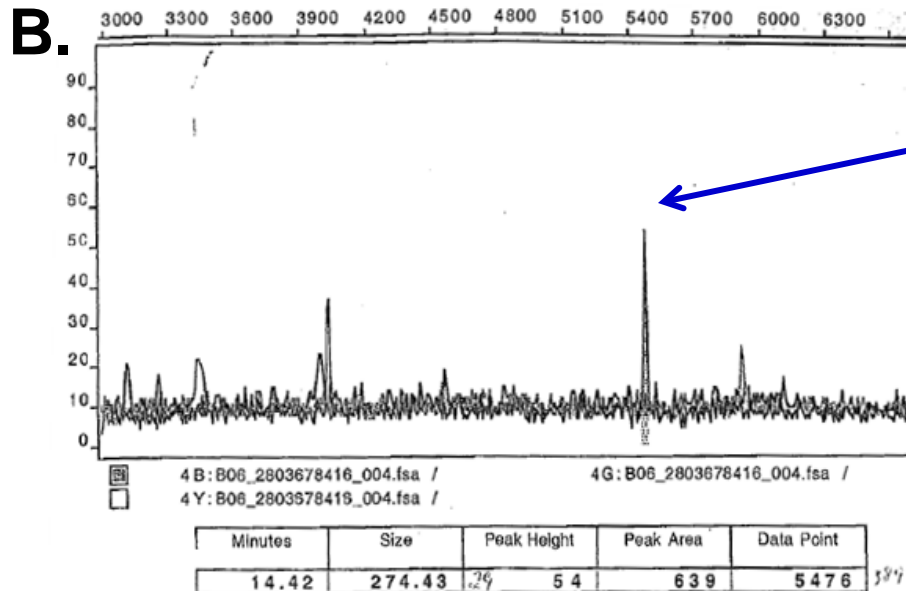
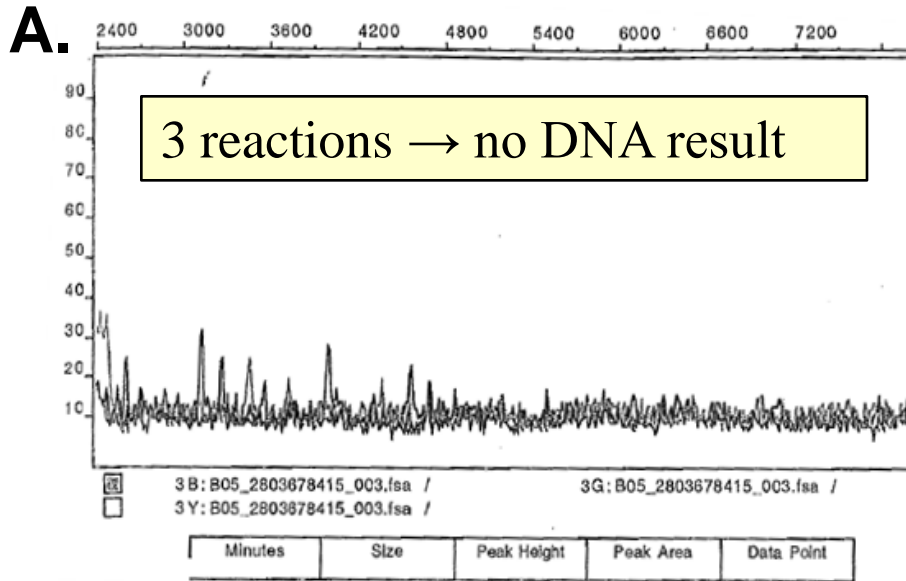
Mr Collins said it was "unsafe" for the Crown to offer its evidence as a reliable basis for a jury to reach a verdict.



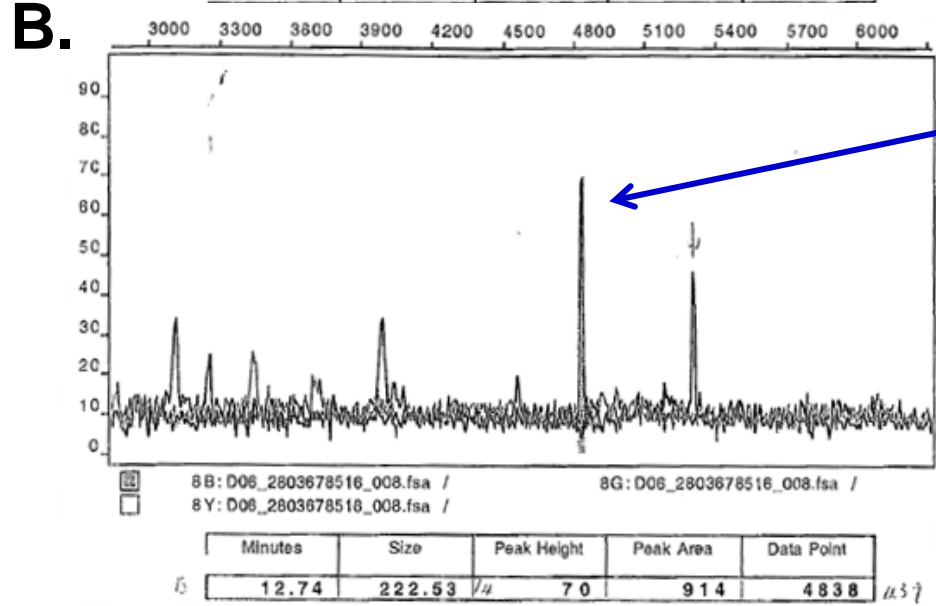
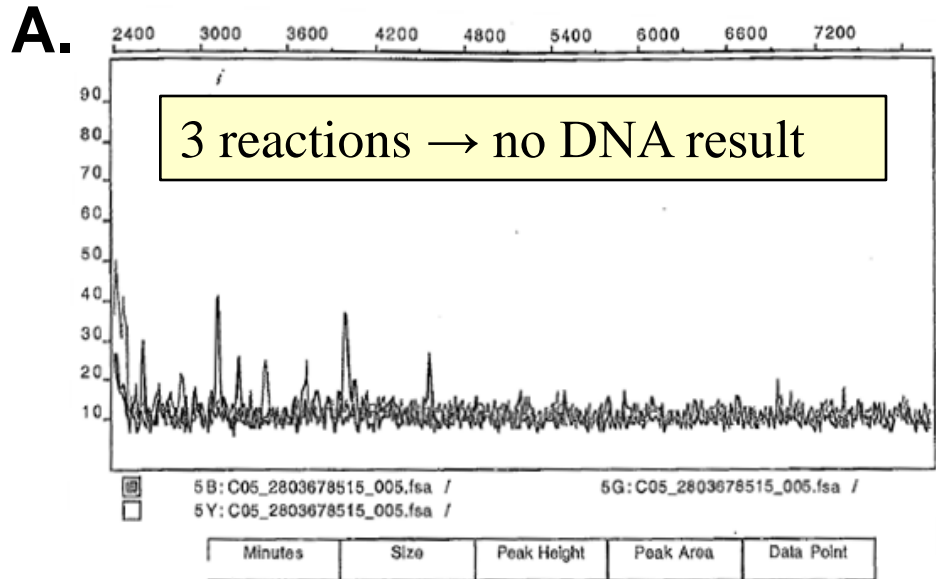
CLEARED: Zion King is relieved to be a free man again

*From Hawkes Bay Today, 9 February 2010*

# Left Cheek Swab



# Right Cheek Swab



# Results

Sample	Result	Note
Left cheek 1	No result	
2	DYS389ii 29	Peak height = 54 RFU
3	No result	
4	No result	
Right cheek 1	No result	
2	DYS439 14	Peak height = 70 RFU
3	No result	
4	No result	

# Case Results

- Two “allelic” peaks, observed at two different loci, were seen in **only one** of four replicates.
  - Consensus profile approach requires alleles to be replicated
  - These peaks should not have been reported as alleles
  - These peaks should not have been used for inclusionary or exclusionary purpose
- No peaks at the other loci (of a total 12 possible) were detected
- Peaks had very low heights of 54rfu and 70rfu (threshold values range from 50 – 250rfu)

# Case Report Conclusions

## Conclusions Drawn by Report

- Person A was excluded
- Person B was excluded as a source of the DNA on the right cheek swab
- Person B **cannot be excluded** as a source of the DNA on the left cheek swab

The possibility of contamination was not discussed in the report (although the relevance of the result was discussed in a report 8 months later)

# Case Example

## LEAD STORY: King walks free after murder case dropped

9th February 2010

 [Email Story](#)  [Print](#)  [larger](#) | [smaller](#)

A "relieved" Zion King emerged from a courtroom a free man yesterday after he was cleared of murdering a Napier grandmother in her Onekawa flat more than two years ago.

Mr King, 49, was charged with murdering Chattrice Maihi-Carroll, 46, in March, 2008 after a two-month police investigation after she was found naked and with stab wounds on the morning of January 21.

Yesterday in the High Court in Napier, Justice Denis Clifford granted a defence application led by co-counsel Peter Williams, QC, to dismiss the charge after Crown prosecutor Russell Collins conceded the case against King was not strong enough.

Mr Collins said it was "unsafe" for the Crown to offer its evidence as a reliable basis for a jury to reach a verdict.



CLEARED: Zion King is relieved to be a free man again

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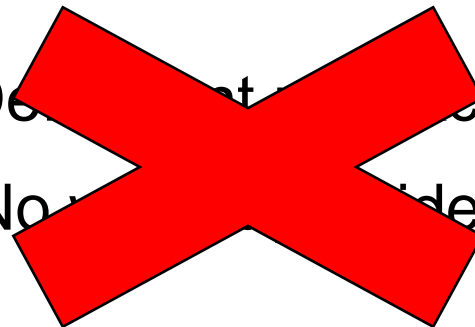
# Case Example

Reference	D3	D8	D21	D5	D13
Complainant	16 17	11 14	28 32.2	12 12	8 9
Defendant	15 17	14 14	29 30	10 11	11 12
Evidence Major Minor	16 17 15	11 14	28 32.2 29	12 10 11	8 9 11 12
Evidence Minor	15	13	29	10 11 13	11 12

- D8 13 allele present
- D5 13 allele present

Report → Minor Profile: Defendant not included

No... included



# NSW Case 1

Evidence = Stain on clothing of Person X

Locus	Major Profile		Minor Profile	
	Allele	RFU	Allele	RFU
D3	15	2670	16	262
	17	2207	18	380
VWA	15	5552	16	103
			17	589
FGA	23	3013	20	264
	24	2782	22	397
D8	15	2115	13	80
	16	2329	14	459
D21	27	2330	30	184
	29	2574		
D18	13	1982	16	283
	19	1565		
D5	11	2936	13	56
	12	3363		
D13	11	4361	9	278
D7	9	2309	10	99

Conclusion “*the minor component is consistent with originating from X*”

BUT

Minor DNA profile, has four alleles which Person X does not have

# NSW Case 1

Minor DNA profile, has four alleles which Person X does not have

	D3	VWA	FGA	D8	D21	D18	D5	D13	D7
Person X	18	17	20 22	14	29 30	16	12	9 12	9 10
Minor Profile	16 18	16 17	20 22	13 14	30 X	16 X	13 X	9 X	10 X

1. If minor DNA profile is from one person it is NOT Person X
2. **IF** DNA from Person X is present, minor DNA must come from two (or more) persons, one (or more) of whom is unknown

Report  
*“the minor component is not with originating from X”*



# NSW Case 2

- Laboratory stated, "A mixture that originated from at least three individuals, possibly more."
  - Reported in oral evidence

## Results From 3 Repeat DNA Tests

Sample	D3	VWA	FGA	D8	D21	D18	D5	D13	D7
Test 1	18 18	19	21	14 15			10 11 12		
RFU Values	18 21	132	21 42	103 119			160 107 138	9	12
Test 2	15 18	13	21 22	15 18				9	12
RFU Values	15 18 207	13 19	21 22 123 152	14 15 18 143			10 11 12	9 10 165	101
Test 3	15	13		18				10	
RFU Values	58	51		68				76	

# NSW Case 2

*“[d]ue to the low levels of DNA and the complexity of each mixture, the profiles of the individual contributors could not be determined”*

BUT

Exclusionary information ignored

Sample	D3	D3	VWA	VWA	FGA	FGA	D8	D8	D21	D21	D18	D5	D5	D13	D13	D7			
Amp 1	18	18	19	19	21	21	14	15	14	15		10	11	12	10	11	12		
Amp 2	18	18			21	22	15	15					9		12	9	12		
Person X	15	19	15	18	25	26	13	13	15	29	31	13	15	10	10	9	12	10	11

Did **not exclude** individuals who can be excluded as contributors

# NSW Case 2

Did **not exclude** individuals who can be excluded as contributors

## Testimony

Q. Looking at the results overall he's excluded. Correct?

A. *It's difficult. He's excluded as major contributor but I couldn't exclude anyone in this court room as being a minor contributor to this mixture*

# Queensland Case

Stain 1	D3	VWA	FGA	D8	D21	D18	D5	D13	D7
Person X	14 16	12 18	22 23	10 11	30 31	13	10 12	8 9	12
Knickers		16	20	13		14	10		

- Stain 1 “mixed partial DNA profile .. indicates the presence of DNA from at least two contributors”
- Further states “it is unsuitable for meaningful interpretation”.
- Stain 2 “mixed DNA profile .. indicates the presence of DNA from at least three contributors
- “there is insufficient information .. to determine whether or not Person X may have contributed DNA”

Stain 2	D3	VWA	FGA	D8	D21	D18	D5	D13	D7
Person X	14 16	12 18	22 23	10 11	30 31	13	10 12	8 9	12
Knickers	13 14	17	18 20 22 24	13	28 30	14	10 11	10	13

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# 'DNA Only' Cases: Contamination

- Contamination

- Leskie (Coronial Inquest)

- Match of DNA on Leskie clothing to rape victim
    - Contamination in laboratory

- Jama (Vincent Report)

- Match of DNA on medical swab to Jama
    - Contamination at sample collection
      - Medical samples taken from 'victim' and a woman who had intercourse with Jama within one day

# 'DNA Only' Cases: Database Match

## – UK Burglary Case

- 1 in 286 million (6 loci)
- Database match
- Parkinsons, alibi

## – Jama

- 19 y.o. Somali man, 48 y.o. 'victim'
- Very low level sperm on 1 of 4 vaginal swabs

# Summary

- DNA can provide powerful evidence
- DNA issues
  - LT-DNA Analysis
  - Mixture DNA Samples (Minor Profile)
  - Contamination
  - Database match, only DNA evidence

Not all DNA is equal

# My Contact Details

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