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What Can Go Wrong with DNA Profiling

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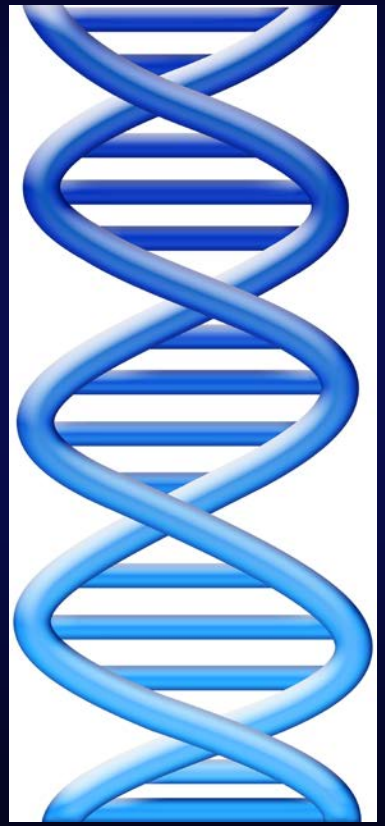
What can go wrong with DNA profiling

Dan E. Krane, Wright State University, Dayton, OH

Forensic DNA Profiling Video Series

Forensic Bioinformatics
(www.bioforensics.com)

What could go wrong?



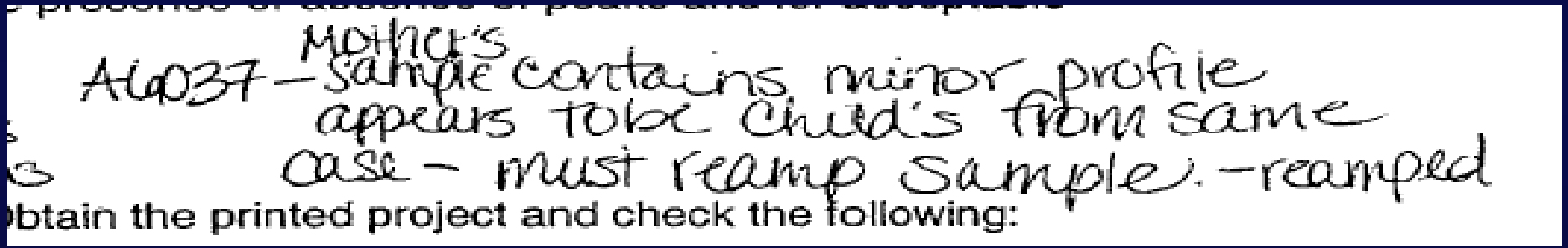
- The science of DNA profiling is sound
- Not all of DNA profiling is scientific
- Especially true in situations involving: small amounts of starting material, mixtures, and analyst judgment calls.

Documenting errors:
DNA Advisory Board Quality Assurance Standards for Forensic DNA Testing Laboratories, Standard 14

[Forensic DNA laboratories must] “follow procedures for corrective action whenever proficiency testing discrepancies and/or casework errors are detected” [and] “shall maintain documentation for the corrective action.”

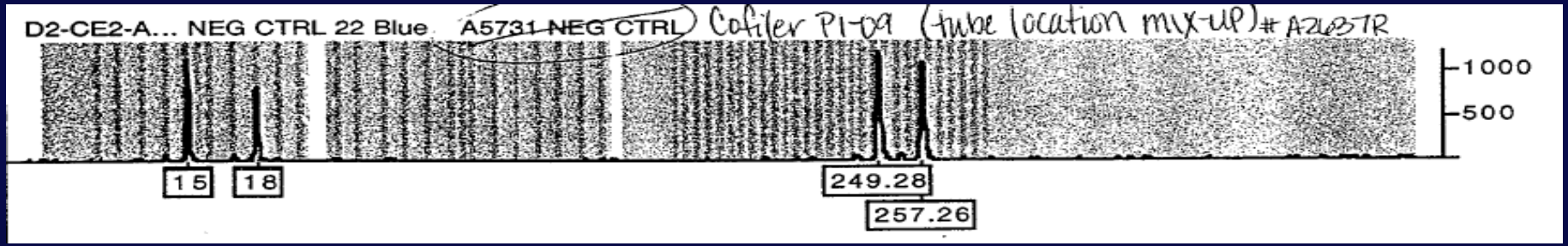
Documenting errors

Cross contamination:



Documenting errors

Positive result in negative control:



Documenting errors

Positive result in negative control, due to tube swap:

Conclusion:

When the data was analyzed as a whole before separating into mini projects, it was clear to see that the tubes in positions D2 and D4 were switched on accident. On the Injection list, the D2 position was labeled as the negative control (A5731) however the data shows a profile consistent with PI-09 in COfiler. The D4 position that was labeled PI-09 (A2637R) shows a profile consistent with that of a negative control.

Corrective Action for future analyses BS.-

Consecutively label 310 tubes, as well as, number w/ DNA numbers.

Check tubes carefully when placing in 310 tube racks.

02274

Documenting errors

Analyst contamination:

Contamination of Known Reference Sample:

On March 7, 2003 it was discovered that the known reference sample for victim Gilbert Osorno, Lab #PE02-00459-02, was contaminated with the Analyst, Vickie Kump's, DNA profile. It could not be determined how or at what stage of the analysis the contamination occurred. The analyst repeated the analysis using the same lab protocols as used previously resulting in a single profile of the victim.

Documenting errors

Separate samples combined in one tube . . . .

Sample Handling Problem During Extraction of Evidence Items for PE96-00286 and PE02-00405

On April 29, 2002 during the extraction procedure for evidence items in Lab Number PE96-00286-03 the extract for A3822 was inadvertently added to the Centricon that already contained the extract for sample A3821. The problem was

Documenting errors

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. . . . leading to corrective action:

Corrective Action

Try to minimize interruptions during any sample transfer procedures. Signs were made for the analysts to put at the end of their work areas indicating that they cannot be interrupted at the time the sign is out. Also, phone calls will not be answered during any sample handling and transfer steps.

Documenting errors

Samples mixed up

1/13/2003

The case file includes 3 sets of data.

Set #1: Item #1 and Item #2 – Known reference samples

Set #2: Item #3 and Item #4 (DATA NOT USED)

Set #3: Item #3 and Item #4

} evidence items - sample switch during processing

Set #2 (DATA NOT USED) was obtained and analyzed, but when compared to the results of Julie Marquez, the data did not match. It was determined that Set#2 results did not match due to a sample mix-up of DNA numbers. Therefore, Item#3 and Item #4 was extracted, quantitated, amplified and analyzed (Set#3) again. The data for Set#3 matched with Julie Marquez results and was used for the CTS#02-576 data.

Documenting errors

Suspect doesn't match himself . . . .

On 5/16/01, we had reported another case (PA01-00171) involving Mr. Phillips. The genetic profiles generated for Mr. Phillips in these two cases differed at all loci tested. Clearly, at least one had to be erroneous. I left a note for Vickie Kump (who was preparing to generate the draft

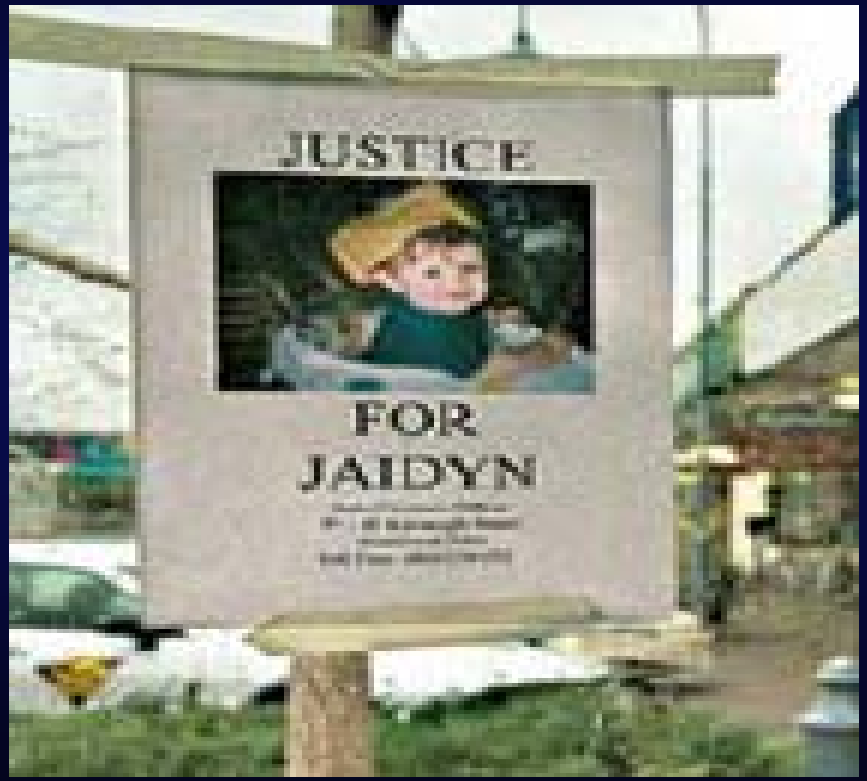
. . . . but then, staff is "'always' getting people's names wrong":

Case Processing Form" (see attached #X) reflects a

from Terry Phillips. I immediately asked Paul why he had not noted of followed up on the difference between the name "Lucio Flores" on both the sample envelope and swab, and "Terry Phillips" on the appointment slip and COC forms. He responded that he did not expect to have to do someone else's job for them, and that they [collection room staff] are 'always' getting people's names wrong, so he only goes by the case number not the name. In addition, he later told me that during pre-extraction sample processing, he fills out the sample identifiers on the case processing form prior to (not during) sample examination.

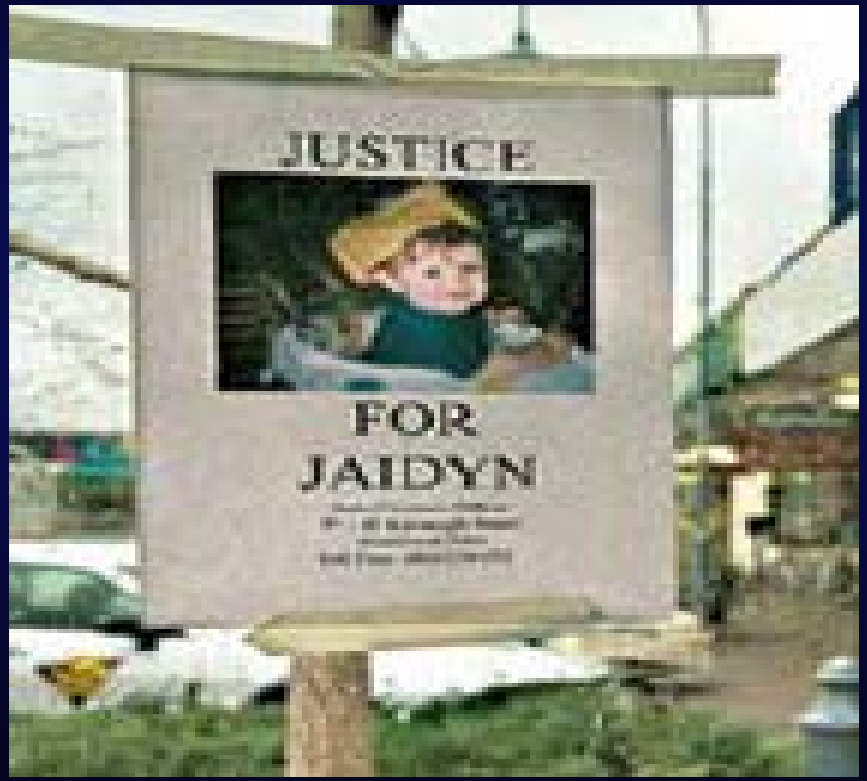
Victorian Coroner’s inquest into the death of Jaidyn Leskie

- Toddler disappears in bizarre circumstances: found dead six months later
- Mother’s boy friend is tried and acquitted.
- Unknown female profile on clothing.
- Cold hit to a rape victim.
- RMP: 1 in 227 million.
- Lab claims “adventitious match.”

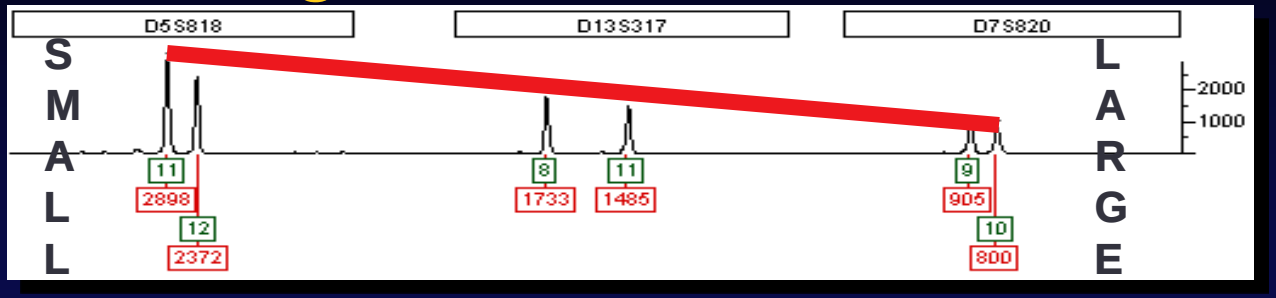


Victorian Coroner's inquest into the death of Jaidyn Leskie

- Condom with rape victim's DNA was processed in the same lab 1 or 2 days prior to Leskie samples.
- Additional tests find matches at 5 to 7 more loci.
- Review of electronic data reveals low level contributions at even more loci.
- Degradation study further suggests contamination.



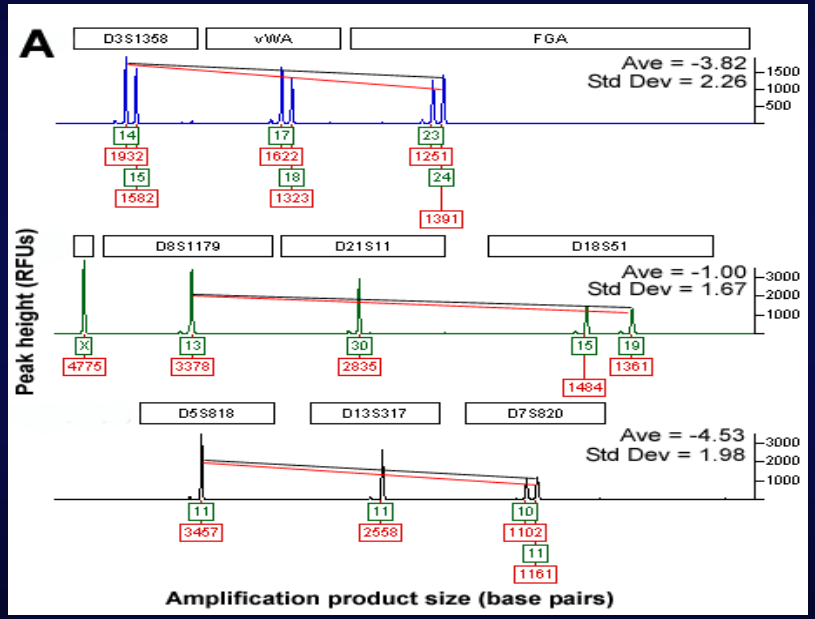
Degradation, inhibition



- When biological samples are exposed to adverse environmental conditions, they can become degraded
  - **Warm, moist, sunlight, time**
- Degradation breaks the DNA at random
- Larger amplified regions are affected first
- Classic ‘ski-slope’ electropherogram
- Degradation and inhibition are unusual and noteworthy.

Degradation, inhibition

The Leskie Inquest, a practical application

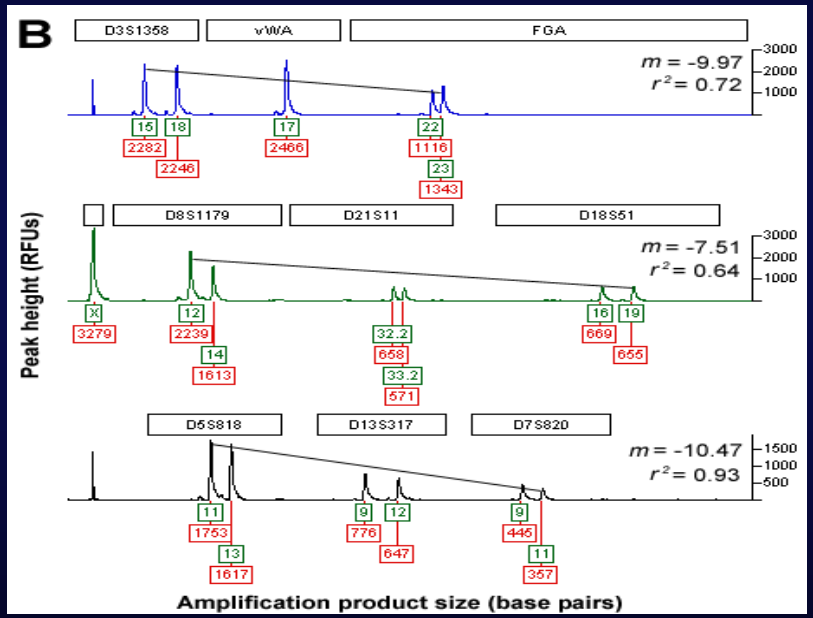


- Undegraded samples can have “ski-slopes” too.
- How negative does a slope have to be to an indication of degradation?
- Experience, training and expertise.
- Positive controls should not be degraded.

Degradation, inhibition

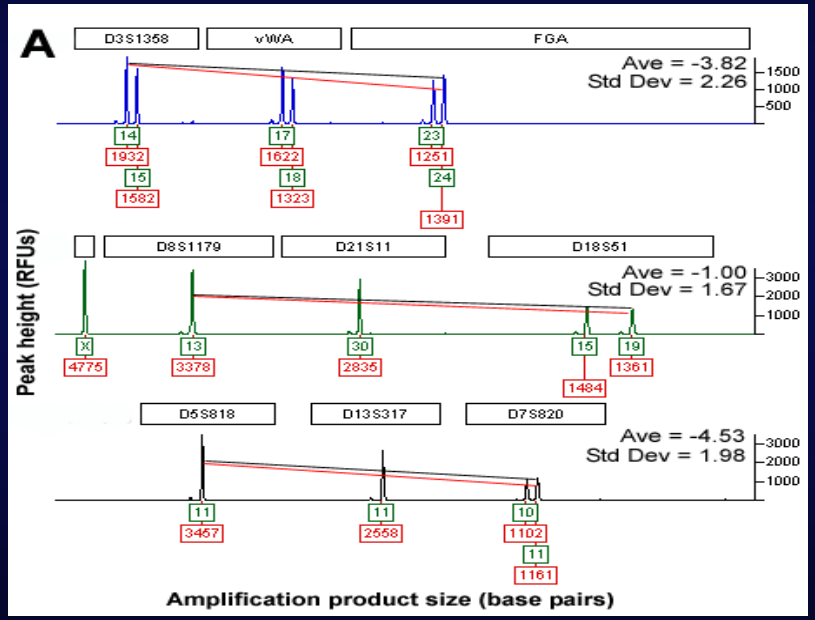
The Leskie Inquest

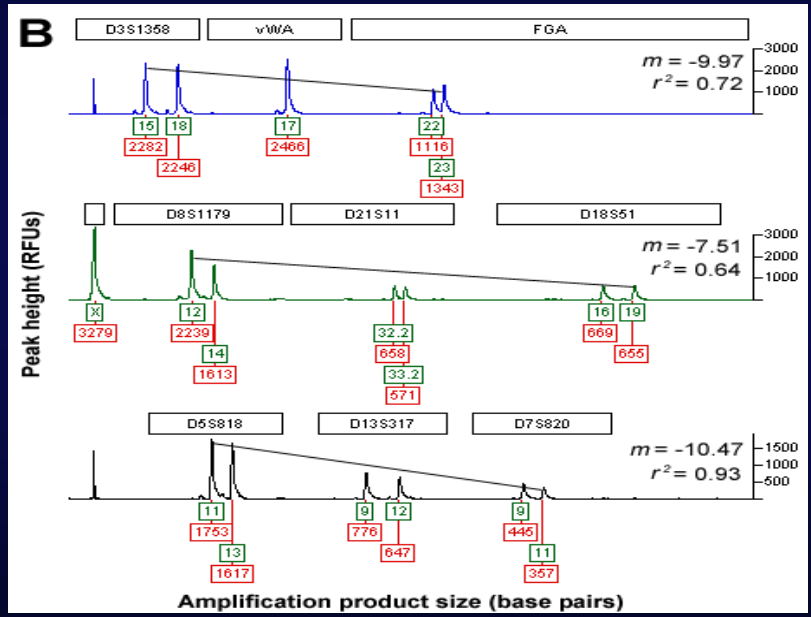
- DNA profiles in a rape and a murder investigation match.
- Everyone agrees that the murder samples are degraded.
- If the rape sample is degraded, it could have contaminated the murder samples.
- Is the rape sample degraded?



Degradation, inhibition

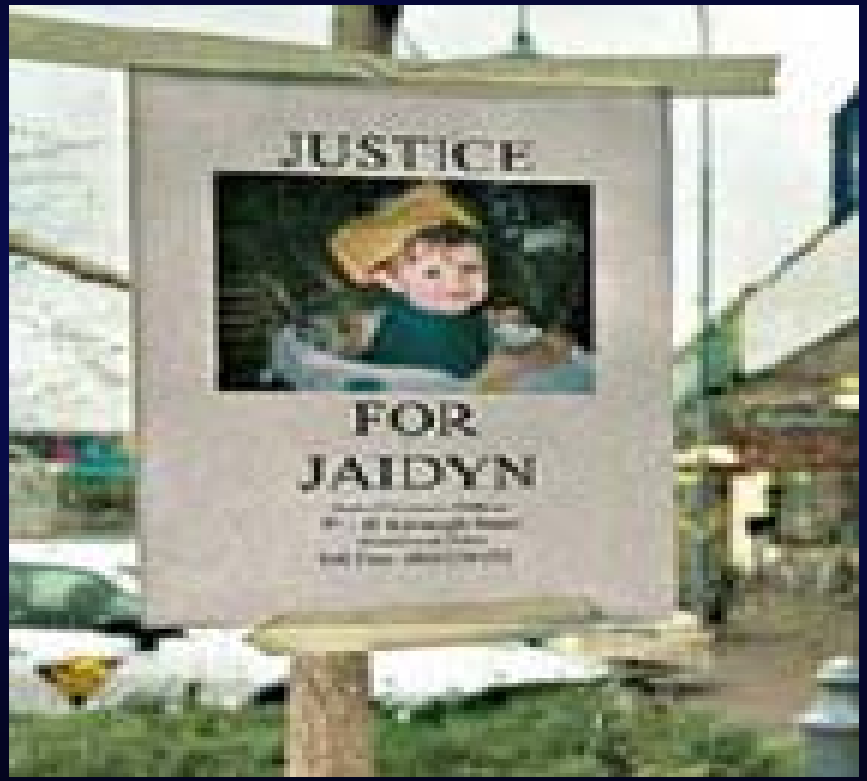
The Leskie Inquest





Victorian Coroner's inquest into the death of Jaidyn Leskie

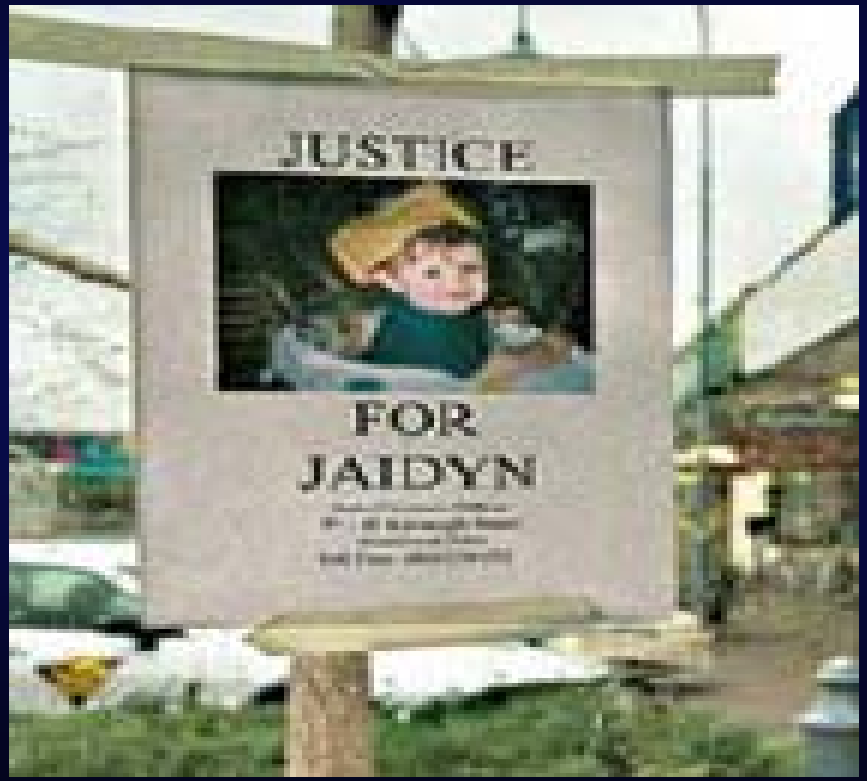
"8. During the conduct of the preliminary investigation (before it was decided to undertake an inquest) the female DNA allegedly taken from the bib that was discovered with the body was matched with a DNA profile in the Victorian Police Forensic Science database. This profile was from a rape victim who was subsequently found to be unrelated to the Leskie case."



Victorian Coroner's inquest into the death of Jaidyn Leskie

"8. The match to the bib occurred as a result of contamination in the laboratory and was not an adventitious match. The samples from the two cases were examined by the same scientist within a close time frame."

www.bioforensics.com/articles/Leskie_decision.pdf



Steps in Preparing a DNA Case

- Obtain all lab reports
- Red flags:
  - unfamiliar techniques
  - equivocal matches (profile “similar but cannot be definitively included nor excluded”);
  - partial/incomplete profiles;
  - mixtures;
  - unusually modest statistics; no statistics; likelihood ratios

Steps in Preparing a DNA Case

- Initial discovery
  - Full history of all samples from collection to current disposition
  - Complete DNA lab notes (bench notes)
  - Electronic data
  - Analysts' credentials, proficiency test record
  - Lab's incidence reports; unexpected event files; accreditation files
- Obtain expert assistance for initial review

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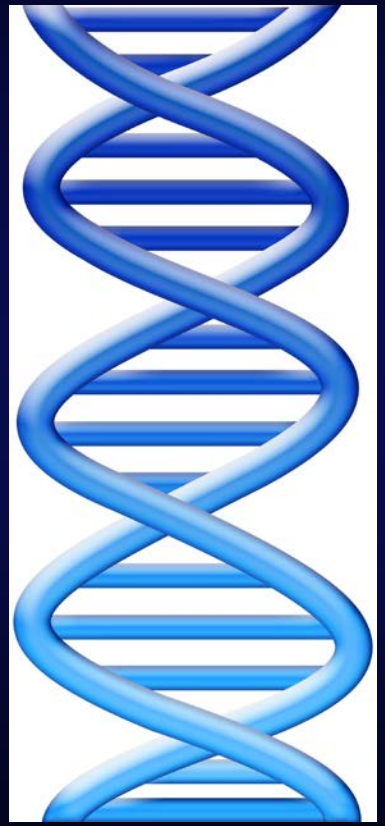

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