

Upsides and Downsides of Successive New DNA Technologies for Operational Forensics

ESRC Seminar, Durham University

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- My Background
- Successive Technical Advances
 - Benefits and Challenges
- Summary of Upsides and Downsides
- Looking Forward
- Future Challenges

My Background

AXIOM

INTERNATIONAL

- Traditional forensic biologist
- HOFSS, Forensic Access, Forensic Alliance, LGC Forensics, and Axiom International Ltd
- Increasingly specialising in complex cases
- Using DNA
- Setting up and running forensic laboratories
- Including DNA
- But not a DNA expert *per se*
- Reviewing and advising about laboratories and individual cases



Forensic
Science
Service

 FORENSIC ACCESS

forensicalliance 

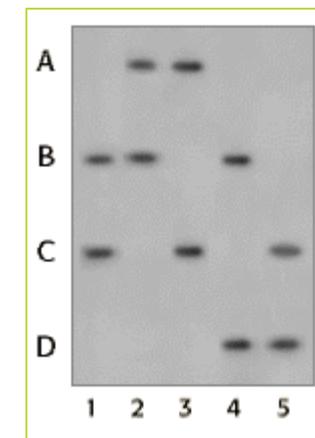
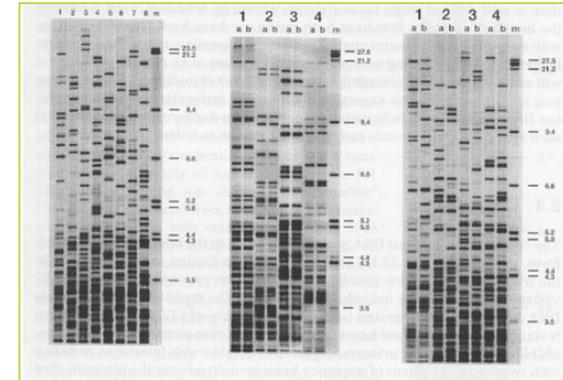
 Forensics



INTERNATIONAL

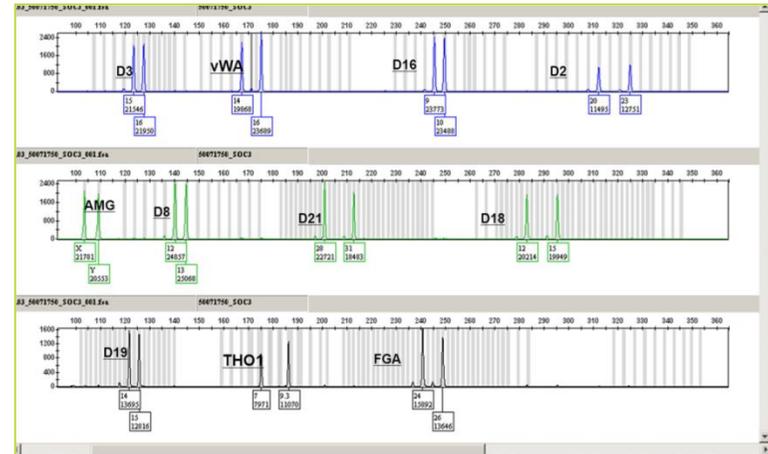
Early Analytical Techniques

- **Multi Locus Probes (MLP): (1985)**
 - Massively more discriminating than blood grouping
 - But still needed a lot of starting material
- **DQ α : (1991/3)**
 - Needed much less starting material
 - But much less discriminating than MLP
- **Single Locus Probes (SLP): (1990/7)**
 - Like DQ α , needed much less starting material
 - But substantially more discriminating



Short Tandem Repeats

- **STR Quad (1994/5), SGM (1995/6), SGM+ (1999)**
 - Increasingly more discriminating and requiring successively smaller amounts of starting material
 - But no competition on price of kits, and risk of being blinded by statistics eg. Bolton burglary
- **LCN (2001)/Enhancement (2004)/DNA SenCE (2006)**
 - Needed much less starting material and just as discriminating
 - But greater risk of contamination contributing to results eg. Omagh bombing



Optional Extras

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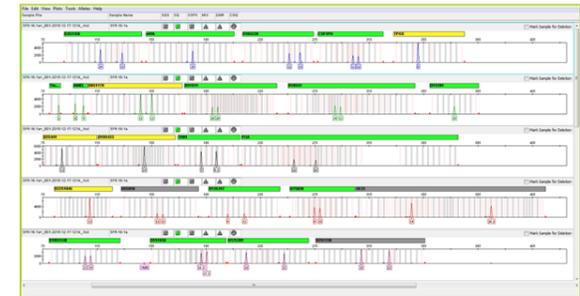
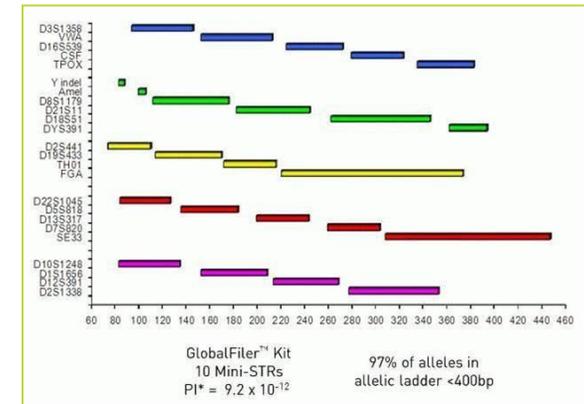
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- **Mt DNA, Identifiler, Minifiler, Y-Filer**
- Variously enabled eg:
 - analysis of wider range of samples
 - greater discrimination
 - better understanding of relative contributions in mixed samples
 - better results from degraded samples



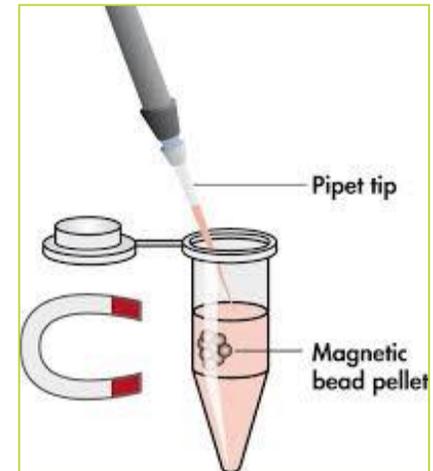
Current Analytical Techniques

- DNA17 (2014), Globalfiler, Powerplex Fusion
- Incorporating some of optional extras
- All extremely discriminating and requiring extremely little starting material
- Producing many more results - with advanced software programmes for mixture deconvolution
- But increased risk of contributing contamination and difficulty with interpretation, eg. Laboratory staff contamination
- Especially in absence of up-to-date transfer and persistence studies and increasing ignorance of individual case contexts eg. fragmentation selection and streamlined reporting (SFR)



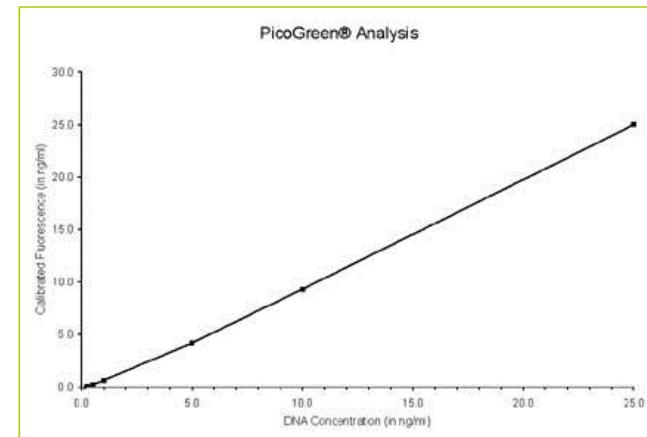
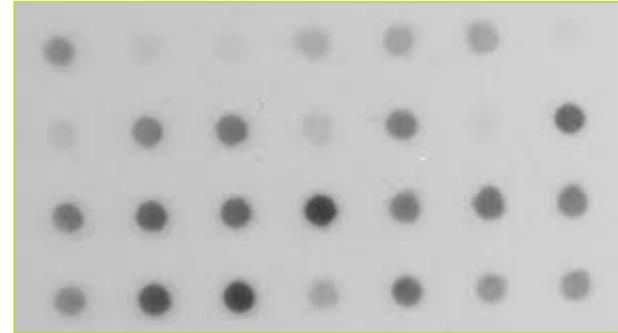
Extraction of DNA

- Innovation also in extraction and quantifying DNA
- Chemical extraction to bead technologies to automation
- Enabling better extraction, faster extraction and extraction of high volumes of samples
- But can still give rise to problems even in the best labs eg. GMP case involving contaminated consumables



Amount of DNA

- Dot blot to picogreen to realtime PCR
- Increasingly more reliable estimates of how much DNA, and how much human, how much male, and presence of degraded or inhibited DNA
- To focus analysis, save money and avoid mistakes eg. Rachel Nickell and Operation Cube



Upsides

- Incredibly powerful tool for identifying source of body fluids and tissues/traces and providing evidential links
- Applicable to wide range of samples/items in all types of criminal activity/cases
- Ideal for investigating historic cases - lasts a long time and detected and analysed in tiny quantities
- National DNA Database routinely provides identifications from cold
- Can now interface effectively with other DNA databases to fight international serious and organised crime



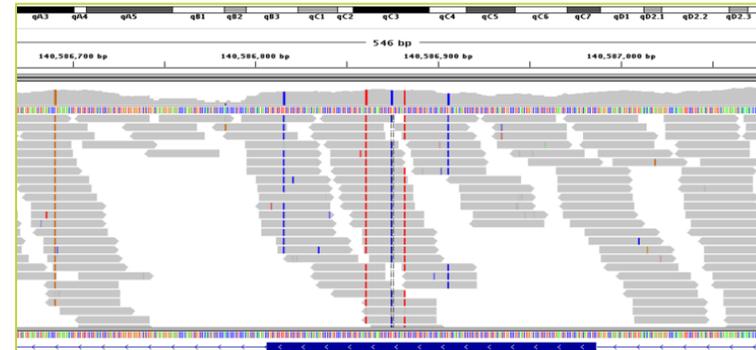
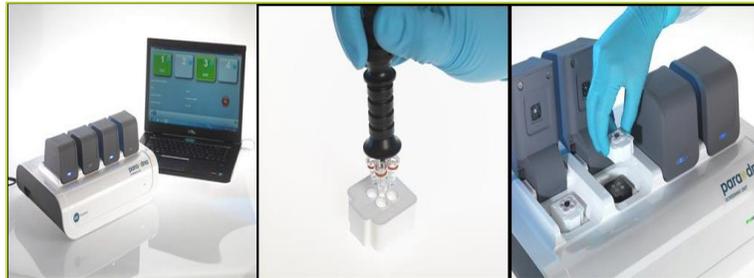
Downsides

- Successive technologies providing increasingly mind numbing statistics
- No common agreement on application of statistics, or clear understanding of statistics by end users
- Insufficient attention paid to transfer and persistence studies using newer techniques, and contextual understanding
- Compounded by eg:
 - Increasingly narrow selection of items to test
 - Summary reports, not always compiled by DNA experts



Looking Forward

- Next Generation Sequencing for: 'Ultimate' identification
 - Information about physical appearance
 - Indication of ancestry/ethnicity
- Rapid, more-or-less portable analytical processes for 'real time' information



Future Challenges

- Addressing some old chestnuts eg:
 - How was the DNA deposited?
 - In what was it deposited?
 - When was it deposited?
- Addressing new chestnuts eg:
 - Ethics and data protection
 - Forensics increasingly provided by police
- And always
 - What does the DNA mean in specific case contexts



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