TRACE DNA COLLECTION METHODS FOR VIABLE DNA PROFILES

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OBJECTIVES

01. To compare and contrast methods of trace DNA sample collection.

02. To discuss humanitarian forensic applications in sample collection for Disaster Victim Identification in a dignified manner.

PART 1

TRACE DNA SAMPLE COLLECTION METHODS: TAPE-LIFTING AND SWABBING

TRACE DNA

- Trace DNA analysis has become an integral part of case work, especially when other types of biological evidence might not be available.

- Acts as a **powerful tool** in the criminal justice system.

- Trace DNA typically refers to **low copy DNA** samples that are either very limited and/or invisible biological samples.

TRACE DNA SAMPLE COLLECTION

- **Identify** which areas to **target**. Trace samples on surfaces are complicated by the challenge of identifying where to find it.

- The **biological material** is neither visible nor does a presumptive test exist to make it visible (except, for example, in cases in which has obvious fingerprints).

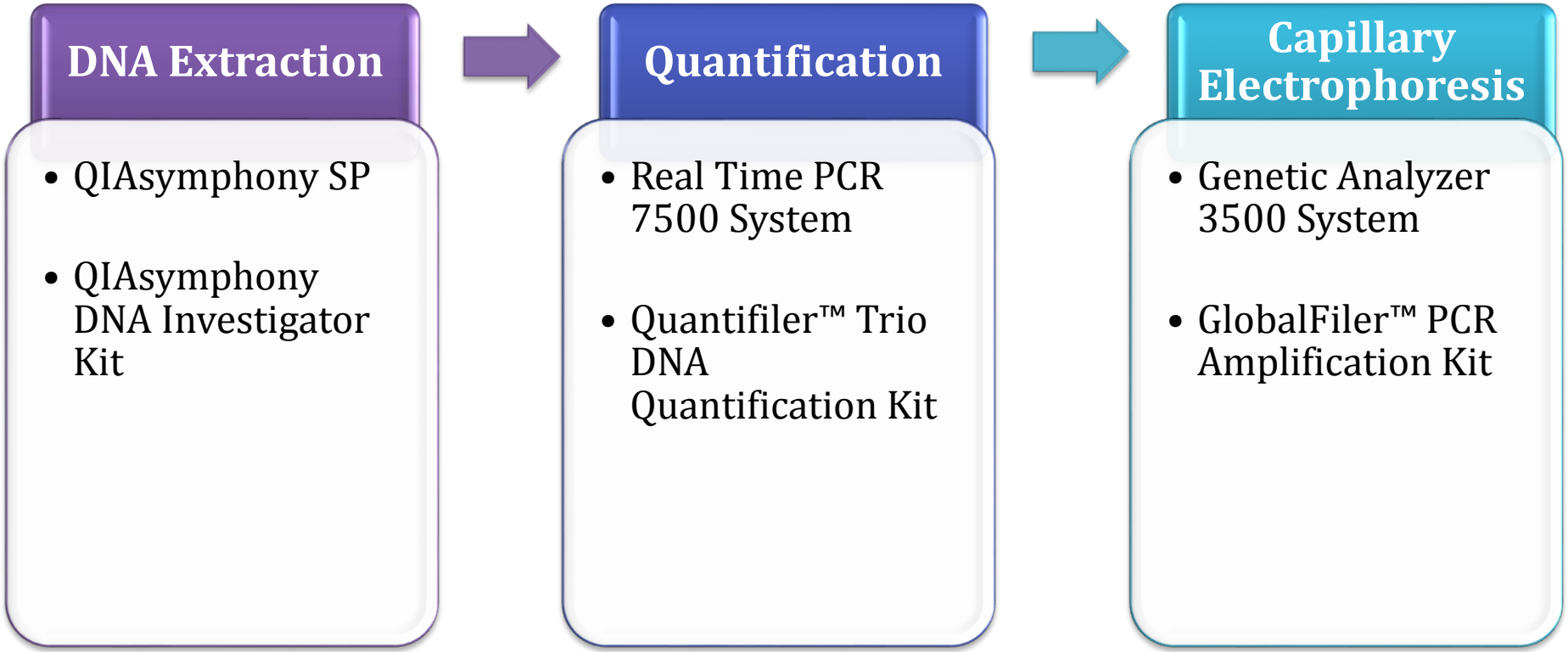
- Employing a method that would **concentrate the trace DNA** as much as possible.

1.0 TAPE-LIFT AND SWAB METHOD FOR TRACE DNA

1.1 CHALLENGES

Tape-lift	Swab
• Sticky • Difficult to place in tubes • Picks fibers & dye	• Non-sticky • Cut and place • Entraps the cells in the cotton mesh

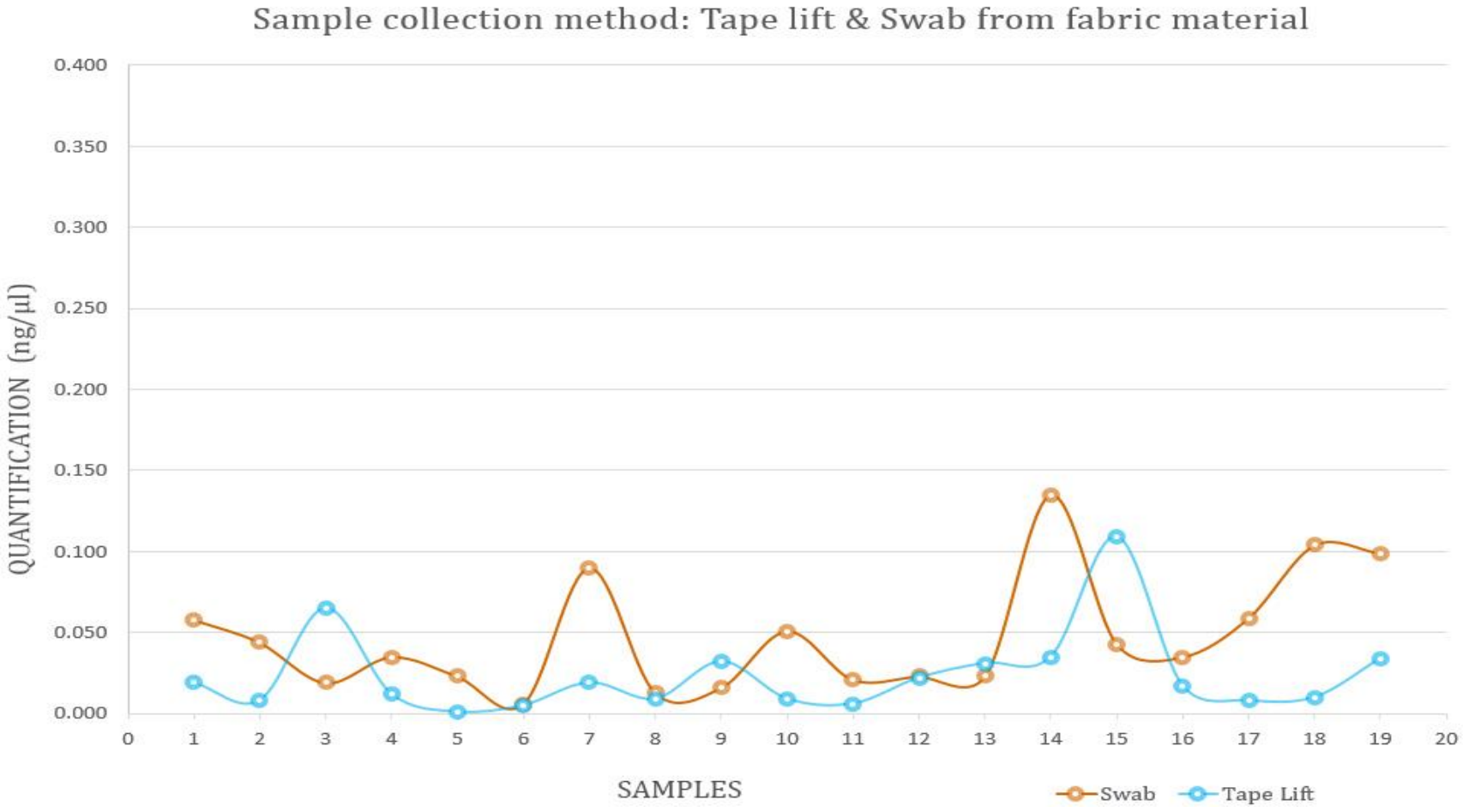
1.2 METHOD VALIDATION



1.3 METHOD VALIDATION RESULTS

Sample collection method: Tape lift & Swab from fabric material			
#	Sample No.	Sample description	Quantification (ng/µl)
1	MV-T-001	Socks 1 (Left)	0.019
	MV-S-001	Socks 1 (Left)	0.058
2	MV-T-002	Socks 1 (Right)	0.008
	MV-S-002	Socks 1 (Right)	0.044
3	MV-T-003	T shirt (Underarm)	0.065
	MV-S-003	T shirt (Underarm)	0.019
4	MV-T-004	Socks 2 (Left)	0.012
	MV-S-004	Socks 2 (Left)	0.035
5	MV-T-005	Socks 2 (Right)	0.001
	MV-S-005	Socks 2 (Right)	0.023
6	MV-T-006	Jacket (Underarm)	0.005
	MV-S-006	Jacket (Underarm)	0.006
7	MV-T-007	Jacket (Collar)	0.019
	MV-S-007	Jacket (Collar)	0.090
8	MV-T-008	Socks 3 (Left)	0.009
	MV-S-008	Socks 3 (Left)	0.013
9	MV-T-009	Socks 3 (Right)	0.032
	MV-S-009	Socks 3 (Right)	0.016
10	MV-T-010	Jeans (Waist area)	0.009
	MV-S-010	Jeans (Waist area)	0.051

Sample collection method: Tape lift & Swab from fabric material			
#	Sample No.	Sample description	Quantification (ng/µl)
11	MV-T-011	Blouse 1 (Collar)	0.006
	MV-S-011	Blouse 1 (Collar)	0.021
12	MV-T-012	Pants 1 (Waist area)	0.022
	MV-S-012	Pants 1 (Waist area)	0.023
13	MV-T-013	Pants 2 (Waist area)	0.031
	MV-S-013	Pants 2 (Waist area)	0.023
14	MV-T-014	Police summer cap	0.035
	MV-S-014	Police summer cap	0.135
15	MV-T-015	Pants 3 (Waist area)	0.109
	MV-S-015	Pants 3 (Waist area)	0.043
16	MV-T-016	Socks 4 (Left)	0.017
	MV-S-016	Socks 4 (Left)	0.035
17	MV-T-017	Blouse 2 (Collar)	0.008
	MV-S-017	Blouse 2 (Collar)	0.059
18	MV-T-019	P-cap (1)	0.010
	MV-S-019	P-cap (1)	0.104
19	MV-T-020	P-cap (2)	0.034
	MV-S-020	P-cap (2)	0.099
20	MV-T-018	Socks 4 (Right)	0.555
	MV-S-018	Socks 4 (Right)	0.011


Sample collection method: Tape lift & Swab from fabric material
QUANTIFICATION (ng/µl)
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
0
1
2
3
4
5
6
7
8
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10
11
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16
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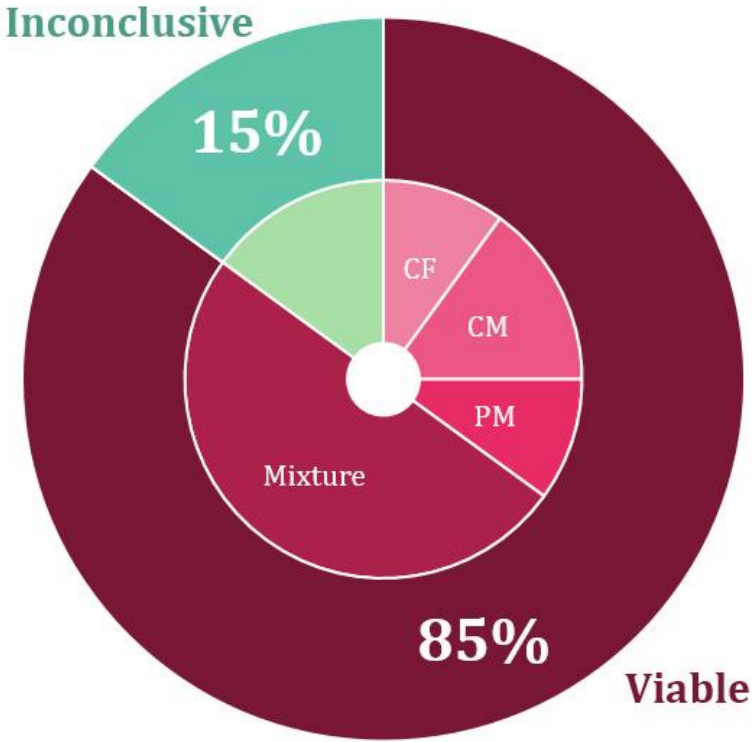
18
19
20
SAMPLES
Swab
Tape Lift

1.4 TRACE DNA EVIDENCE

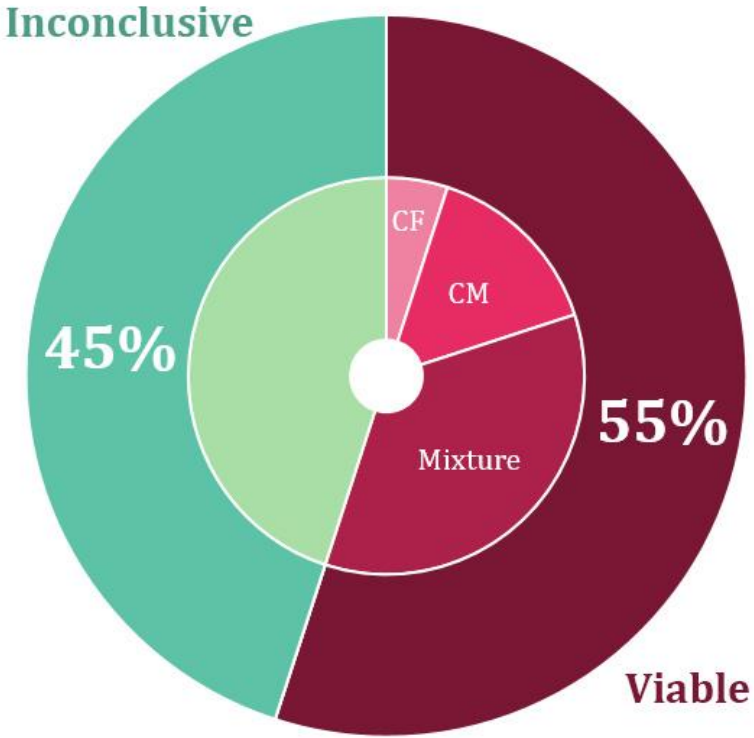
Sample collection method: Swabbing technique				
#	Sample No.	Sample description	Quantification	CE
1	SQE001	Padding and chin strap of helmet	0.130	CM
2	SQE002	Headband	0.117	CF
3	SQE003	Jeans	0.069	CM
4	SQE004	Summer cap	0.046	CM
5	SQE005	Bra	0.050	CF
6	SQE006	Summer cap	0.023	PM
7	SQE007	Summer cap	0.042	PM
8	SQE008	Piece of cloth (used as a noose)	0.046	Mixture (2)
9	SQE009	Padding of Helmet	0.263	Mixture (2)
10	SQE010	Padding and chin strap of helmet	0.061	Mixture (2)
11	SQE011	Padding and chin strap of helmet	0.491	Mixture (2)
12	SQE012	Pair of shorts (trace)	0.022	Mixture (2)
13	SQE013	T-shirt	0.190	Mixture (2)
14	SQE014	Camisole	0.091	Mixture (2)
15	SQE015	Black cardigan	0.130	Mixture (2)
16	SQE016	Bra	0.049	Mixture (2)
17	SQE017	Boxer	0.422	Mixture (2)
18	SQE018	Piece of cloth (used as a noose)	0.004	_
19	SQE019	T-shirt (faint stain)	0.001	_
20	SQE020	T-shirt (faint stain)	Undetected	_

Sample collection method: Tape-lift technique				
#	Sample No.	Sample description	Quantification	CE
1	TQE001	Bra	0.245	CF
2	TQE002	Pair of shorts	0.047	CM
3	TQE003	Jeans	0.02	CM
4	TQE004	Shorts	0.041	CM
5	TQE005	T-shirt	0.02	Mixture (2)
6	TQE006	T-shirt	0.045	Mixture (2)
7	TQE007	Bra	0.834	Mixture (2)
8	TQE008	Shirt	0.105	Mixture (2)
9	TQE009	Bra	0.035	Mixture (2)
10	TQE010	Shirt	0.038	Mixture (2)
11	TQE011	Gloves	0.03	Mixture (2)
12	TQE012	T-shirt	0.033	Inc
13	TQE013	Pair of shorts	0.013	Inc
14	TQE014	Shirt	0.011	No profile
15	TQE015	Bra	0.013	No profile
16	TQE016	T-shirt	0.004	No profile
17	TQE017	Piece of cloth	0.007	No profile
18	TQE018	Shirt	0.004	No profile
19	TQE019	Shirt	Undetected	No profile
20	TQE020	Hood	Undetected	No profile

Swab technique



Tape-lift technique



PART 2

SAMPLE COLLECTION METHODS: HUMAN REMAINS

2.0 HUMANITARIAN FORENSIC APPLICATION

- DNA profiling has become the gold standard for the identification of victims in both mass disasters and forensic cases with decomposed human remains.
- High degree of discrimination.
- DNA profiling also offers the ability to re-associate body parts in mass disaster events.

2.1 WHY HUMANITARIAN FORENSIC?

Often the primary sample type

- **Bone** typically provides a good yield of quality DNA due to its hard structure protecting the DNA from degradation.
- However,
  - An **invasive** method (requires surgical procedure),
  - Occupational **health and safety risks** to staff.

In addition to this,

- **Longer time** to prepare and sample the bone.

- Relatively **complex handling** procedures (requires refrigeration for storage and transportation of the sample).

- Affect individuals and families. Also, has adverse effects on communities and societies.

- Alleviating suffering of the victims, families, societies while also maintaining the human dignity.

(Hofmeister and Navarro, 2017; Puerto and Tuller, 2017)

2.2 OUR SAMPLE TYPE AND SUCCESS RATE

- Sample preparation
- Extraction method
- Sensitivity
- Sample itself

#	Sample No.	Sample type	Quantification (ng/µL)	CE result
1	D13C17-23	Femur bone	Undt	No profile
2	D13E08-30	Teeth	Undt	No profile
3	D14B14-61	Teeth	Undt	No profile
4	D14L16-81	Teeth	Undt	No profile
5	D14L16-82	Skull (pieces)	Undt	No profile
6	D18A7-001	Femur bone	0.015	Partial profile
	D18A7-002		0.013	
	D18A7-003		0.008	
	D18A7-004		0.010	
7	D18B18-001	Femur bone	0.020	Complete Male
	D18B18-002		0.063	
	D18B18-003		0.018	
	D18B18-004		0.043	
	D18B18-005		0.003	
8	D18C23-001	Femur bone	0.016	Partial profile
	D18C23-002		0.022	
	D18C23-003		0.019	
	D18C23-004		0.006	
	D18C23-005		0.007	
9	D18H13-001	Femur bone	Undt	No profile
	D18H13-002		Undt	
	D18H13-003		Undt	
	D18H13-004		Undt	
	D18H13-005		Undt	
	D18H13-006		Undt	
10	D19C38	Tissue sample	0.030	Complete Male

2.3 OTHER TYPES OF SAMPLES

- Nail samples (clippings and whole)
- Deep-seated red muscle tissue

- In mass fatality events, nails have the benefit of being able to be collected by persons with minimal training in sample collection.
- Minimal storage space and no requirement for refrigeration.

Schlenker et al 2016; Watherston et al. 2018

FUTURE PROSPECTS:

1. Study the efficiency of various swabs for trace DNA collection.

2. Study the efficiency of various types of tape for trace DNA collection.

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