OFFICE OF CHIEF MEDICAL EXAMINER
THE CITY OF NEW YORK

Proof of Concept:
Use of Rapid DNA Systems in Disaster Victim Identification

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Presentation Outline

- DVI Process Background
- Regional Mass Fatality Management (MFM) Exercise with Rapid DNA technology
- Results, Conclusions and Recommendations

DVI process in MFM operations

Victim identification is accomplished by comparing postmortem data to ante mortem data

DV INFORMATION PROCESS

Postmortem

DISASTER MORGUE

Process human remains efficiently separate from day to day operations in an infrastructure capable of supporting additional personnel & equipment

Ante Mortem

FAMILY **A**SSISTANCE **C**ENTER (FAC)

Facilitate exchange of timely & accurate information with family and friends of injured/MP/deceased; investigative authorities; ME/Coroner

DVI process in MFM operations

Victim identification is accomplished by comparing postmortem data to ante mortem data

DV INFORMATION PROCESS

Postmortem

DISASTER MORGUE

DNA UNIT – collect multiple samples from decedents/human remains (blood, muscle, bone, oral swab, etc.)

Ante Mortem

FAMILY **A**SSISTANCE **C**ENTER (FAC)

Relatives can provide reference samples (for future kinship analysis)
Provide decedents' personal effects (razor, toothbrush, etc.)

DVI process in MFM operations

Traditional DNA Testing can take up to 10 hours of bench work; Overall ID process can take several days

Rapid DNA typing systems can automate above processes:

- reduce sample processing time to < 2 hrs
- mobile and rugged
- simple to use with all consumables in disposable format

5TH ANNUAL REGIONAL MASS FATALITY MANAGEMENT RESPONSE SYSTEM TRAINING

Fort Hamilton Army Base, Brooklyn, NY

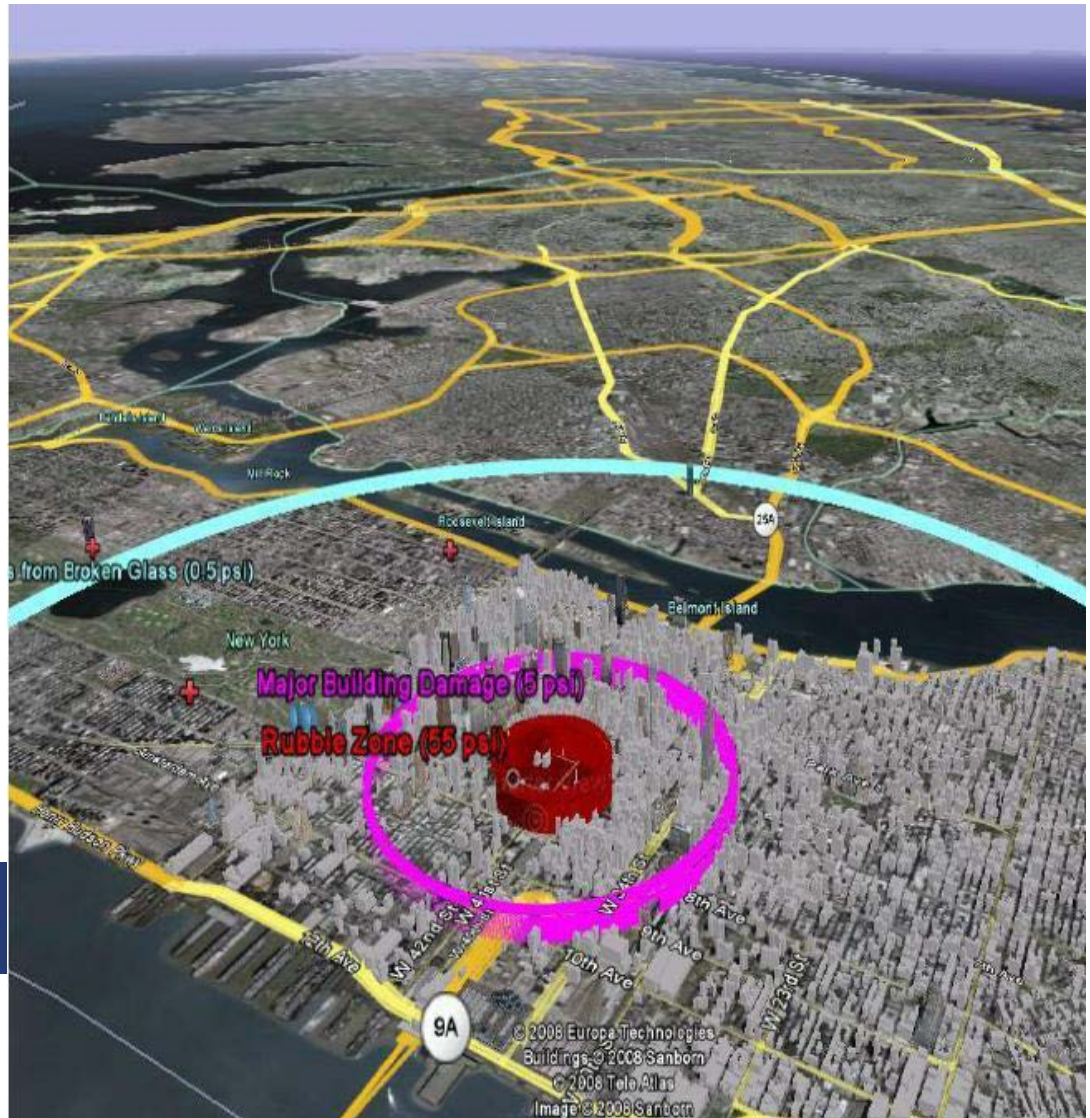
June 04-06, 2014

Rapid DNA in DVI

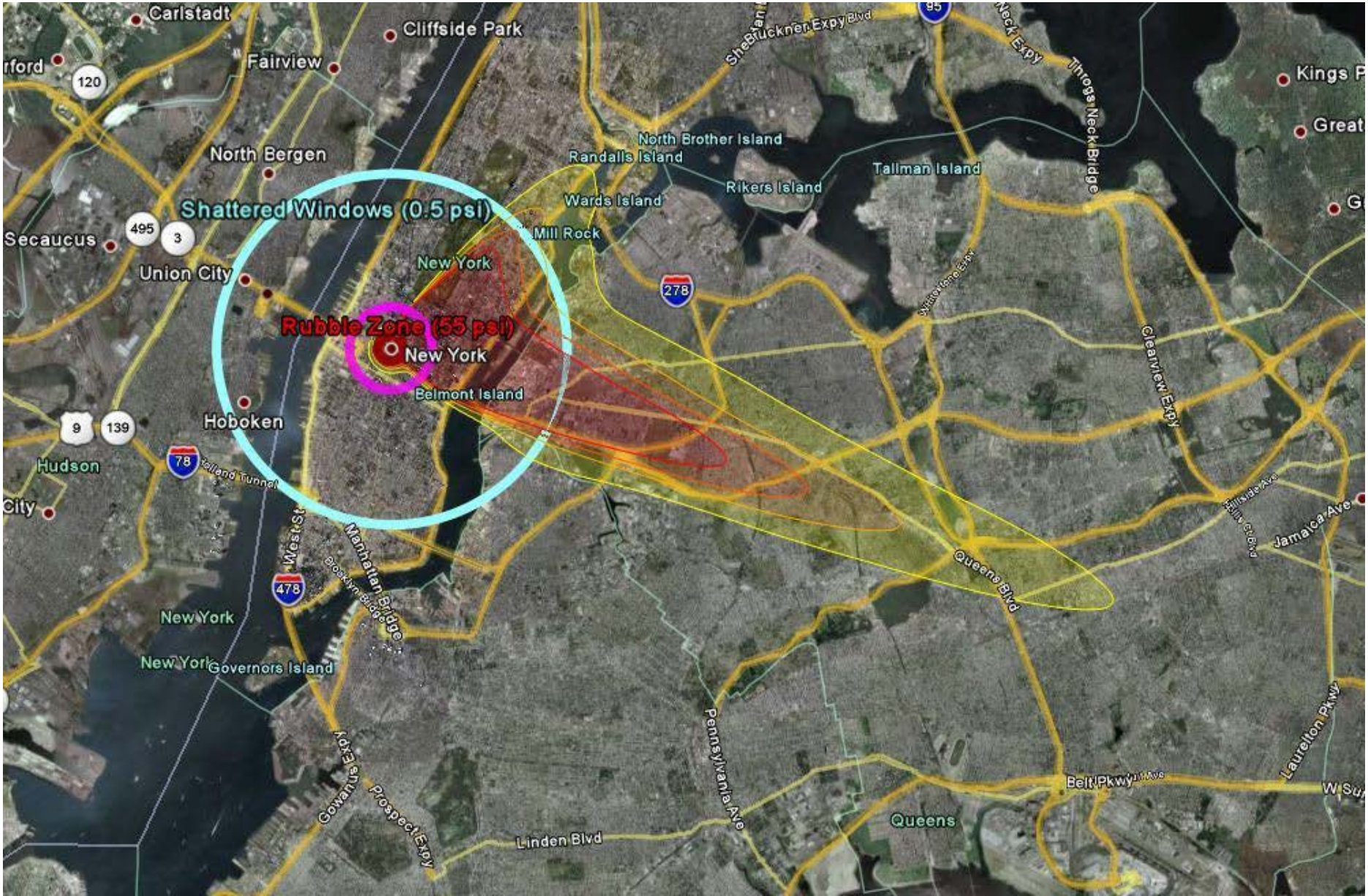
SCENARIO

10 KILOTON IMPROVISED NUCLEAR DEVICE (IND) DETONATED IN TIMES SQUARE, NEW YORK CITY

- Attack occurs at 0928 local time on May 27, 2014
- Initial estimates: ~ 680,000 persons within 0.6 mi radius
- Currently, the FM Branch is being established 6 days following the detonation



Radiation Plume Radius



MFM EXERCISE – DNA MORGUE (DAY 1 & 2)

IntegenX RapidHit®200

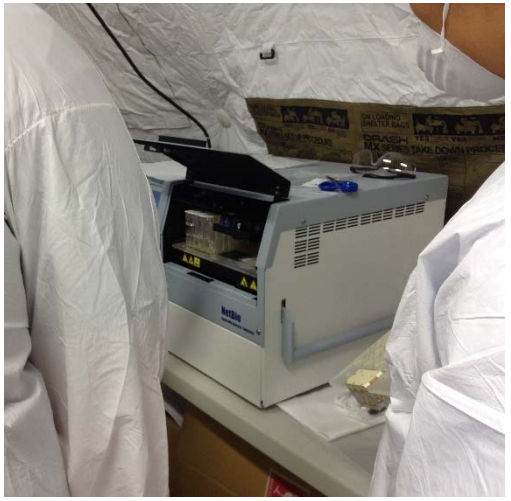
GE/NetBio DNAscan™

Rapid DNA in DVI

Regional MFM Response System Training

June 4, 2014 Clean Morgue (Tent)

- Tent Temperature Range = 73° F – 87° F



June 5, 2014 Contaminated Morgue (Tent)

- Tent Temperature Range = 59° F – 79° F

June 6, 2014 Family Assistance Center (Building)

- Room Temperature = 76° F

MFM Exercise Days 1 - 3

DNAScan™ Rapid DNA Analysis™ System

RapidHit®200

DNA MORGUE

- Simulated Recovered Remains
  - 4 PM Degraded Muscle Tissue
  - 4 PM Fresh Muscle Tissue
  - 2 PM Bloodstain FTA Cards

FAC

- Simulated Family Member Reference Samples
  - 5 Buccal Swabs and 10 Buccal Swabs

MFM Exercise days 1 - 3

DNAScan™ Rapid DNA Analysis™ System

RapidHit®200

SAMPLE PROCESSING

Muscle → cut into chunks
Blood → ~ 3 mm x 3mm
Buccal → swabs provided

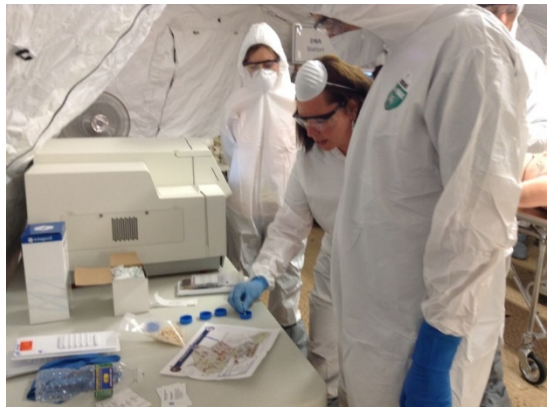
Muscle → cut into chunks
Blood → ~ 3 mm x 3mm
Buccal → sterile cotton

MFM Exercise days 1 - 3

DNAScan™ Rapid DNA Analysis™ System

RapidHit®200

SAMPLE PROCESSING



SAMPLE LOADING

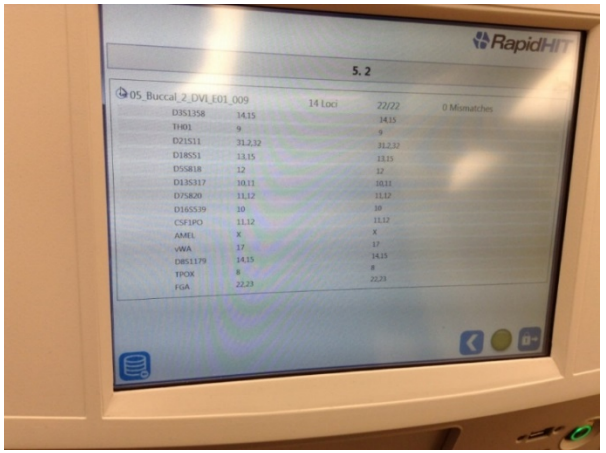
MFM Exercise days 1 - 3

	DNAScan™ Rapid DNA Analysis™ System	RapidHit®200
PROTOCOL USED	Buccal Protocol	Non Buccal → Other Protocol Buccal → Buccal Protocol
EXTRACTION, PCR, CE AUTOMATED	Promega® PowerPlex® 16 HS kit	
DATA ANALYZED AUTOMATICALLY	Integrated software with fixed analysis parameters	SoftGenetics® GeneMarker® HID STR Human Identity Software

MFM Exercise days 1 - 3

DNAScan™ Rapid DNA Analysis™ System

RapidHit®200



- Small-scale implementation of the Rapid DNA systems was assessed
- Output data were evaluated
  - Profile completeness, alleles called, and peak height balance.

RESULTS

INTEGENX RAPIDHIT DNA

RESULTS – RapidHIT® (IntegenX)

Instrument Output (Auto-Analysis)

Sample		Ref. Profile Alleles	# Correct Alleles Called	% Alleles Called
PM Degraded Muscle Tissue	D1	29	11	38%
	D3	26	6	23%
	D4	29	22	76%
	D5	29	7	24%
				40.7%

RESULTS – RapidHIT® (IntegenX)

Instrument Output (Auto-Analysis)

Sample		Ref. Profile Alleles	# Correct Alleles Called	% Alleles Called
PM Fresh Muscle Tissue	F1	28	19	68%
	F2	27	0	0%
	F4	26	21	81%
	F5	28	0	0%
				37.3%

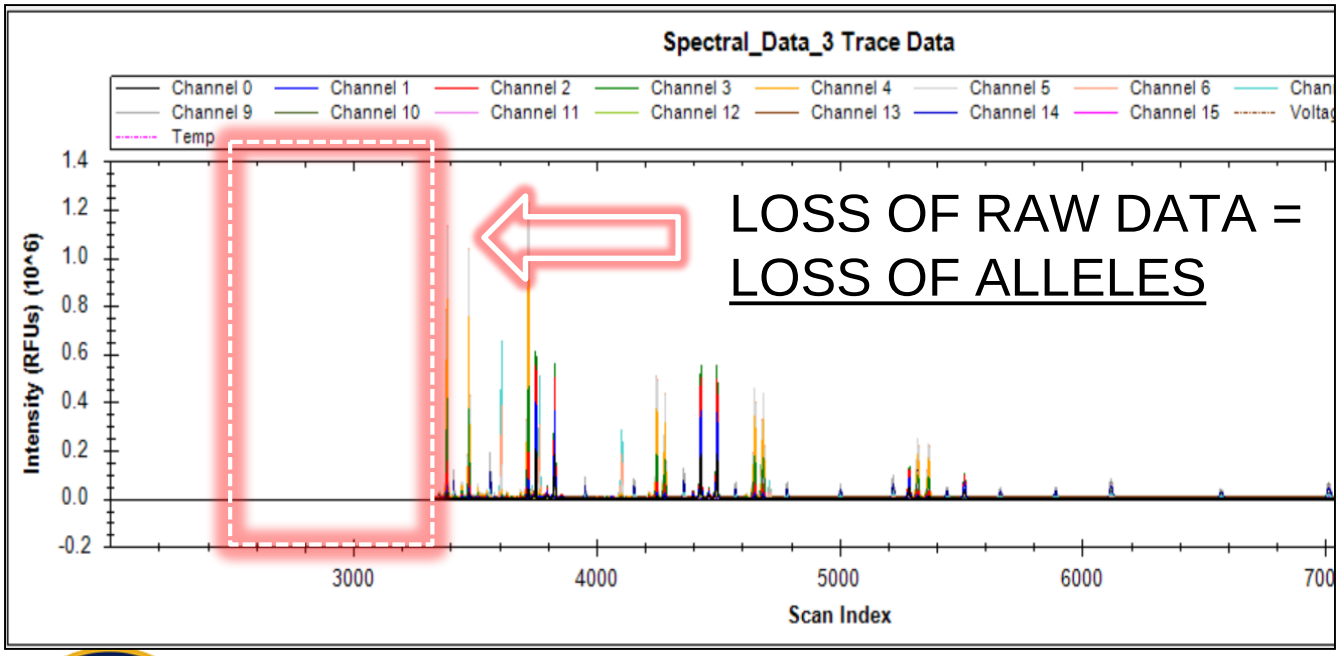
RESULTS – RapidHIT® (IntegenX)

Instrument Output (Auto-Analysis)

Sample		Ref. Profile Alleles	# Correct Alleles Called	% Alleles Called
Bloodstained	363	29	29	100%
FTA	359	29	0	0%
				50%

RESULTS – RapidHIT® (IntegenX)

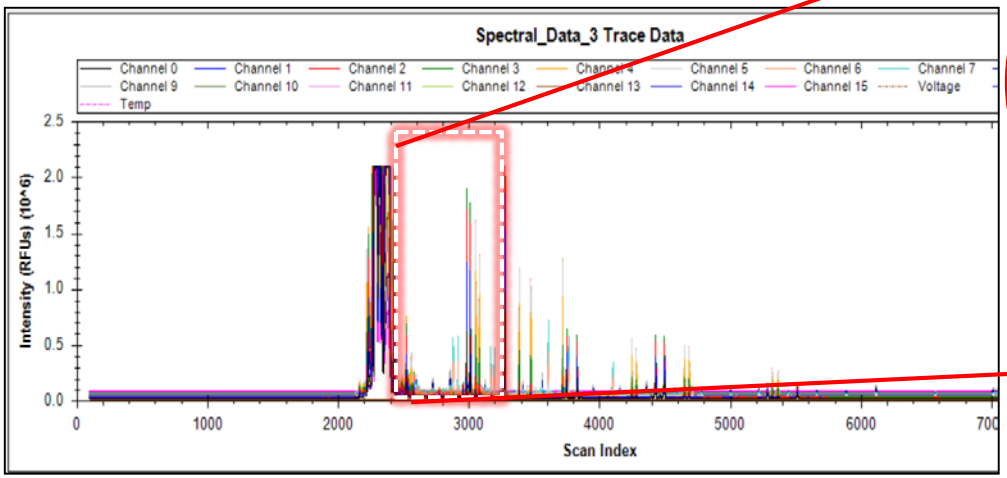
Sample:	F4B	F2B	F5B	359
Range:	<180 bp	< 200 bp	< 120 bp	<160 bp

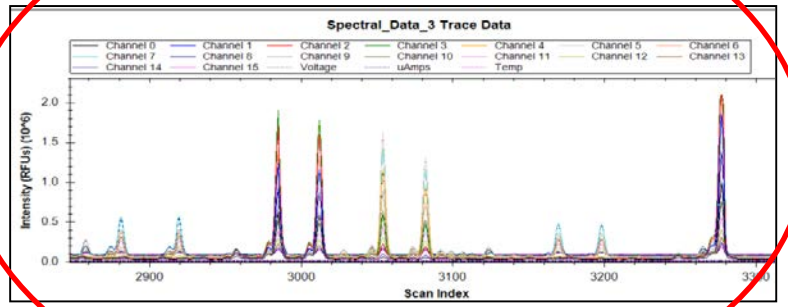


Automatic primer peak trimming

RESULTS – RapidHIT® (IntegenX)

- IntegenX performed manual data analysis and recovered lost data due to automatic primer peak trimming
- Due to too much input sample





- IntegenX was able to recover raw data using their software
- Overall 95% (18/19 loci) of alleles lost during auto analysis was recovered by Manual Recovery

RESULTS – RapidHIT® (IntegenX)

Re-Analysis & Manual Review

Sample		Ref. Profile Alleles	# Correct Alleles Called		% Alleles Called	
PM Degraded Muscle Tissue	D1	29	11	23	38%	79%
	D3	26	6	15	23%	58%
	D4	29	22	29	76%	100%
	D5	29	7	14	24%	48%
			~12	~20	**40%**	**~71%**

RESULTS

GE/NETBIO DNASCAN RAPID DNA ANALYSIS SYSTEM

RESULTS – DNAscan™ Rapid DNA system

Instrument Output vs. Manual Review

Sample		Ref. Profile Alleles	# Correct Alleles Called	% Alleles Called
PM Degraded Muscle Tissue	D1	29	"NR" 14	0% 48%
	D3	26	"NR" 5	0% 19%
	D4	29	"NR" 0	0% 0%
	D5	29	"NR" 7	0% 24%

RESULTS – DNAscan™ Rapid DNA system

Instrument Output vs. Manual Review

Sample		Ref. Profile Alleles	# Correct Alleles Called		% Alleles Called	
PM Fresh Muscle Tissue	F1	28	0	11	0%	39%
	F2	27	25	26	93%	96%
	F4	26	24	24	92%	92%
	F5	28	28	28	100%	100%
			~19	**~22**	**~71%**	**~81%**

RESULTS – DNAscan™ Rapid DNA system

Instrument Output vs. Manual Review

Sample		Ref. Profile Alleles	# Correct Alleles Called		% Alleles Called	
Bloodstained	363	29	0	0	0%	0
FTA	359	29	0	26	0%	90%
					0%	**~45%**

CONCLUSIONS

- The MFM exercise demonstrated that Rapid DNA systems can be used in DVI
- Both instruments were easy to use with little to no training required
- Both generated full and partial profiles, but not until after manual intervention
  - All 25 samples tested on the RapidHIT® produced useable data
  - All but 2 for GE/NetBio's DNAScan™ produced useable data

CONCLUSIONS

- Samples resulting in partial profiles were expected, as they were degraded tissue samples ~12-17 years old; or bloodstained cards from 2000
- Allele detection and labeling are dependent upon sample quality, input amount (cutting size), processing protocol and software analysis parameters

GENERAL RECOMMENDATIONS

- Provide user capability to recover pre-processed data (raw data)
- Establish input amount and sample preparation
- Establish instrument protocols based on sample type
- Establish software analysis parameters using various sample types
- Investigate potential inhibitors
- Develop standard operating procedure for rapid DNA systems in DVI

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