2014 Rapid DNA Maturity Assessment Results

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National Institute of Standards and Technology
U.S. Department of Commerce

Disclaimer

We will mention commercial STR kit and instrument names, but we are in no way attempting to endorse any specific products.

NIST Disclaimer: Certain commercial equipment, instruments and materials are identified in order to specify experimental procedures as completely as possible. In no case does such identification imply a recommendation or it imply that any of the materials, instruments or equipment identified are necessarily the best available for the purpose.

Information presented does not necessarily represent the official position of the National Institute of Standards and Technology or the U.S. Department of Justice.

Previous Maturity Assessments

- Conducted Summer 2013
- Presented at the 2013 Global Identity Summit
- Two R-DNA developers
- Three testing sites
- A total of 350 reference buccal swabs run
- Success defined as the automated calling of the 13 core STR loci
- Overall success = 87.4%

2014 Maturity Assessment

- Purpose to assess the status in the fall 2014 of rapid DNA typing technology for the CODIS 13 core loci
  - In support of lab use and future external (non-lab-based) Rapid DNA implementation
- Integrated (swab in – allele detection) instruments capable of genotyping the core CODIS 13 STR markers were eligible for the study

Rapid DNA Instruments

ANDE (NetBio)

- One biochipset
  - Stored at RT
  - Shelf life ≈ 6 months
- RFID swabs tagged for sample tracking

PowerPlex 16 loci
≈86 min runtime
(5 samples)

ANDE PP16

RapidHIT 200 (IntegenX)

- Kit = 4 components
  - Stored between RT-4ºC
  - Shelf life ≈ 6 months @ 4ºC
- Cotton Swabs

PowerPlex 16 loci
≈90 min runtime
(5 samples)

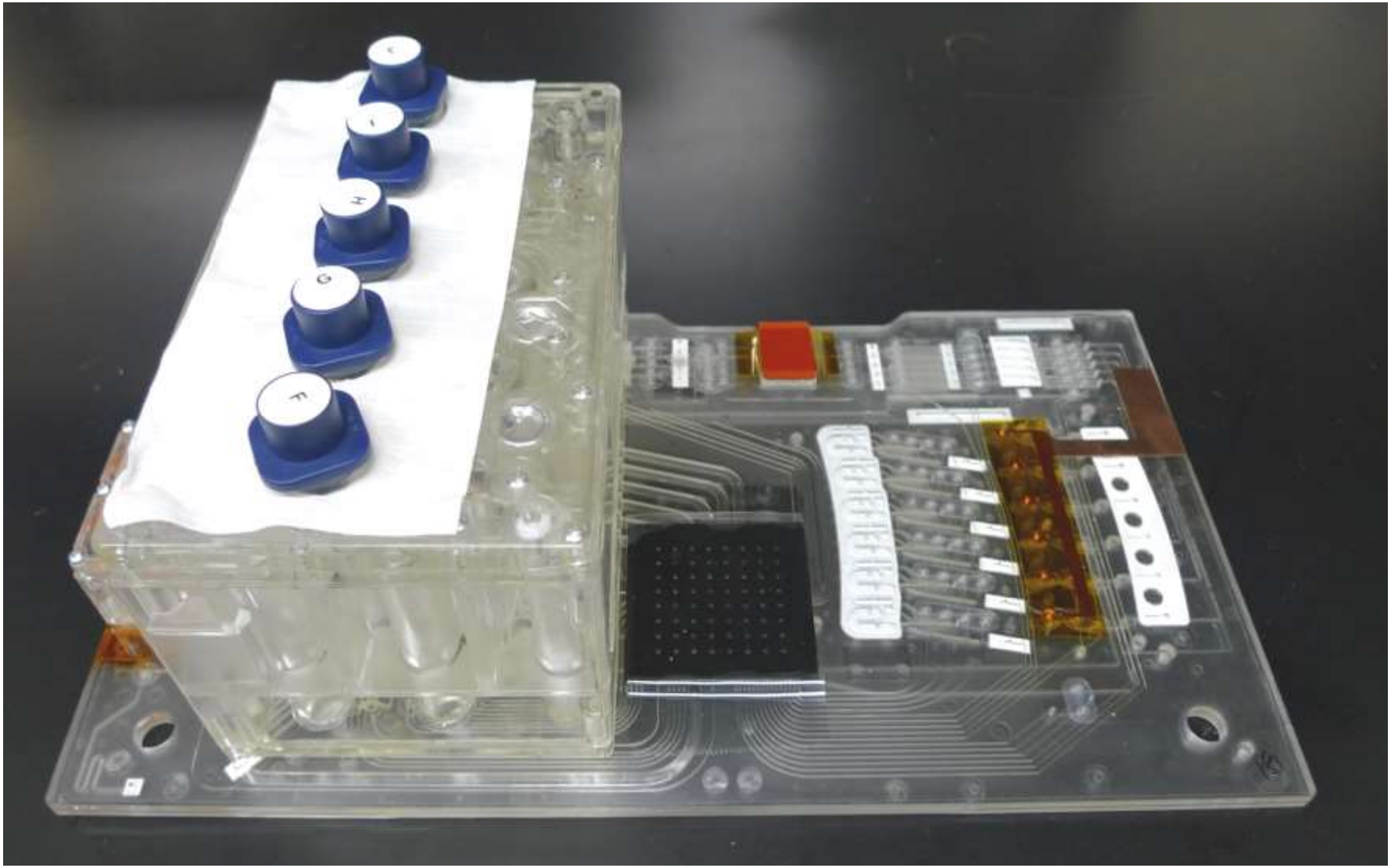
RH200 PP16

GlobalFiler Express loci
≈120 min runtime
(1-7 samples)

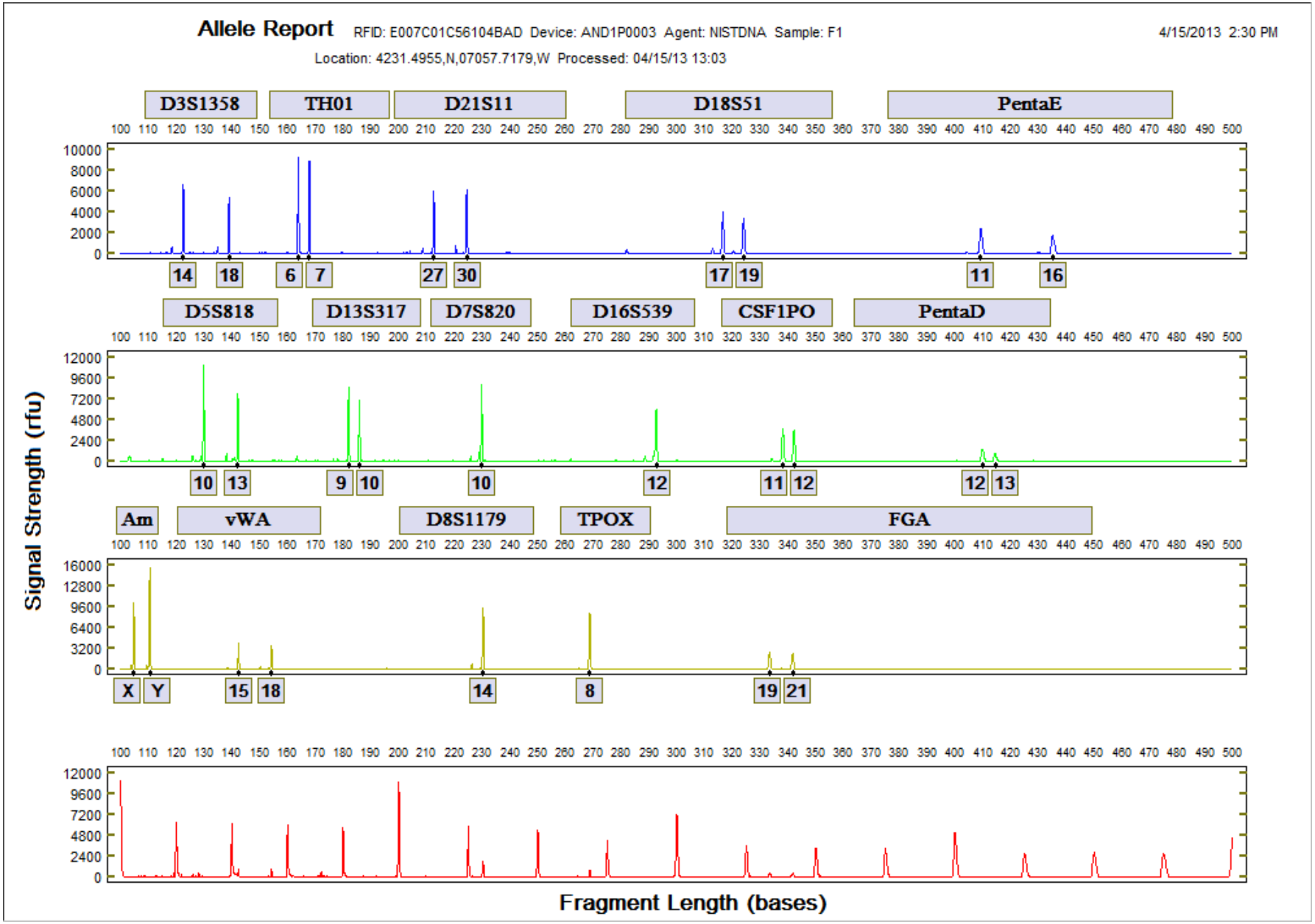
RH200 GFE

ANDE (NetBio)

ANDE (NetBio)



ANDE-Successful Profile



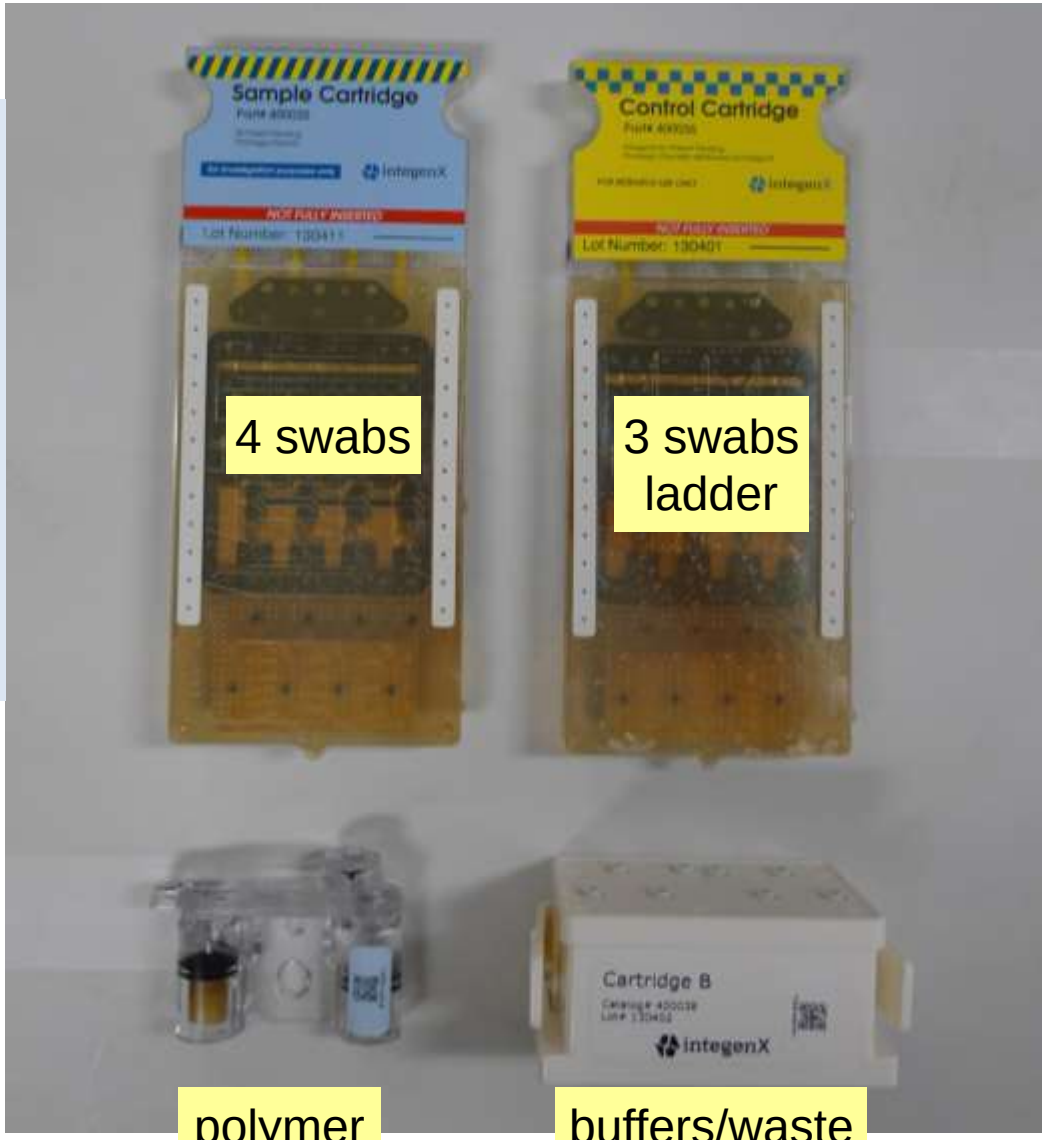
RapidHIT 200 (IntegenX)

RapidHIT 200 (IntegenX)

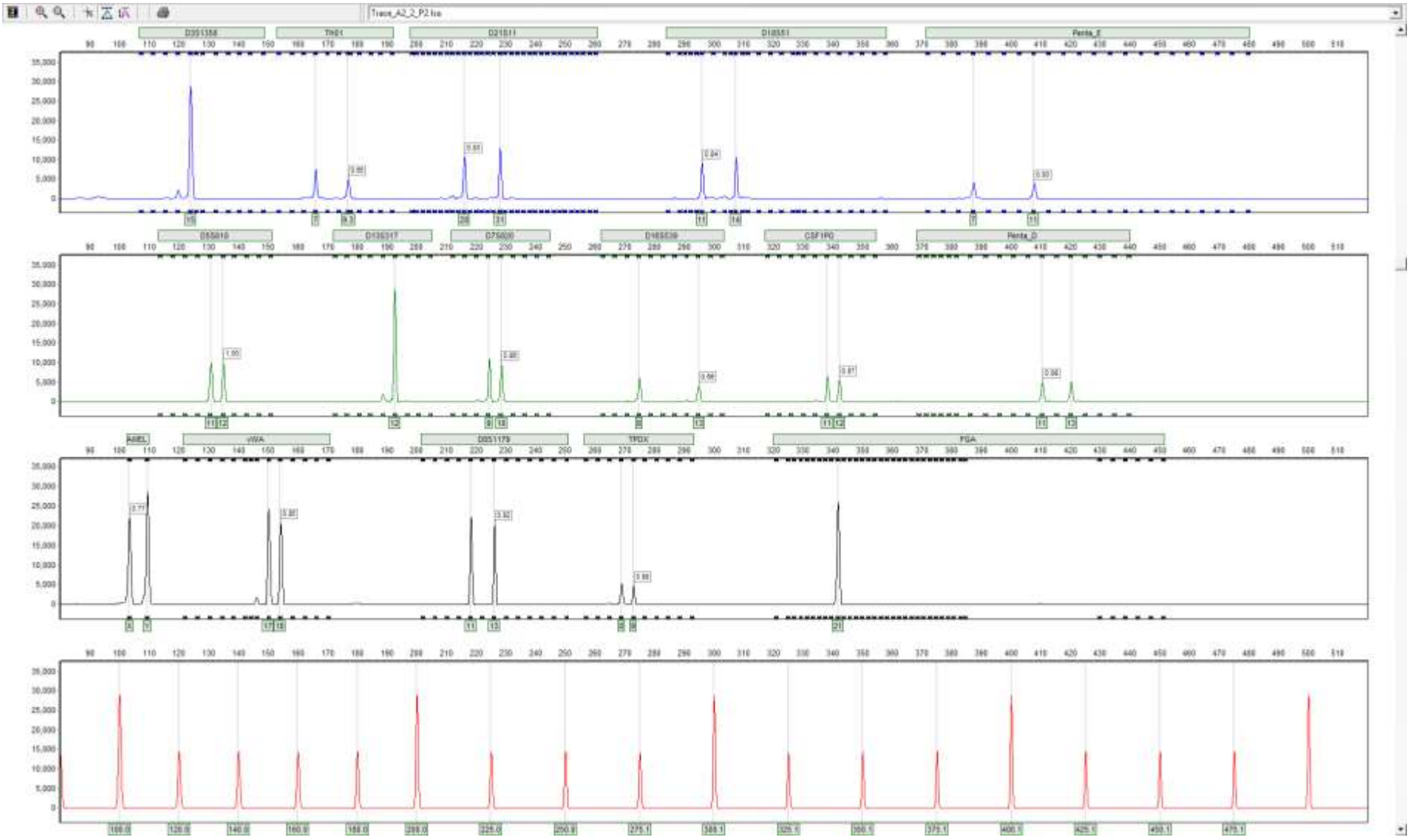
Kit = 4 components
Stored at 4°C
Shelf life ≈ 3 months
Cotton swabs

Running PP16 loci
≈108 min runtime

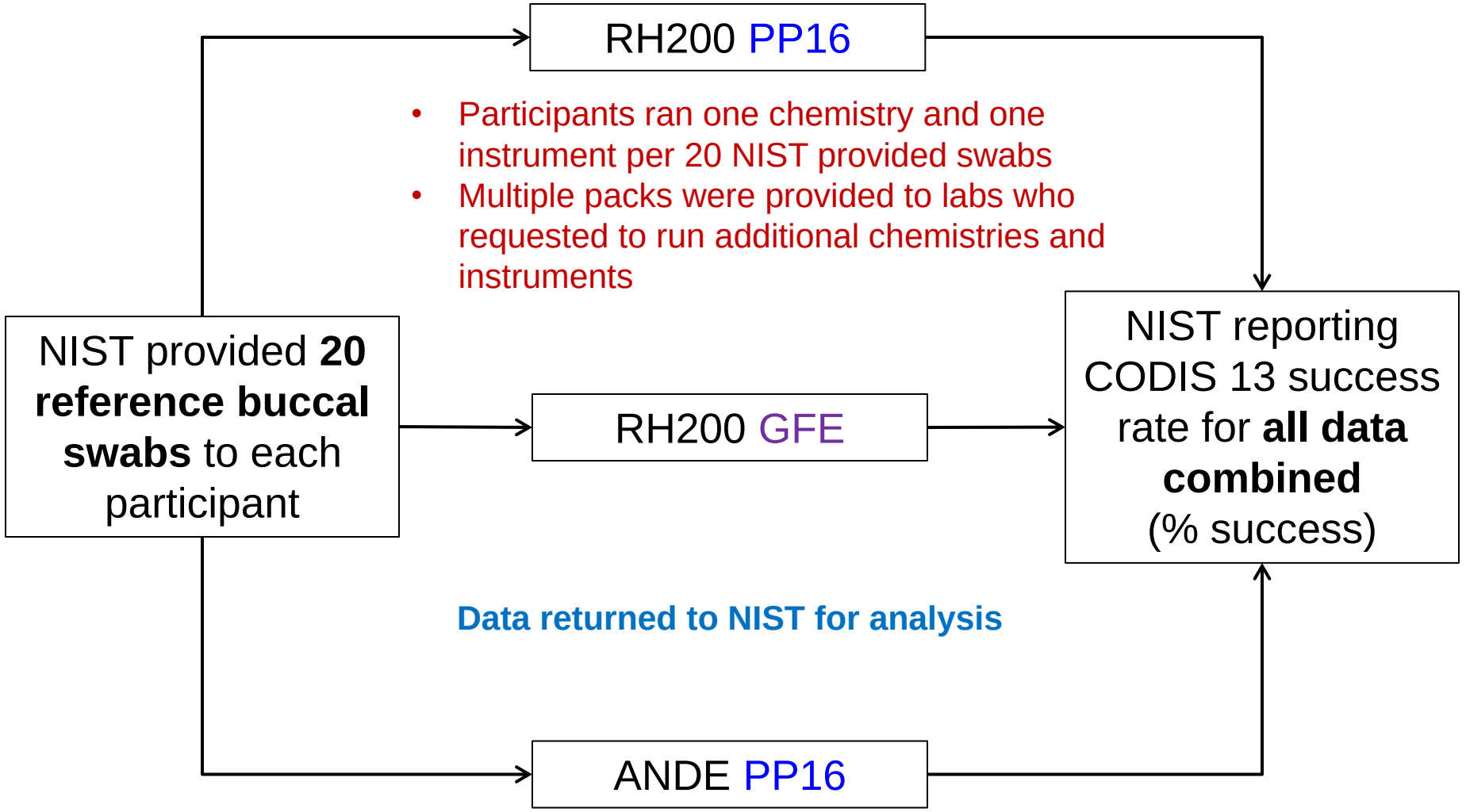
Running GFE loci
≈180 min runtime



RapidHIT 200-Correct Profile



2014 R-DNA Maturity Assessment



Timeline of Maturity Assessment

January 2014: Buccal samples collected at NIST and stored at RT

October 2014: Samples shipped to participating laboratories

October-December 2014: Data generated and electronically returned to NIST

November-December 2014: Data analyzed at NIST

20 Swabs provided

Maturity Assessment

Participating Laboratories (7)	Instrument Platforms (2)	Independent Instruments (11)	Chemistry	Total Samples Tested (280)
Federal State	NetBio ANDE 	5	PowerPlex 16	100
Private	IntegenX RapidHIT 200 	6	PowerPlex 16	60
			GlobalFiler Express	120

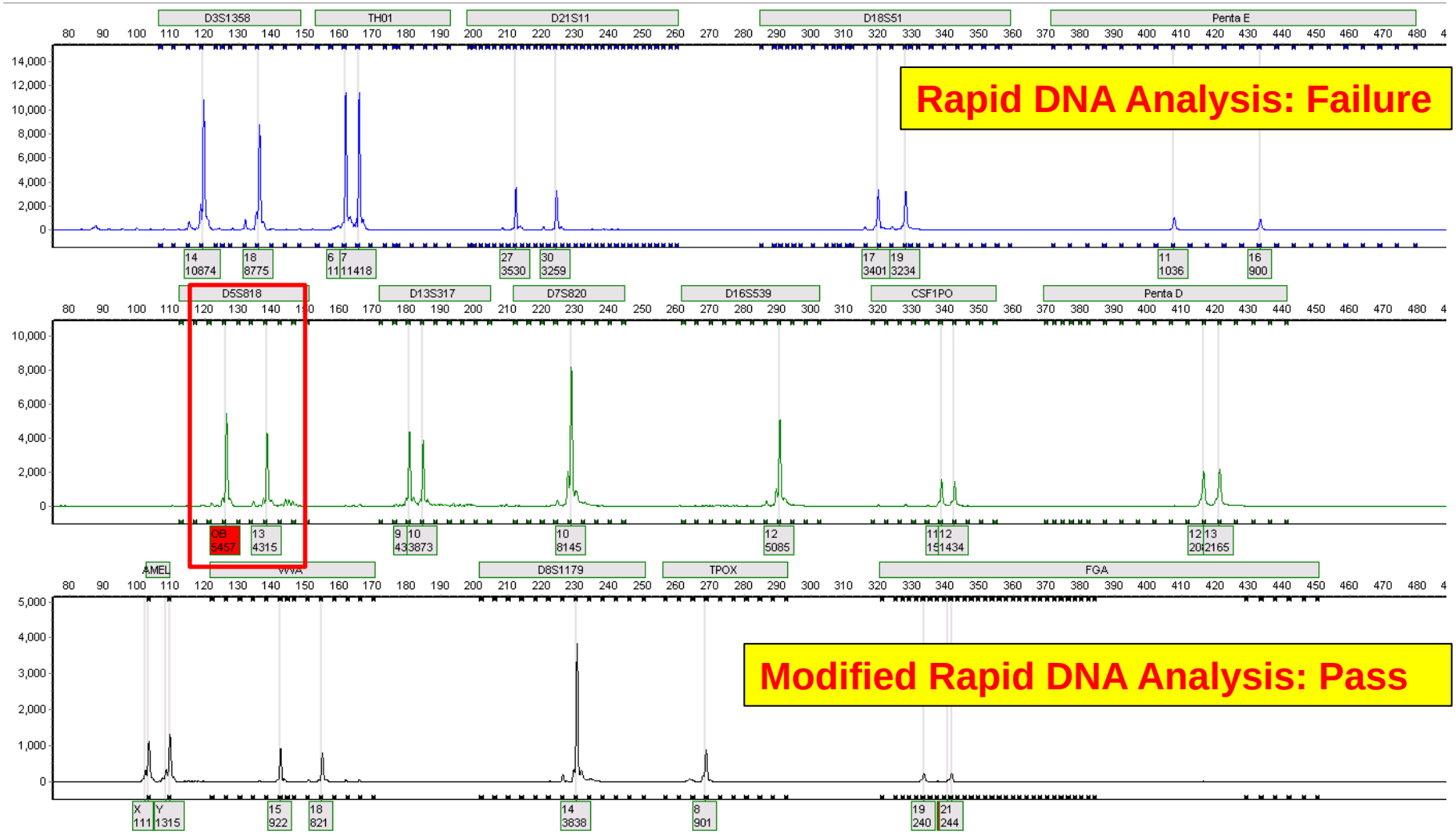
Analysis: FBI Definitions

- **Rapid DNA Analysis**: describes the fully automated (hands free) process of developing a CODIS Core STR profile from a reference sample buccal swab. The "swab in – profile out" process consists of automated extraction, amplification, separation, detection and allele calling without human intervention.

- **Modified Rapid DNA Analysis**: describes the automated process of developing a CODIS Core STR profile from a reference sample buccal swab. This process consists of integrated extraction, amplification, separation, detection without human intervention, but requires human interpretation and technical review.

https://www.fbi.gov/about-us/lab/biometric-analysis/codis/rapid-dna-addendum-to-qas-final-effective-12-1-2014

D3S1358	TH01	D21S11	D18S51	PentaE	D5S818	D13S317	D7S820	D16S539	CSF1PO	PentaD	AMEL	vWA	D8S1179	TPOX	FGA



D3S1358	TH01	D21S11	D18S51	PentaE	D5S818	D13S317	D7S820	D16S539	CSF1PO	PentaD	AMEL	vWA	D8S1179	TPOX	FGA

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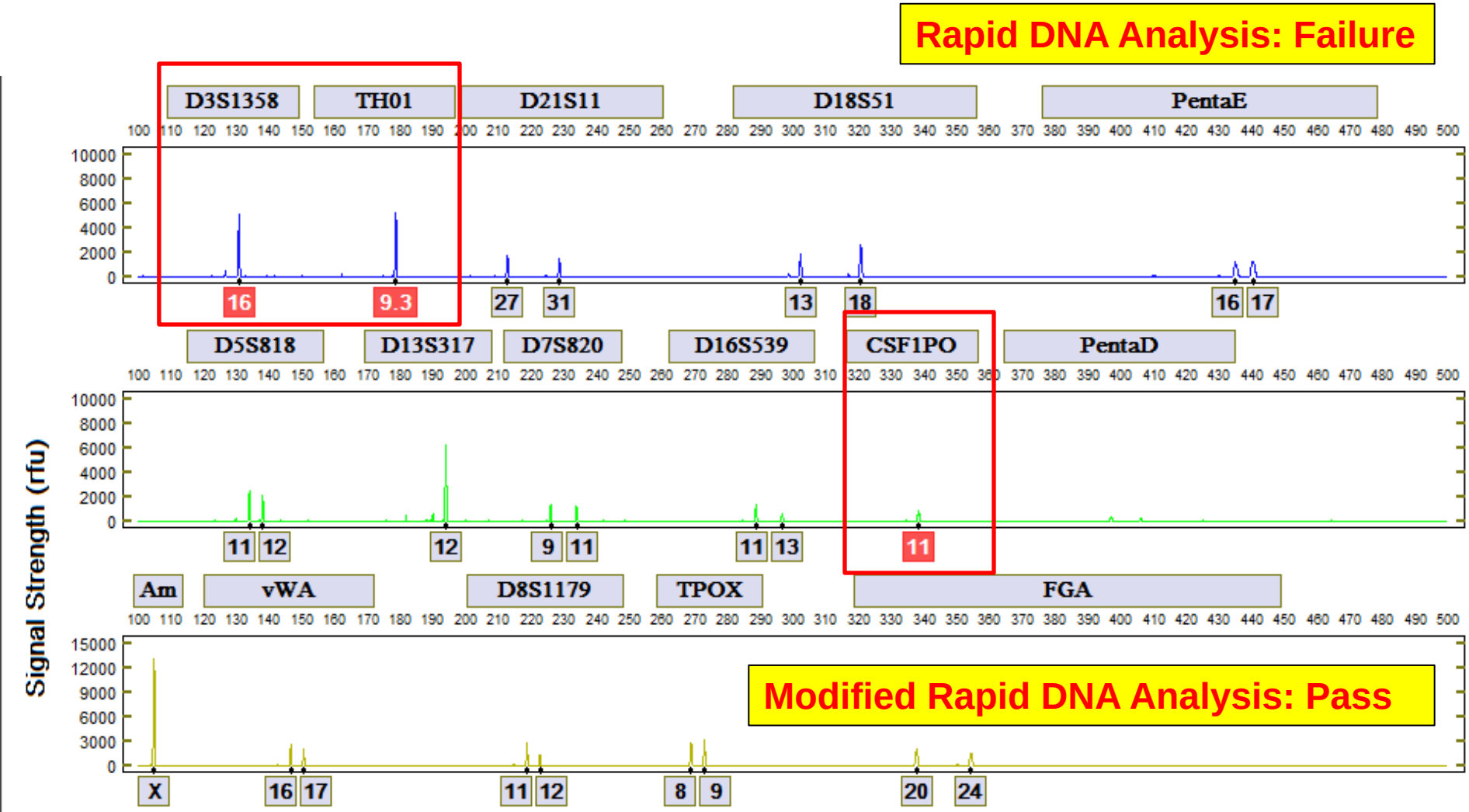


D3S1358	TH01	D21S11	D18S51	PentaE	D5S818	D13S317	D7S820	D16S539	CSF1PO	PentaD	AMEL	vWA	D8S1179	TPOX	FGA

NIST Analysis Parameters

- Additional analysis (PHR, Stutter, etc.) of the data performed with GeneMapper IDX v 1.3
  - Custom bins and panels designed for analysis of all data in GeneMapper IDX v1.3 for both ANDE and RapidHIT 200

- In-house Excel programs used to analyze peak height ratios, stutter, and precision

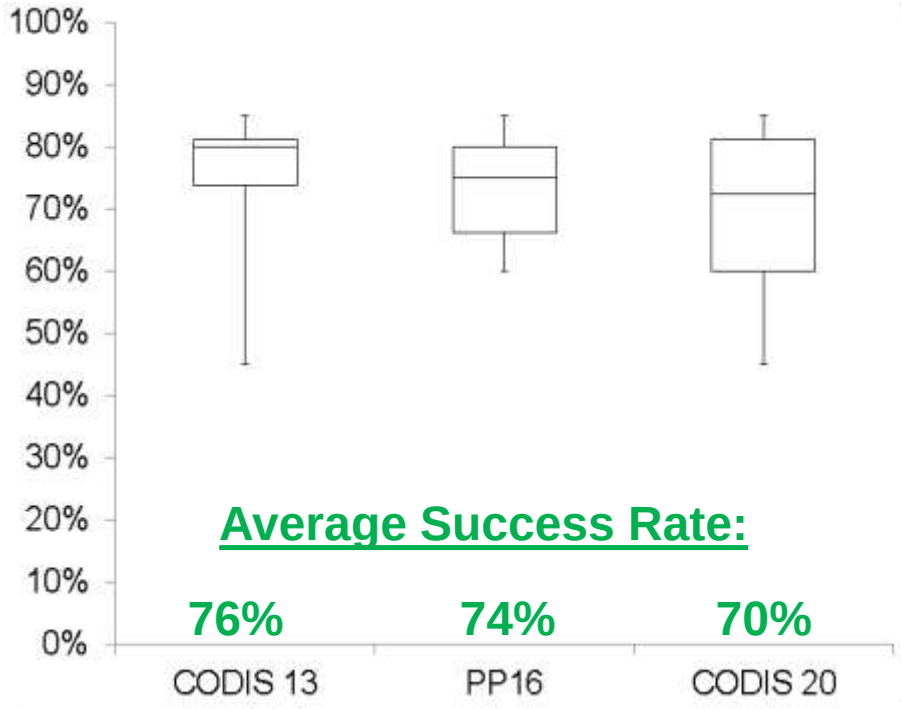
http://www.cstl.nist.gov/strbase/software.htm

Overall Success

Success was measured by **complete and concordant genotypes** produced by the integrated rapid DNA devices as compared to lab generated correct genotypes

Rapid DNA Analysis

Analysis without human intervention

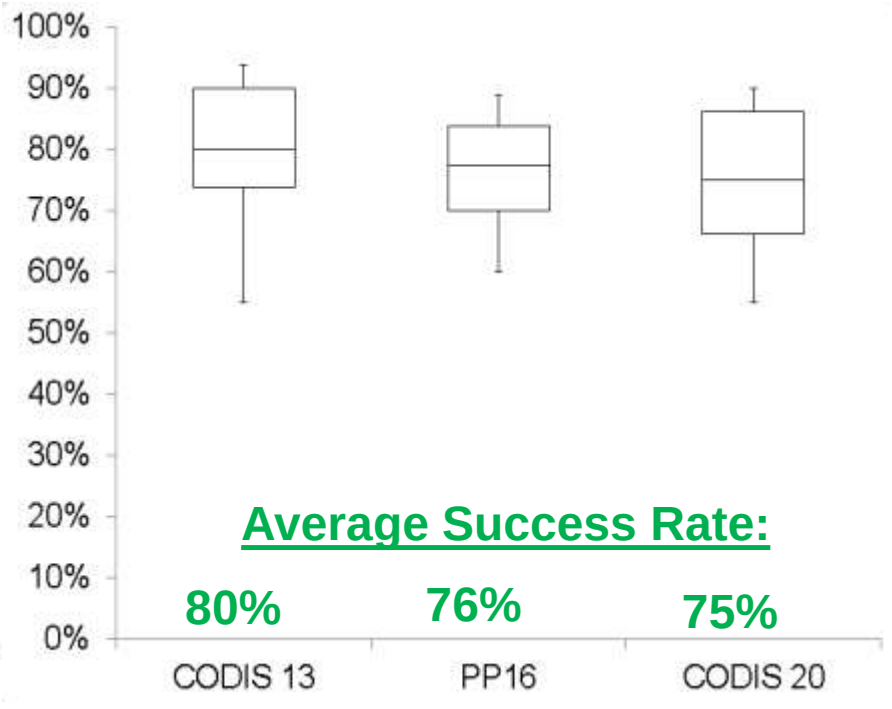


Average Success Rate:

CODIS 13	PP16	CODIS 20
76%	74%	70%

Modified Rapid DNA Analysis

Analysis involved manual interpretation

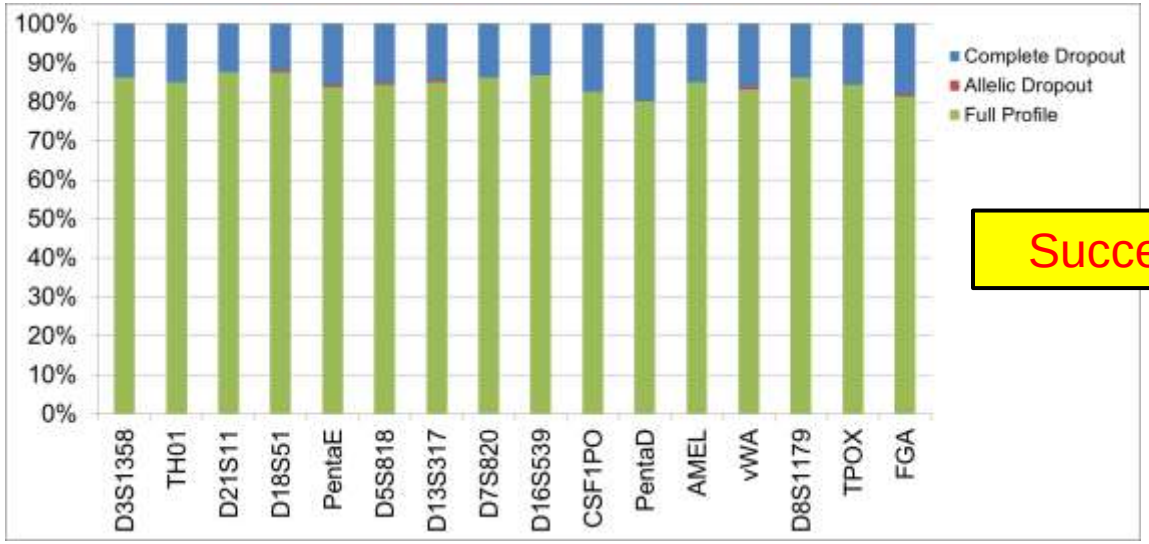


Average Success Rate:

CODIS 13	PP16	CODIS 20
80%	76%	75%

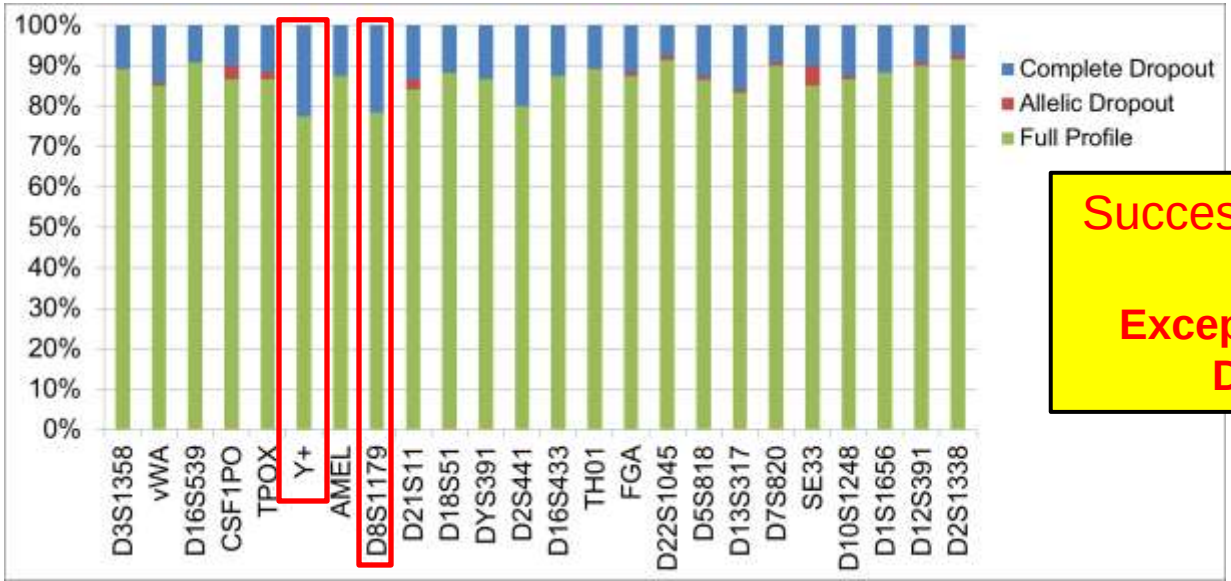
Locus Success (Rapid Analysis)

PowerPlex 16



Success above 80%

GlobalFiler Express



Success above 80%

Except for Y+ and D8S1179

RH200 PP16: n=49
ANDE PP16: n=80
RH200 GFE: n=88

Peak Height Ratios

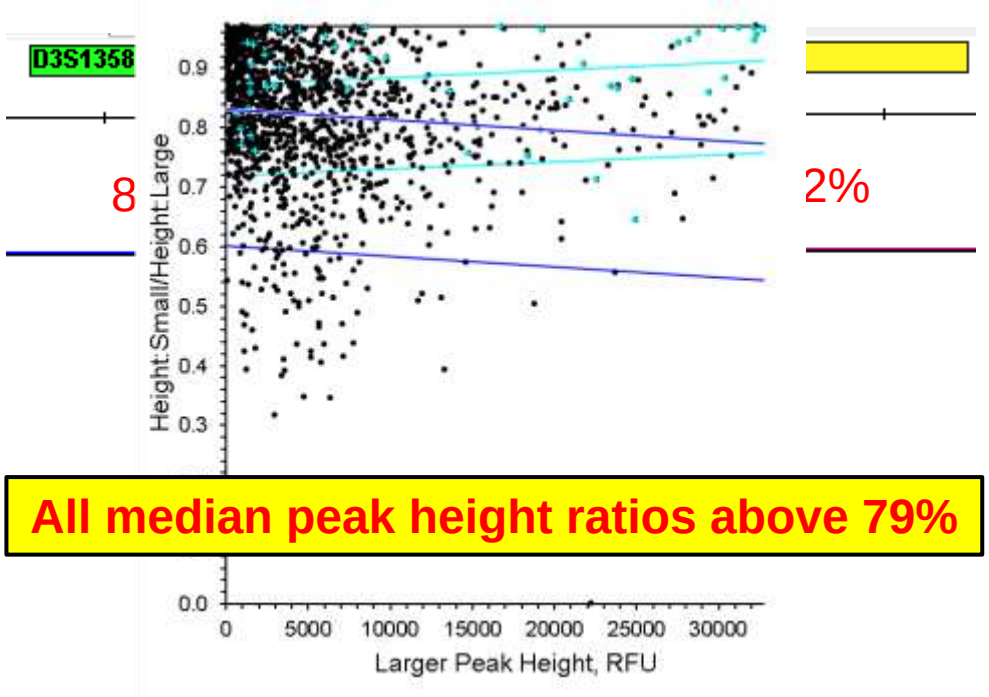
PowerPlex 16

Locus	Median
Penta_E	0.81
AMEL	0.83
Penta_D	0.84
D18S51	0.86
D3S1358	0.87
D8S1179	0.87
TPOX	0.87
D5S818	0.88
vWA	0.88
D21S11	0.88
D16S539	0.88
D13S317	0.89
CSF1PO	0.89
FGA	0.89
D7S820	0.89
TH01	0.93

Full Profiles: n=118

Peak height ratios were calculated for all **complete profiles** for the PowerPlex 16 and GlobalFiler Express chemistries.

The PowerPlex 16 data is a **combination of the data generated** from both ANDE and the RapidHIT 200.



All median peak height ratios above 79%

GlobalFiler Express

Locus	Median
SE33	0.79
D2S1338	0.82
D5S818	0.85
D18S51	0.85
D12S391	0.86
D21S11	0.87
CSF1PO	0.87
vWA	0.88
D7S820	0.88
TPOX	0.89
D16S539	0.89
D1S1656	0.89
D22S1045	0.89
D8S1179	0.90
D13S317	0.90
AMEL	0.90
D3S1358	0.90
D19S433	0.90
D10S1248	0.91
TH01	0.91
FGA	0.92
D2S441	0.92

Full Profiles: n=67

Stutter Percentage

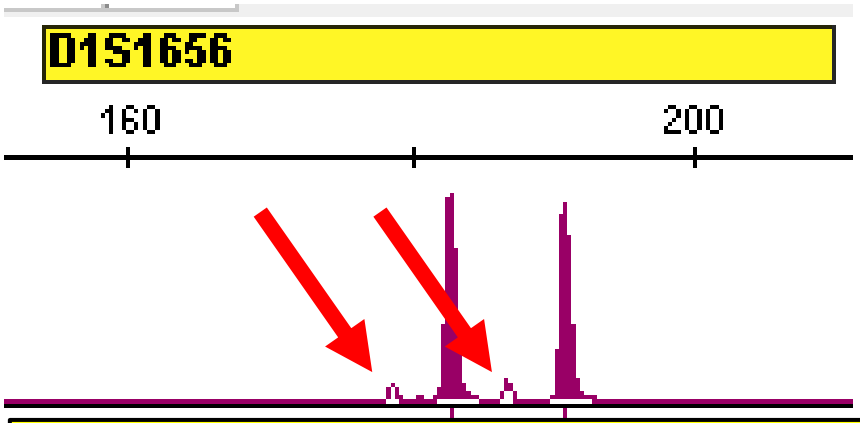
PowerPlex 16

Locus	Median
Penta_D	1.47
TH01	2.28
TPOX	2.82
Penta_E	4.12
D7S820	5.76
D13S317	6.48
D18S51	7.15
D8S1179	7.30
CSF1PO	7.52
D16S539	7.67
D5S818	8.36
FGA	8.78
vWA	9.30
D3S1358	10.23
D21S11	10.72

Full Profiles: n=118

Stutter percentages were calculated for all **complete profiles** for the PowerPlex 16 and GlobalFiler Express chemistries.

The PowerPlex 16 data is a **combination of the data generated** from both ANDE and the RapidHIT 200.



All stutter percentages within observed kit manufacturer developmental validation range

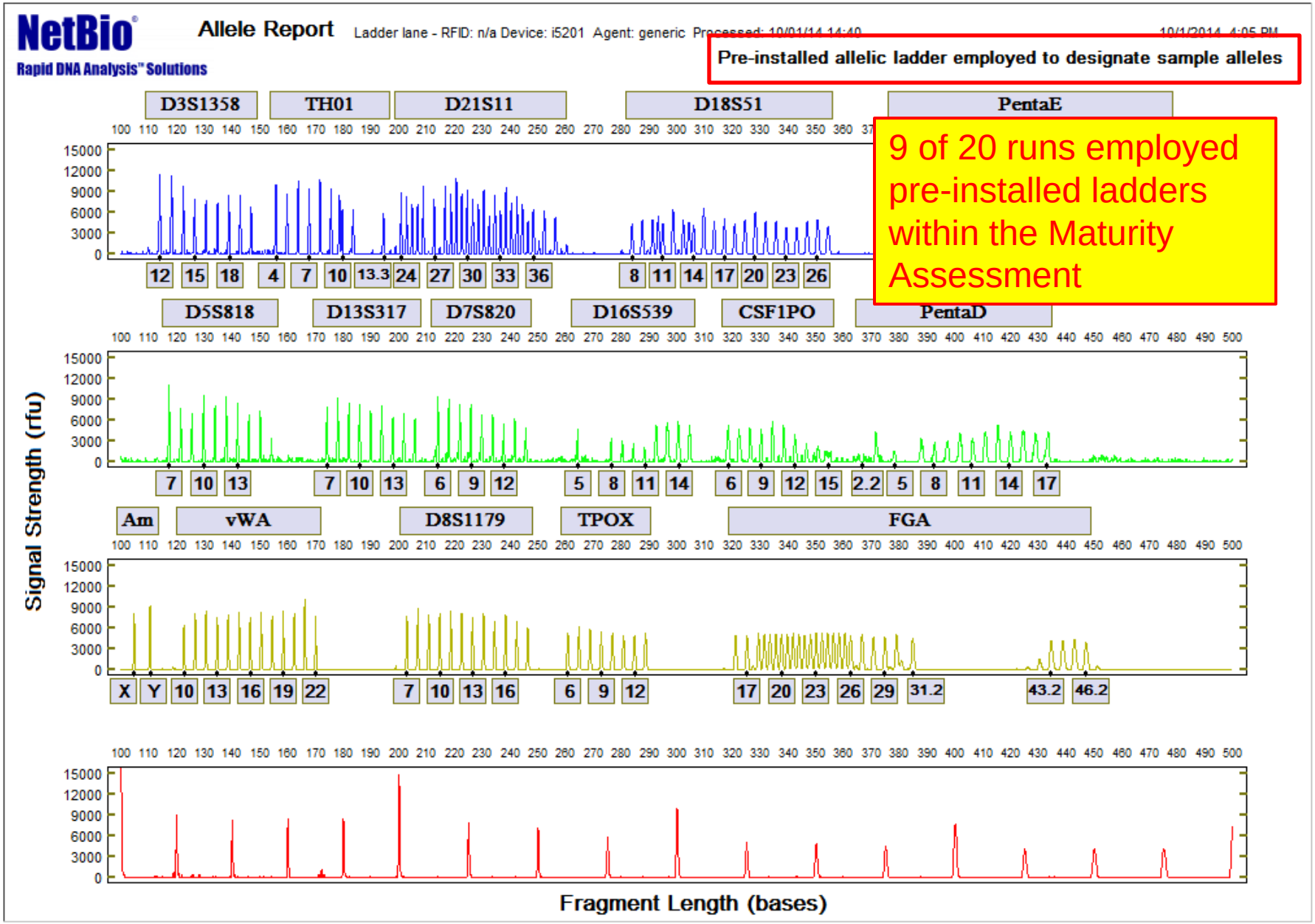
GlobalFiler Express

Loci	Median
TH01	1.27
TPOX	3.64
D7S820	4.75
D2S441	4.76
DYS391	5.73
D16S539	5.84
D13S317	5.90
CSF1PO	6.12
D8S1179	6.59
D18S51	6.67
D5S818	6.76
D22S1045	7.00
D19S433	7.10
FGA	7.20
D3S1358	8.31
D10S1248	8.36
D21S11	8.60
D2S1338	8.71
D1S1656	8.77
vWA	9.28
D12S391	9.46
SE33	15.56

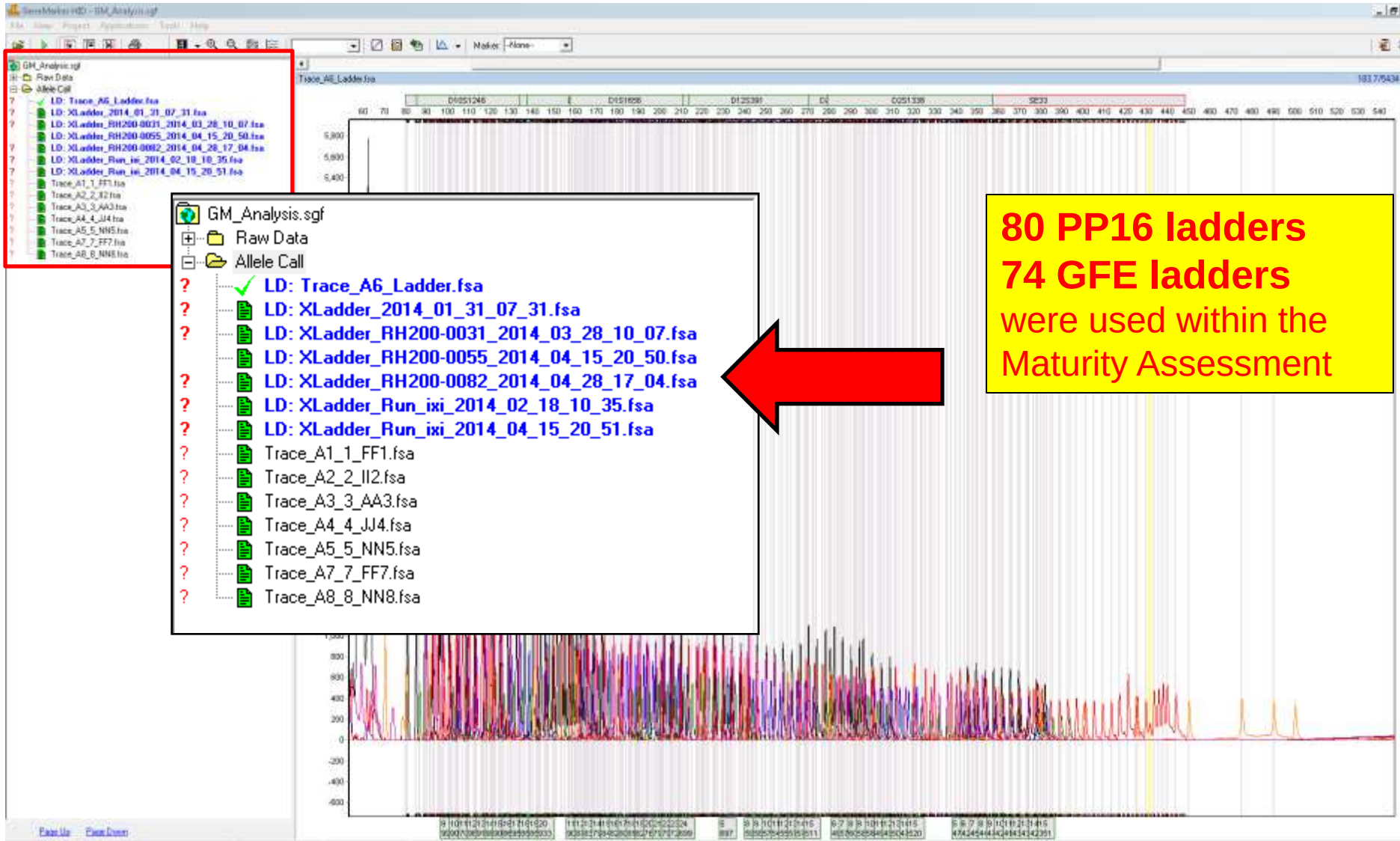
Full Profiles: n=67

Ladders

- Both instruments run a ladder with each run
  - Incorporated into the chip/kit
- Each instrument contains an “onboard” ladder(s)
  - For use if the ladder on the chip fails
- Ladders and internal size standard allow for accurate allele calling
  - Poor precision (>0.5 bp) can result in miscalled data

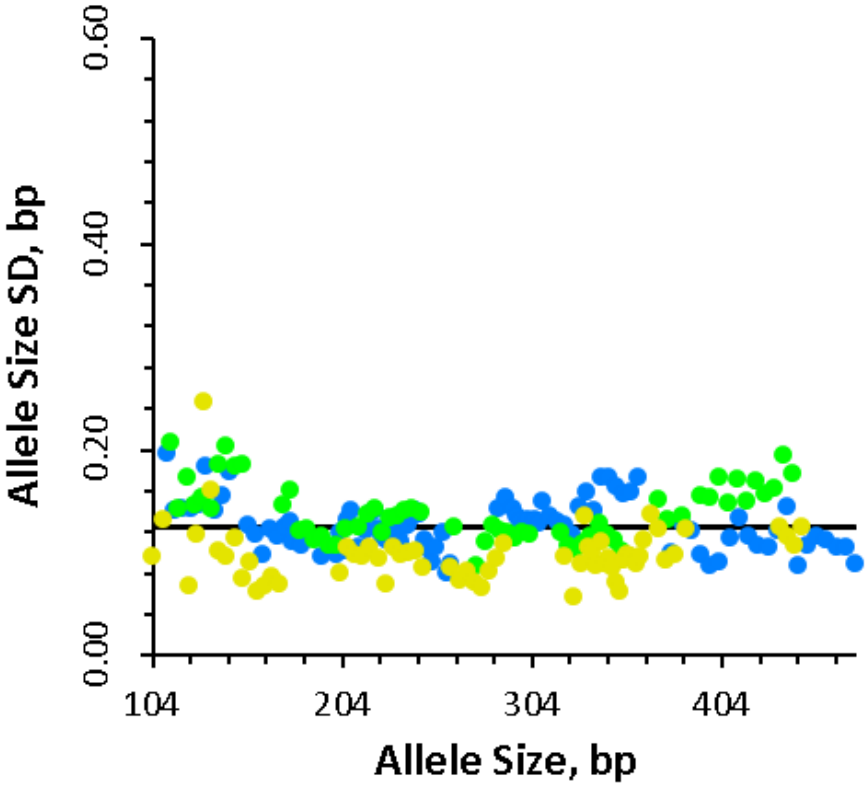

NetBio
Rapid DNA Analysis™ Solutions
Allele Report
Ladder lane - RFID: n/a Device: i5201 Agent: generic Processed: 10/01/14 14:40
10/1/2014 4:05 PM
Pre-installed allelic ladder employed to designate sample alleles
9 of 20 runs employed pre-installed ladders within the Maturity Assessment
D3S1358
TH01
D21S11
D18S51
PentaE
12 15 18 4 7 10 13.3 24 27 30 33 36
8 11 14 17 20 23 26
D5S818
D13S317
D7S820
D16S539
CSF1PO
PentaD
7 10 13 7 10 13 6 9 12 5 8 11 14 6 9 12 15 2.2 5 8 11 14 17
Am
vWA
D8S1179
TPOX
FGA
X Y 10 13 16 19 22 7 10 13 16 6 9 12 17 20 23 26 29 31.2 43.2 46.2
Signal Strength (rfu)
Fragment Length (bases)

IntegenX Ladders



Ladder Precision

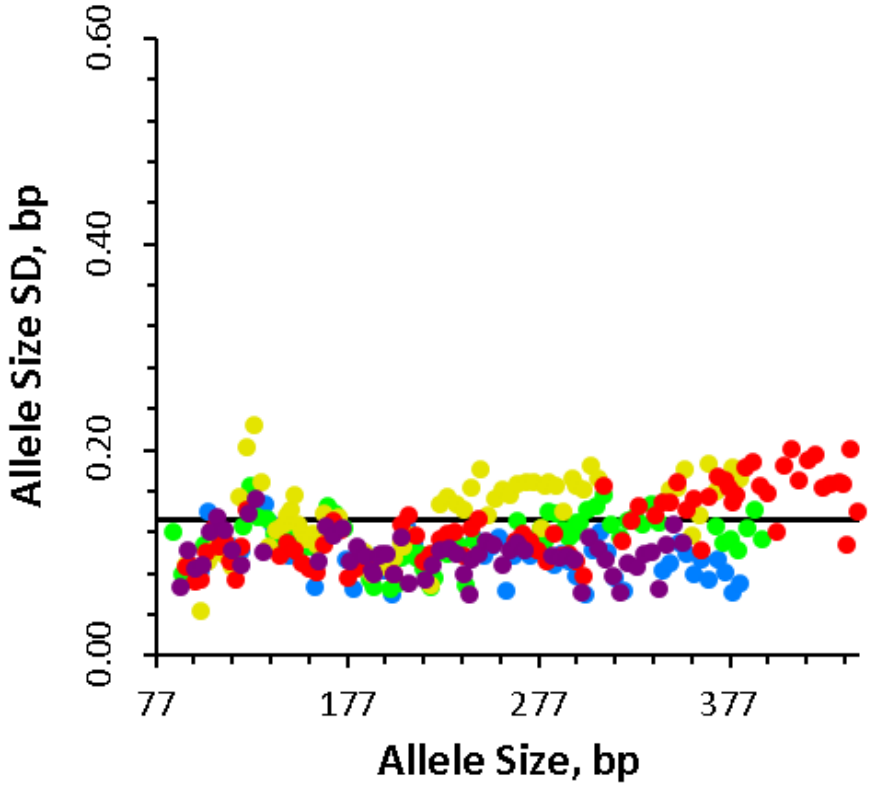
PowerPlex 16



Allelic Precision of 0.125 bp

Ladders: : n=46

GlobalFiler Express



Allelic Precision of 0.133 bp

Ladders: : n=74

Maturity Assessment Summary

- 11 instruments within 7 laboratories tested
  - Total of 280 samples examined
- Data generated October-December 2014 and returned to NIST
- Changes since 2014 Maturity Assessment Data was generated (between both companies)
  - Known changes to manufacturing, software, and hardware

Summary of Results

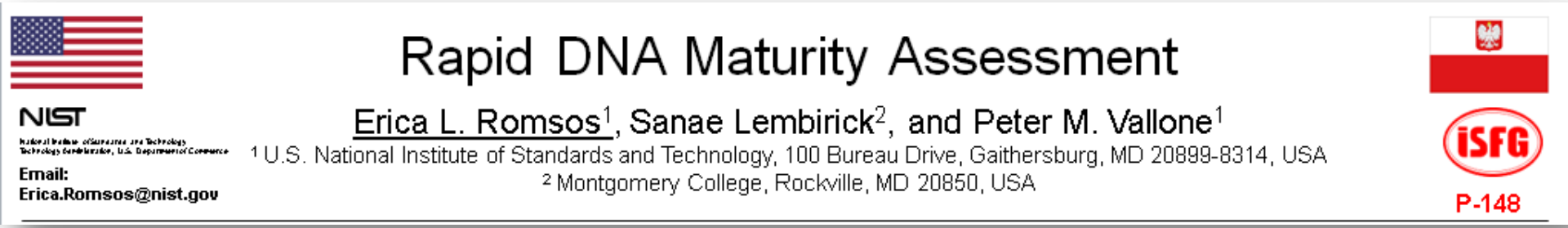
- 2014 R-DNA Maturity Assessment exhibited a 76% success rate for the CODIS 13 Core Loci using Rapid DNA Analysis
  - Success ranged from 45% to 85% across laboratories, chemistries, and instruments
- Precision is below 0.25 bp on for both PP16 and GFE data generated
- Continuing to run R-DNA platforms with newer chemistries and upgrades

Final Results Available Online

Rapid DNA Instrument Platforms	Number of Participating Labs	Total Instruments	Samples Attempted	Core CODIS Success (Rapid DNA Analysis)	Core CODIS Success (Modified Rapid DNA Analysis)
2	7	11	280	76.1%	80.0%

Overall success for the R-DNA maturity assessment is reported:

http://www.nist.gov/mml/bmd/genetics/dna_biometrics.cfm



Rapid DNA Maturity Assessment

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ISFG

P-148

Poster presented at the 26th Congress of the International Society for Forensic Genetics (Krakow, Poland), September 2-5, 2015

http://www.cstl.nist.gov/strbase/pub_pres/RomsosISFG2015RapidDNA.pdf

Thank you for your attention!

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DHS – Rapid DNA Prototype and Kinship Performance Evaluation

FBI - the Evaluation of Forensic DNA Typing as a Biometric Tool