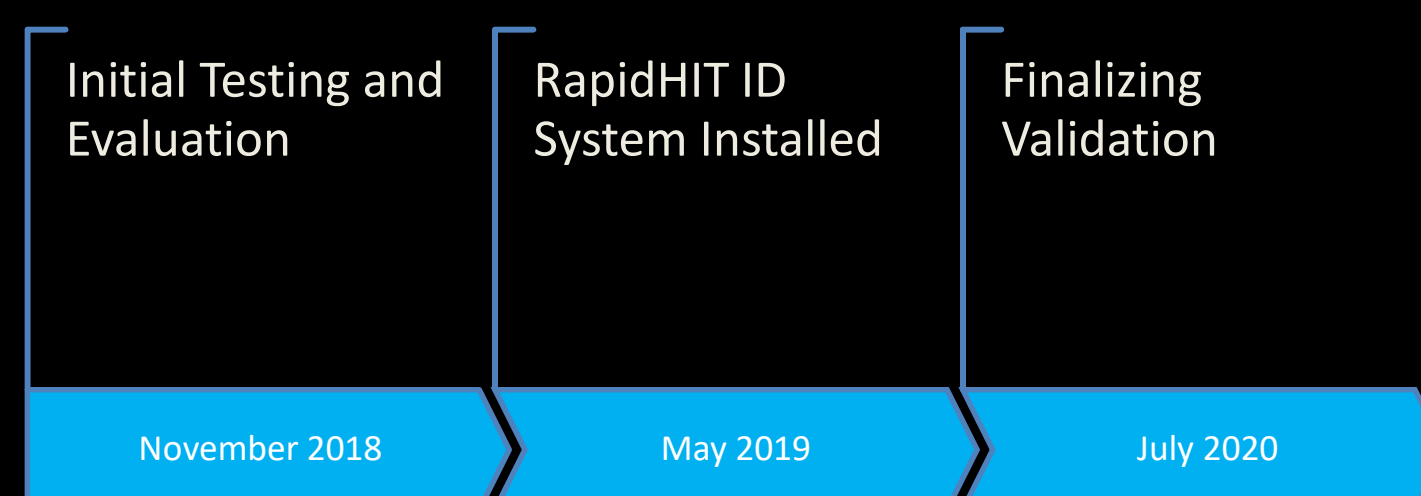


ABSTRACT

Technology has changed dramatically for human identification in recent years. In addition to recent innovations in human identification the needs and expectations of society have increased as well. Law enforcement and the public want answers quickly and more efficiently. The spread of social media along with expanded public awareness of forensic tools and techniques among lay persons and law enforcement mean the demand for forensic scientists to solve cold cases, provide answers quickly and share that information has risen. Unsolved cold cases, high profile rush cases and Disaster Victim Identification requiring reassociation of fragmented remains have led to the need for Rapid DNA testing, genealogy, and more efficient extractions. This poster will outline the newest tools at the disposal of the forensic scientists to provide victims, families, law enforcement and the community with the answers and investigative leads that they need and deserve.

RapidHIT ID SYSTEM



WHAT IS RAPID DNA

- The FBI defines Rapid DNA as “the fully automated (hands free) process of developing a DNA profile from a reference sample buccal (cheek) swab without human intervention”
- Develop a DNA profile in under two hours from a body fluid sample as investigative aid.
- If it can develop DNA profiles from body fluids, why not bone?

WHY TEST BONES USING RAPID?

- Most bone extractions take anywhere from 12-72 hours (laboratory dependent).
- Bone extractions are labor intensive.
- Involve extensive bone preparation.
- Require designated screening areas.

INITIAL TESTING SCHEME

- Obtained high quality bone samples from a known source.
- Grounded bone sample into small chunk consistency.
- Prepared two sets of bone samples weighing approximately 10mg, 50mg, and 100mg.

Set 1	Set 2
9.9mg	10mg
50.5mg	47.3mg
97mg	93.7mg

- Run samples through Rapid using Intel cartridges.
- Processed raw data for average, heterozygous peak heights and sister allele balances.
- Analyzed in GeneMarker – off instrument.

SMALL CHUNK CONSISTENCY

- What does this mean?
- If consistency is too fine will clog the system.
- Think of a sea salt grinder.

KINSHIP
GENEALOGY
RAPID IDENTIFICATION
RE-ASSOCIATION
PHENOTYPING

COMPARISON TO CURRENT METHODS

Demineralization Bone Extraction Method

- Overnight Incubation
- Hands on time ~3 hours
- Additional processing to obtain a fine powder
- Multiple tubes often required
- Two PCIA washes to remove inhibitors

Large Volume Extraction Method

- Overnight incubation
- Hands on time ~3 hours
- Additional Processing to obtain a fine powder.
- May require more than one PCIA washes to remove inhibitors.

TOTAL DNA RECOVERED

Current Bone Extraction Method

- Average ~0.006ng/mg of bone

Large Volume Protocol Method

- Average ~0.009ng/mg of bone

RapidHIT Inputs Initially Tested

- 10mg, ~0.06ng to 0.09ng
- 50mg, ~0.3ng to 0.45ng
- 100mg, ~0.6ng to 0.9ng

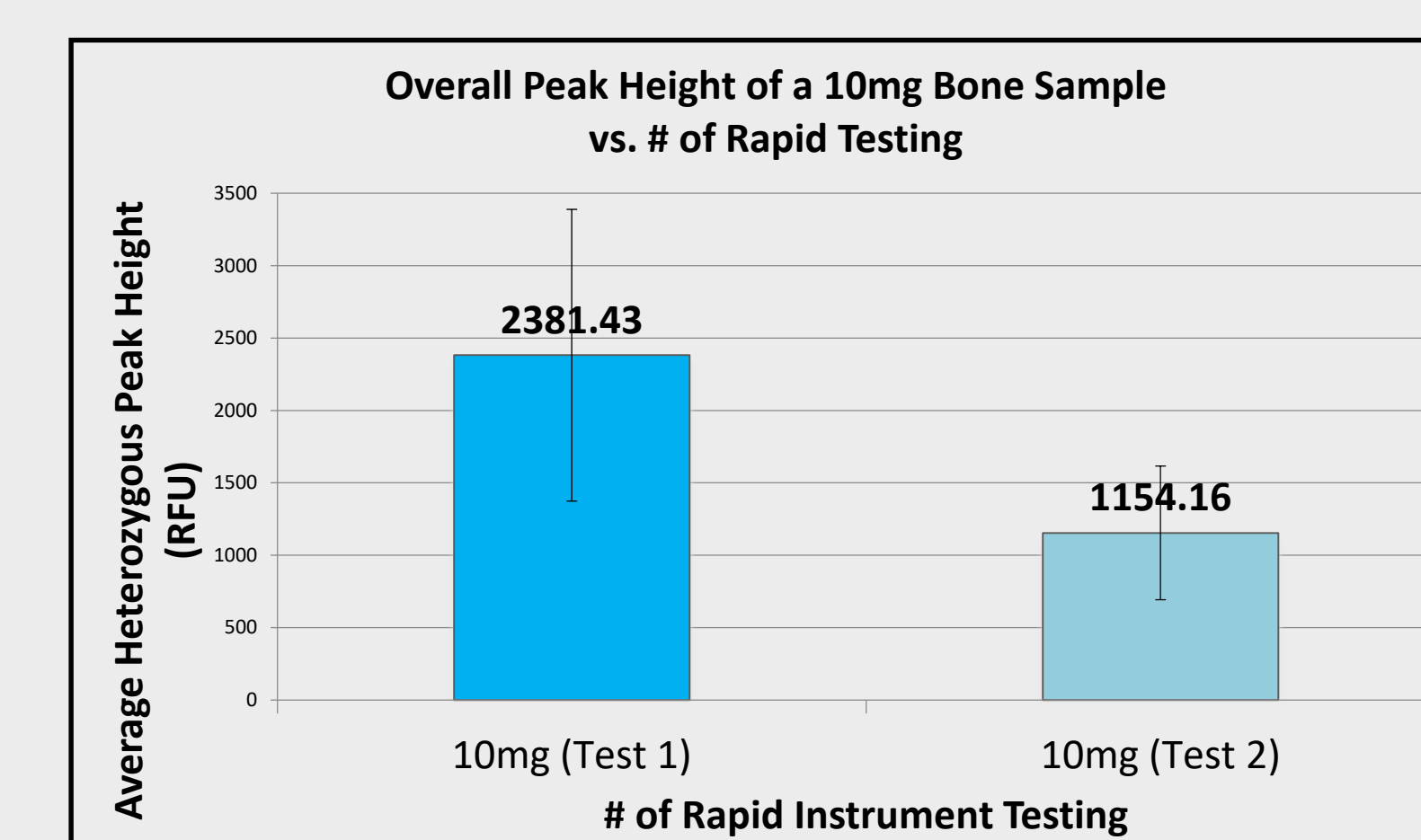
WHAT ABOUT QUALITY?

- All samples had the correct profiles obtained.
- Multiple replicates of same bone source produced consistent profiles.
- No signs of contamination.

WHAT HAPPENS TO THE BONE AFTER TESTING?

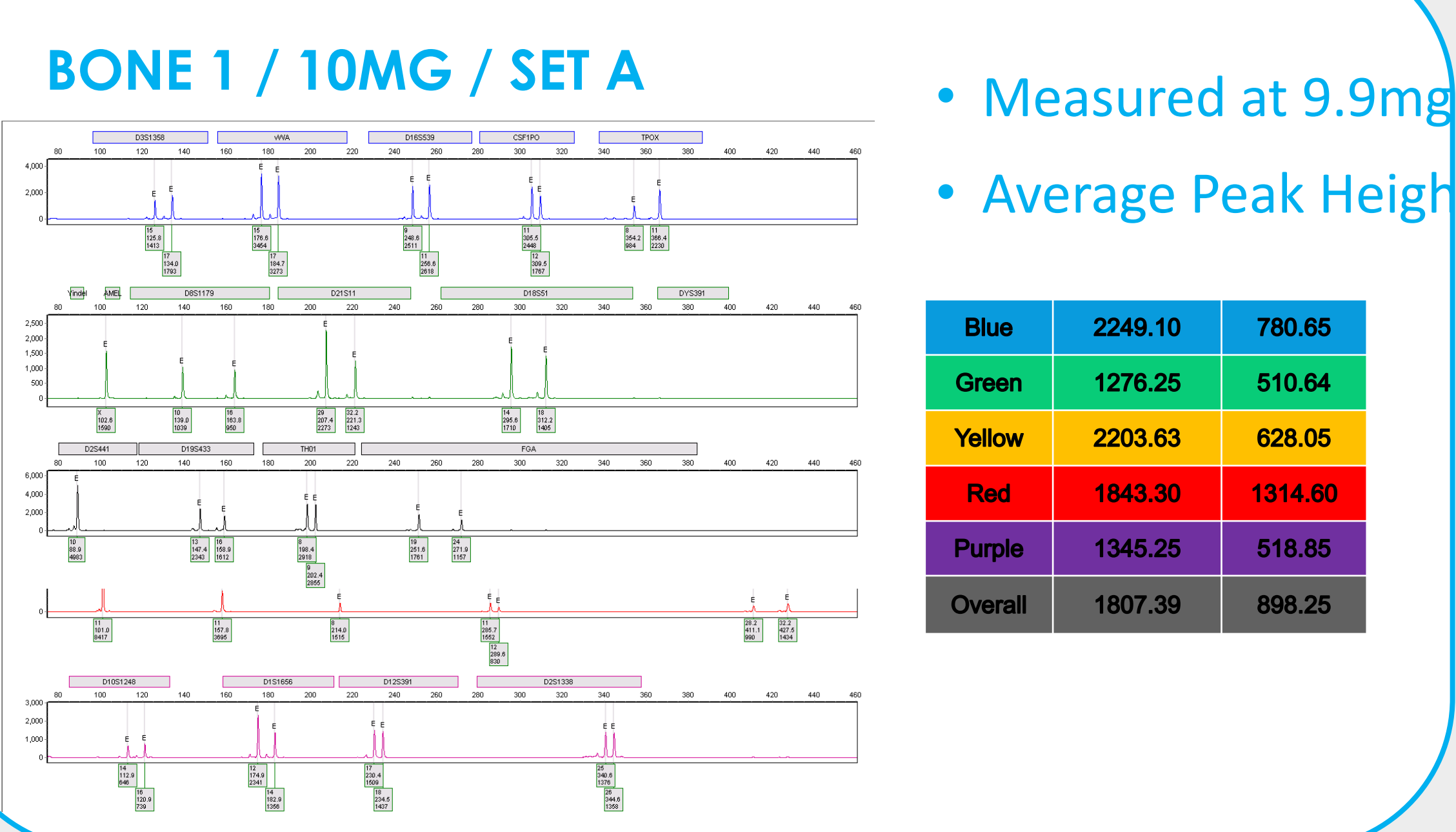
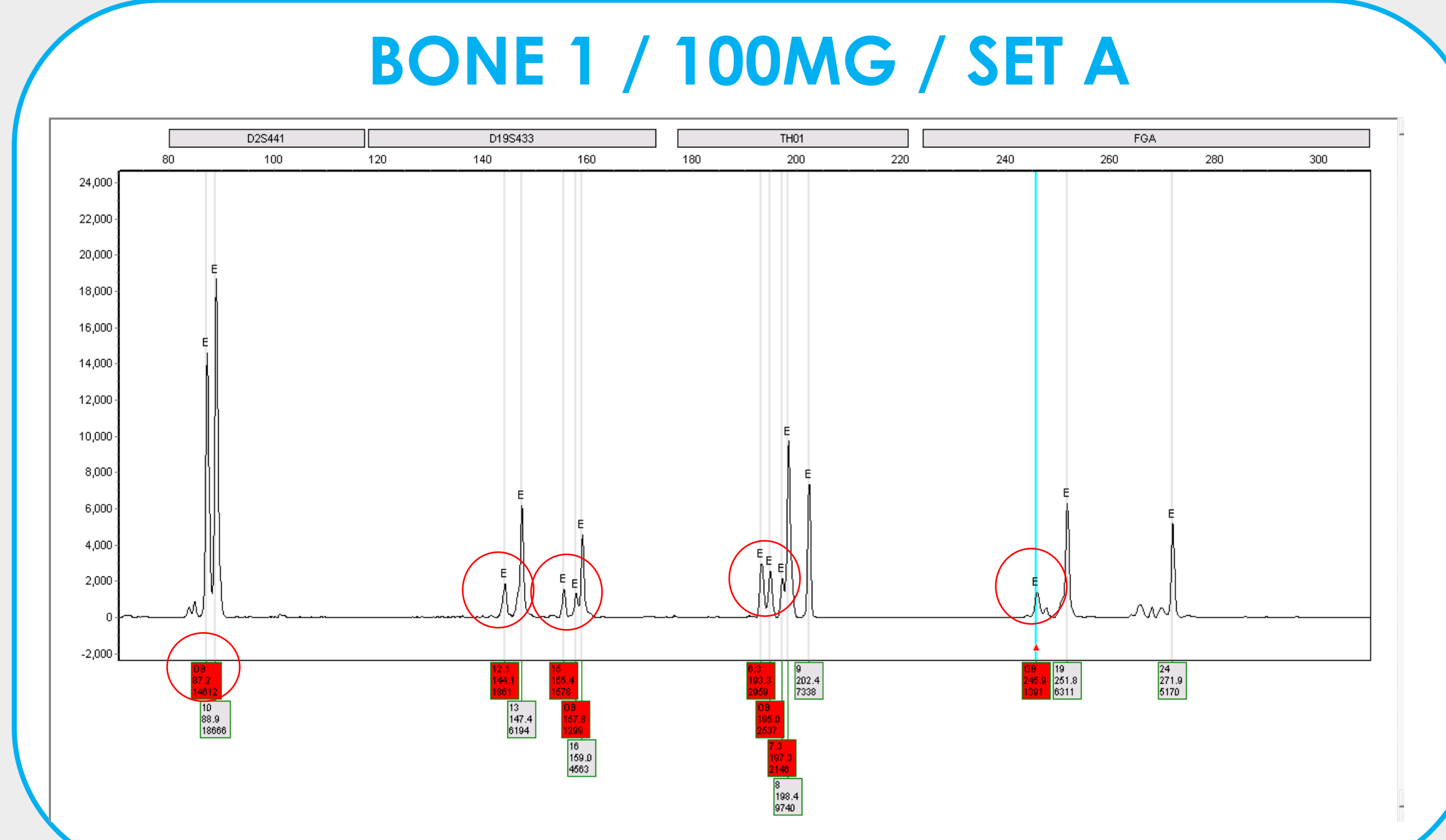
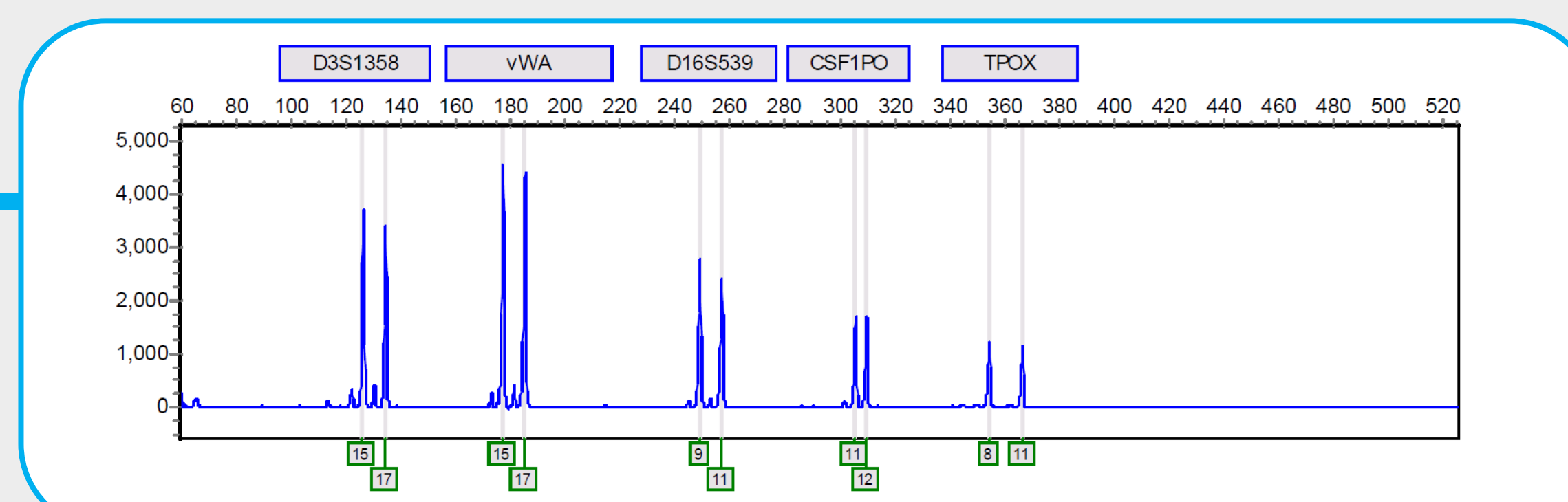
- Bone can be removed from the cartridge after testing.
- Bone can be reanalyzed in a new cartridge.

MULTIPLE TESTING OF A BONE SAMPLE THROUGH RAPIDHIT ID SYSTEM USING INTEL CARTRIDGES



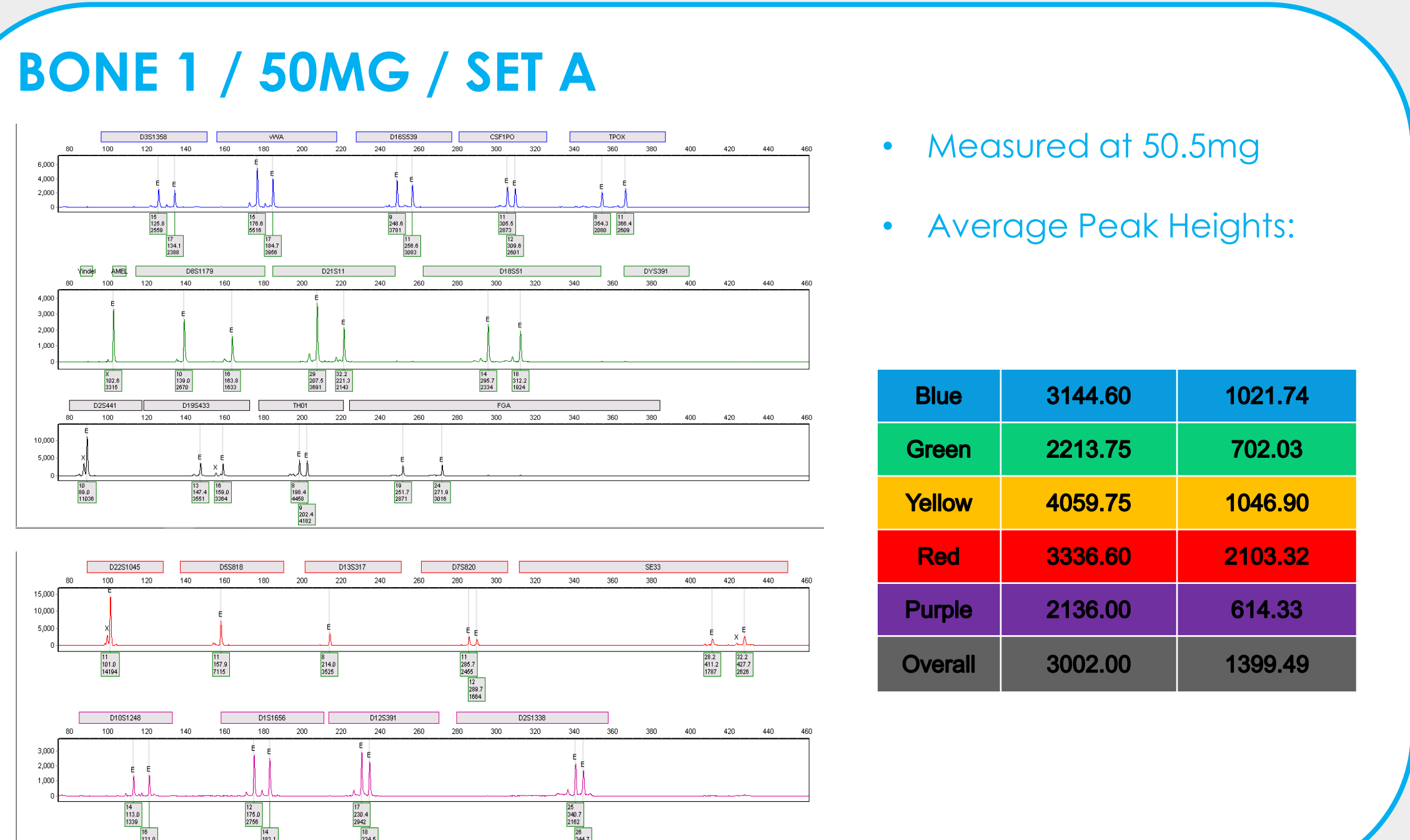
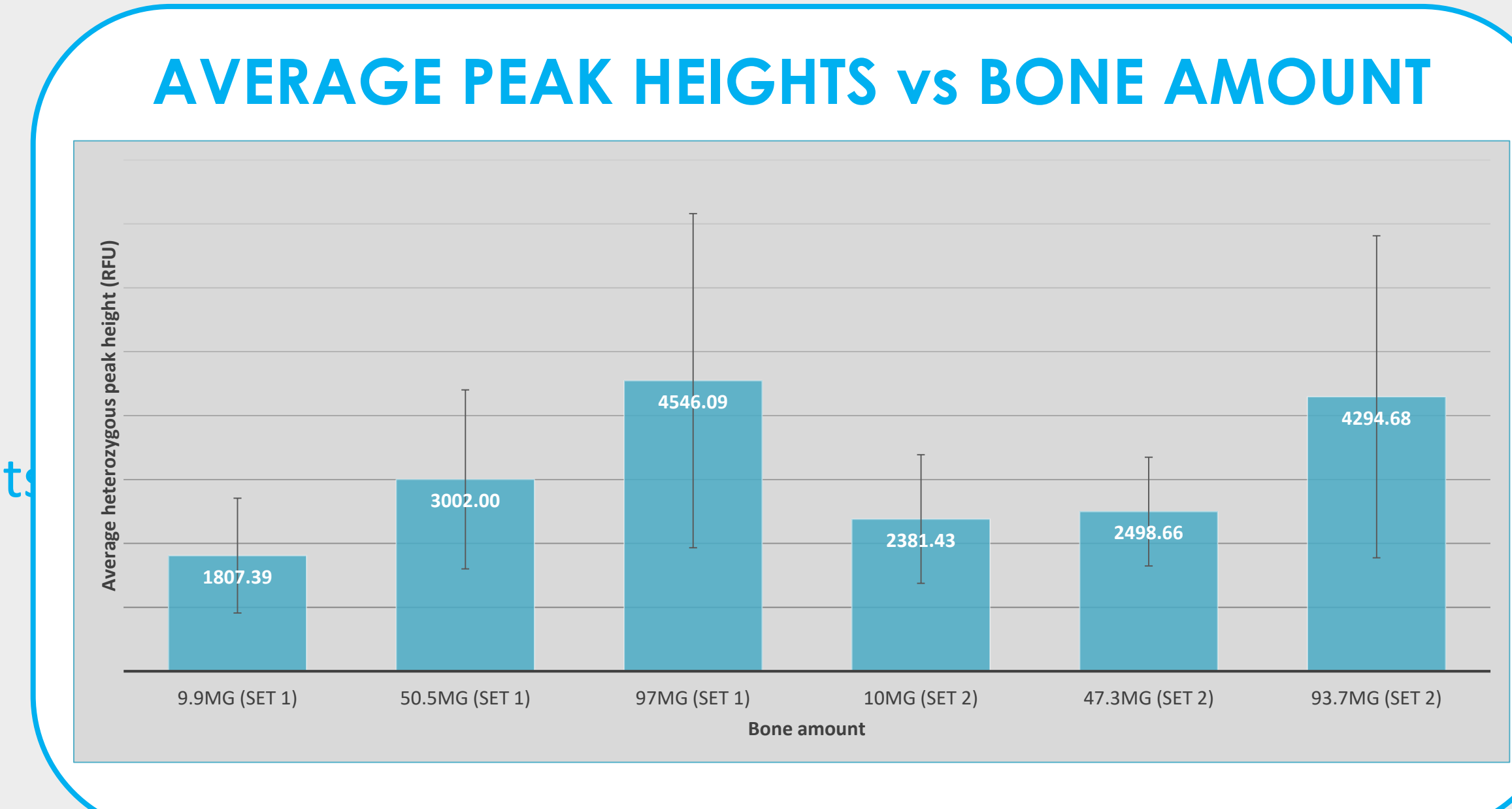
So How Is The Data?

- High quality bones resulted in full DNA profiles for all amounts tested.
 - 10mg, 50mg and 100mg
- High quality: recent remains not exposed to extreme environments (heat, fire, bog, acidic soil).



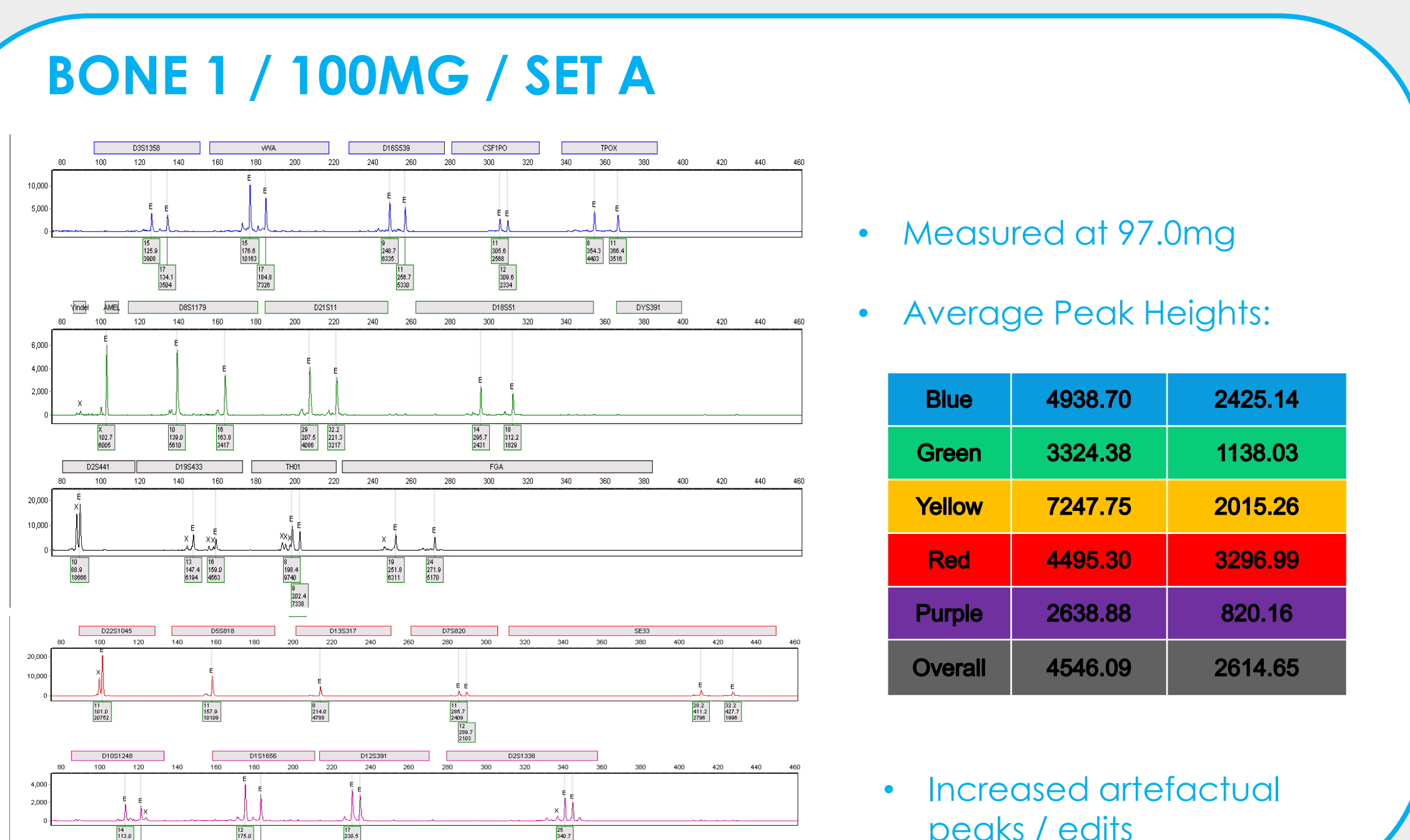
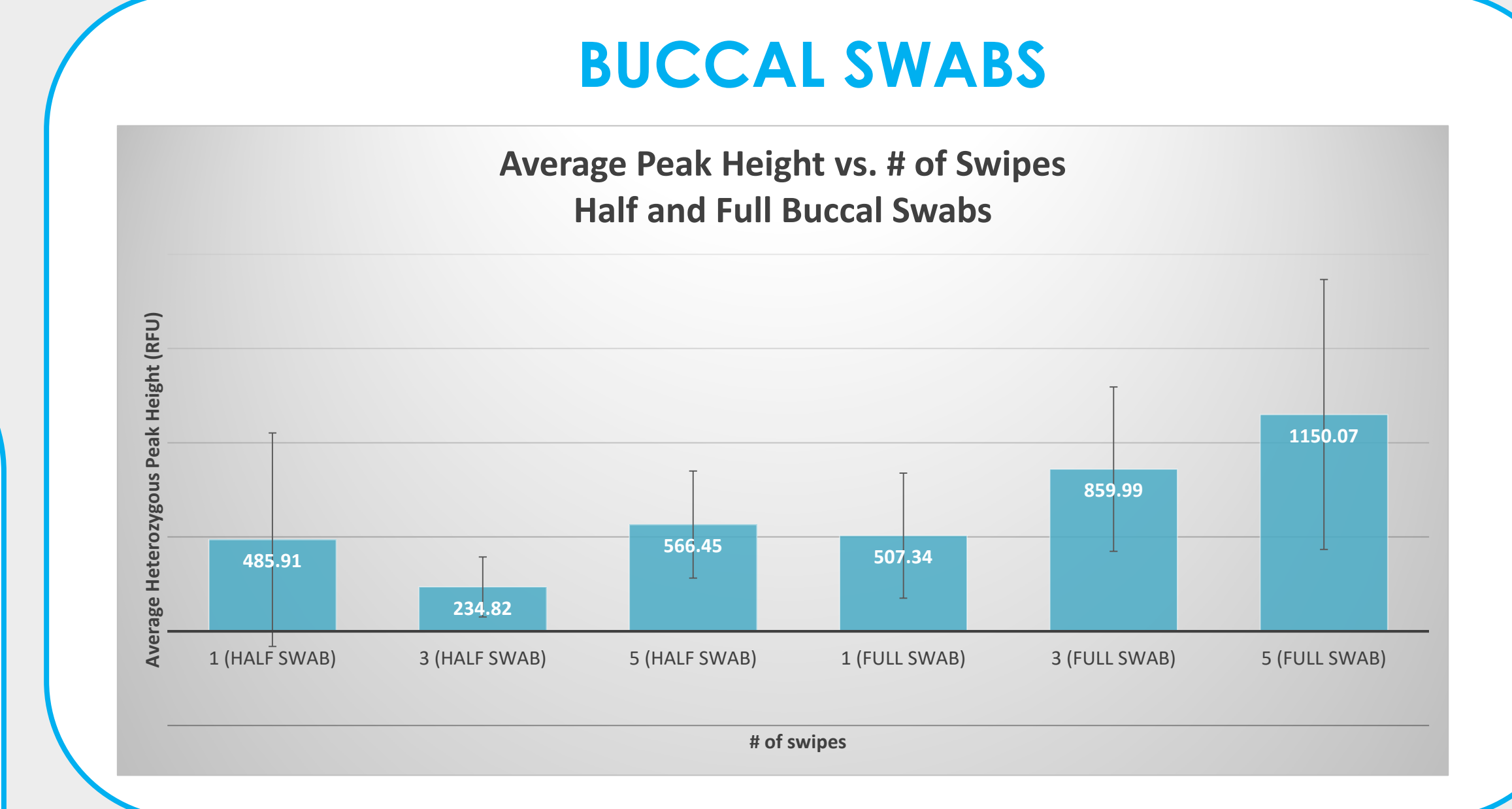
- Measured at 9.9mg
- Average Peak Heights:

Blue	2249.10	780.65
Green	1276.25	510.64
Yellow	2203.63	628.05
Red	1843.30	1314.60
Purple	1345.25	518.85
Overall	1807.39	898.25



- Measured at 50.5mg
- Average Peak Heights:

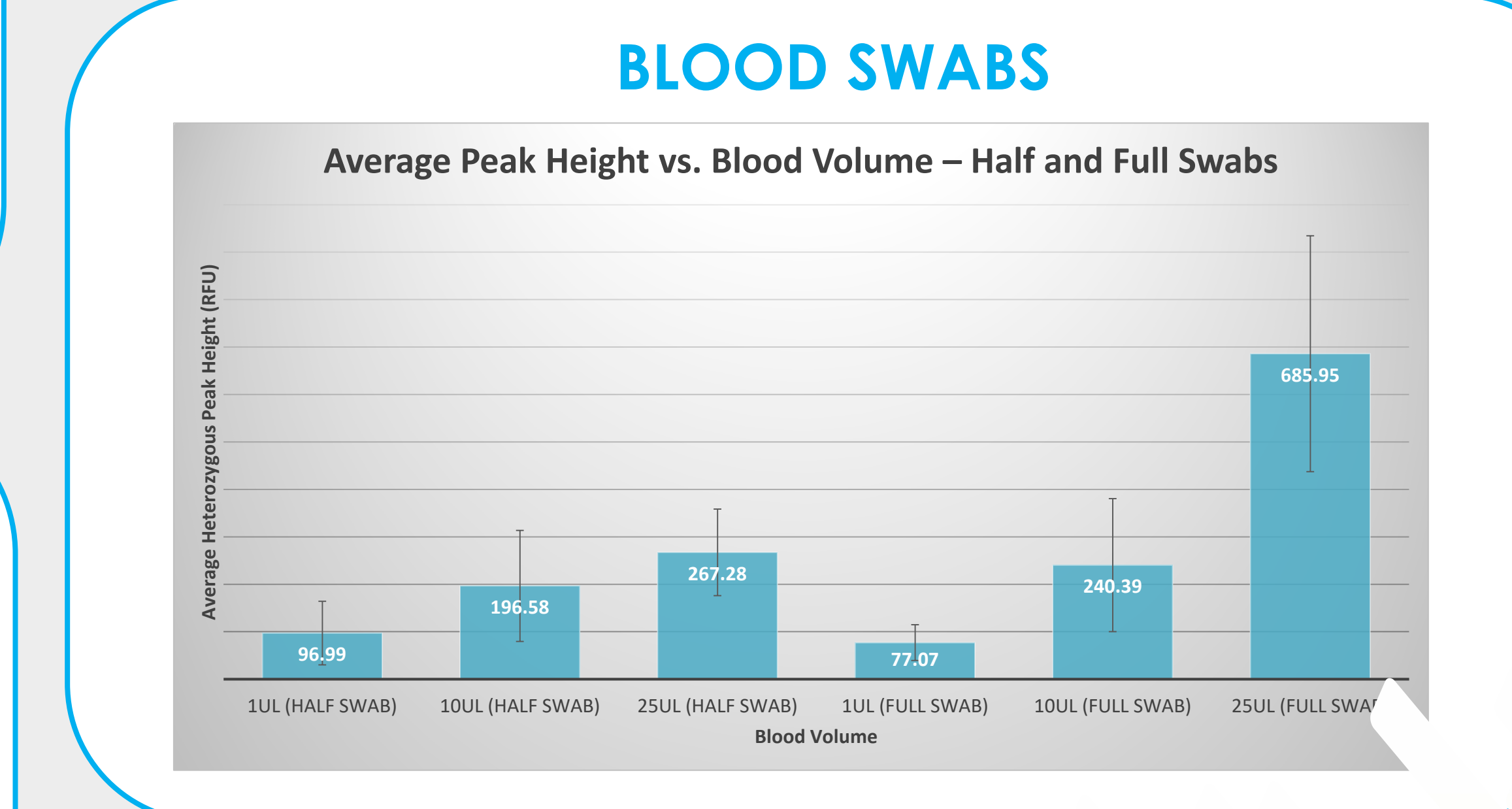
Blue	3144.60	1021.74
Green	2213.75	702.03
Yellow	4059.75	1048.90
Red	3336.60	2103.32
Purple	2136.00	614.33
Overall	3002.00	1389.49



- Measured at 97.0mg
- Average Peak Heights:

Blue	4938.70	2425.14
Green	3324.38	1138.03
Yellow	7247.75	2015.26
Red	4495.30	3296.99
Purple	2638.88	620.16
Overall	4546.09	2814.85

- Increased artefactual peaks / edits



USES FOR RAPID TESTING OF BONES

Statistical Analysis Of

- Reassociation of highly fragmented remains
- Disaster Human Identification
- Rush Cases

Also Analyzed

- Muscles
- Organs (heart/spleen/liver)
- Teeth work excellent!

Degraded Bones

- Large scale format to produce higher yields of DNA.
- Larger quantities of DNA needed for genealogy testing!

FORENSIC GENEALOGY

- A genealogical DNA test establishes family relationships.
- We identify a subject by matching *DNA from evidence* left at a crime scene to family members.
- For Unidentified Remains
- Violent Crimes
 - Homicides
 - Sexual Assaults
 - Unidentified Babies

#DNAOptIn

Anyone and everyone can help solve crime. You may even know someone who has been the victim of a violent crime or had a loved one who has gone missing. These photos are the faces of the many victims of unsolved violent homicides. It is our mission to find justice for them. Opting in your DNA on GEDMatch may help investigators to find a killer, a rapist or identify the thousands of unidentified remains in morgues around the country.

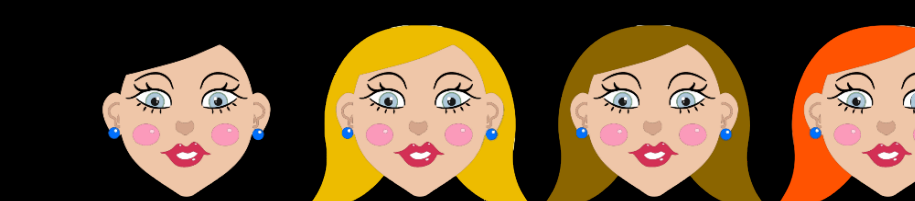
You need a lot more DNA than required for CODIS.

- As low as 1 NG of DNA but as high as 10-20 NG required, even more for bones.
- Mixtures possible depending upon ratios.

Can be time consuming and expensive.

Leads need to be investigated.

ANCESTRY & PHENOTYPING



- With evidence left at the crime scene, we can predict the physical appearance of an individual or suspect.
 - Example: Hair, Skin, Eye Color Using NGS Technology

KINSHIP ANALYSIS

- Statistical analysis of:
 - Parent/Child
 - Siblings
 - Half-Sibling Relationships

