ParaDNA Presumptive Screening:
DNA on the Investigative Timeline

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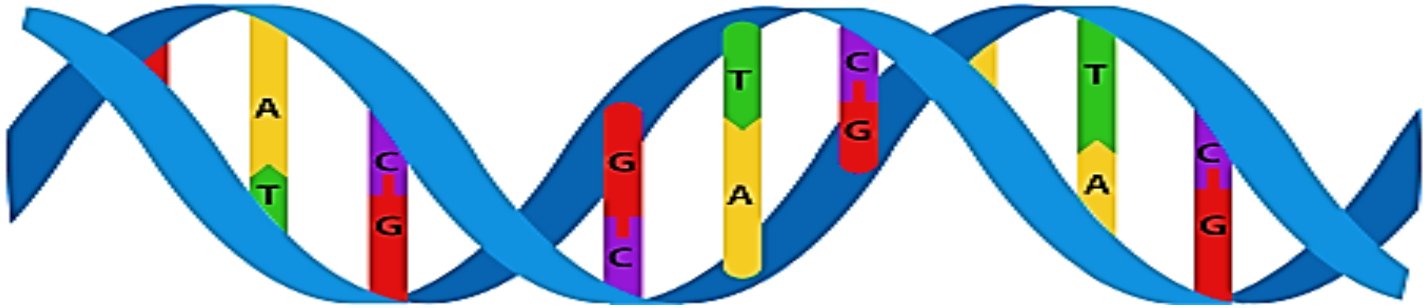
Forensic DNA

- DNA is a “gold standard” in forensic science
  - Extremely Durable
  - Suspects do not need to be present
  - Only need a trace amount to be present
  - Can be found from almost any tissue, including hair (mitochondrial vs. nuclear), fingernails, bone, teeth and body fluids
  - Can be left on a wide range of evidence
  - Uniquely identifies every individual (except for twins)
    - STR statists routinely exceed 1 in 6 billion with trillions, quadrillions and quintillions common (World Population ~7.13 Billion, Kauai Population ~72,000)



Effects of DNA on Crime

- British Home Office
  - Suspect Identification: from 16% without DNA to 41%
  - 2x suspect identification over fingerprint evidence
  - Prevented an average of 7.4 addition crimes per criminal
- National Institute of Justice, DNA Field Test
  - 5x suspect identification over fingerprint evidence
  - 9x times more likely to result in an arrest
  - 2x as many cases accepted by prosecution
  - The Denver District Attorney's Office
    - 26% drop in property crime
    - 5.5x successful prosecution rate
    - Longer prison sentences achieved
    - $29 million in savings through identifying criminals faster, shortening investigation and prosecution timelines, and achieving longer sentences

Standard Method of DNA Analysis

Collect sample from arrestee

Log sample into police evidence system

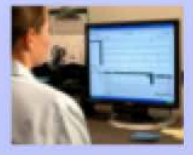
Transport sample to forensic lab

Log sample into lab's evidence system

place sample in evidence vault

remove sample from evidence vault

Test sample



Review sample data

Report sample result to police

Arrest suspect second time

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The Current Issue: Backlog

Single sample processing time: 54hrs and 15min

Honolulu Police Department Backlog

- Case backload of approximately 600 cases
- Each analyst can only process around 42 cases per year.

- HPD Approximate Timeline
  - Murder: 2-3 Months
  - Sexual Assault: 3-6 Months
  - Property Crimes: 2+ Years

Legislature changes:

Act 207 passed, Sexual Assault Kit Backlog

Arrestee sample collection on certain types of cases

Exhibit 4. Turnaround time for violent crimes vs. property crimes

	Number of days
Average turnaround time for violent crimes	106
Average turnaround time for property crimes	154

Making Sense of DNA Backlog, 2012, NIJ

Ramifications of the DNA Backlog

Current Private Options

- Sorenson Forensics and Bode Cellmark Forensics
  - Standard turn around time approximately 8 weeks
  - Cost per sample: $525-750
  - $75 comparison to control profile, $150 for evidence profile
  - One suspect/one control minimum of $1050
  - HPD has to review for CODIS upload
  - Expedited processing available
  - Both have expert witness fee of around $2,200 per day plus expenses

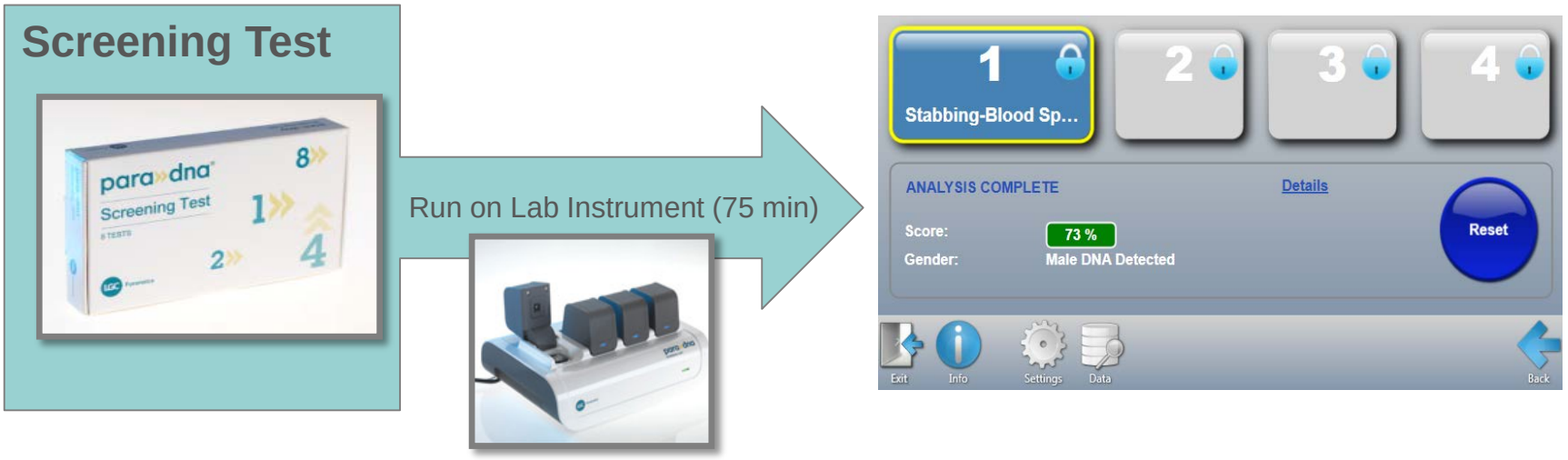
Sorenson Forensics®

Bode Cellmark FORENSICS
LabCorp Specialty Testing Group

THE SOLUTION

ParaDNA® Product Family

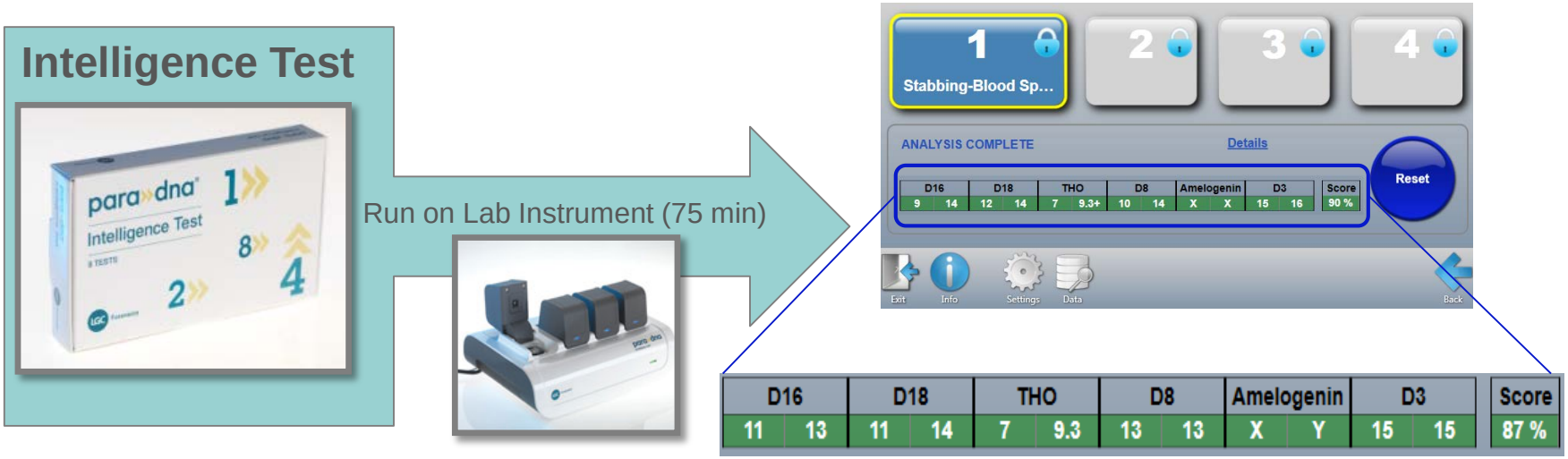
ParaDNA® Screening Test



- Generates a relative percent DNA score and gender call
  - Utilizes 2 STRs plus Amelogenin (gender marker)
- Sample types: saliva, blood, semen, touch/cellular
- Develops more reliable, targeted and *cost-effective* submissions policies
  - Triage samples effectively; exclusion of low level DNA samples
  - Inclusion of key items for full DNA analysis
  - Focus resources more appropriately and more cost effectively
  - Reduce evidence backlogs
  - Increase effective submissions of touch DNA samples (e.g. triage property crime)

ParaDNA® Intelligence Test

- 5 STR profile plus Amelogenin (gender marker) and relative percent DNA score
  - Mixture detection
- Sample types: saliva, blood, semen, touch/cellular, buccal
- Provides early tactical intelligence
  - Quickly include or eliminate suspect(s) from investigation
  - Rapid linking of individual's DNA at the scene
  - Link scenes easily by comparing profiles held on-instrument database (import/export functionality)
  - Allocate staff resource earlier and more cost effectively
  - On scene analysis using Field-portable option
    - Immediate sampling and identification
    - Triage and prioritise samples



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The Current Picture

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Collect evidence at the scene

Goal: Recover probative evidence items and assess what may have happened at the scene

ParaDNA screening

Goal: Triage and prioritize samples that are best suitable for DNA analysis, improve submission success rates and gain rapid investigative leads as quickly as possible

Forensic DNA processing (traditional STR or Rapid)

Goal: Generate useable DNA profiles for comparisons and database searches and produce reports

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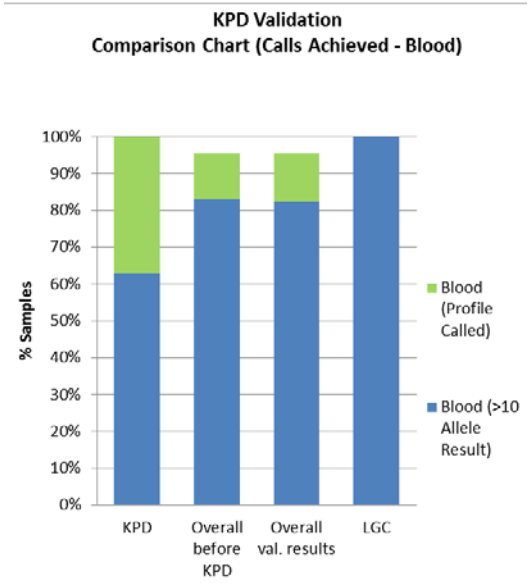
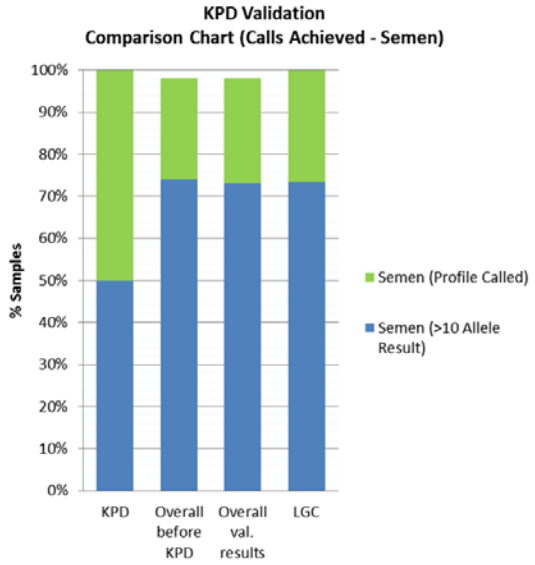
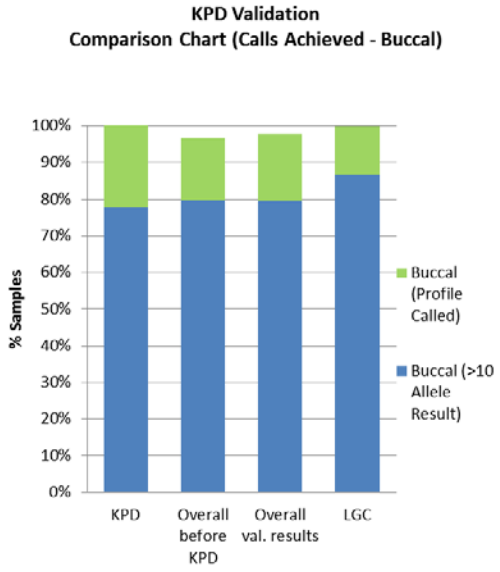
Limitations

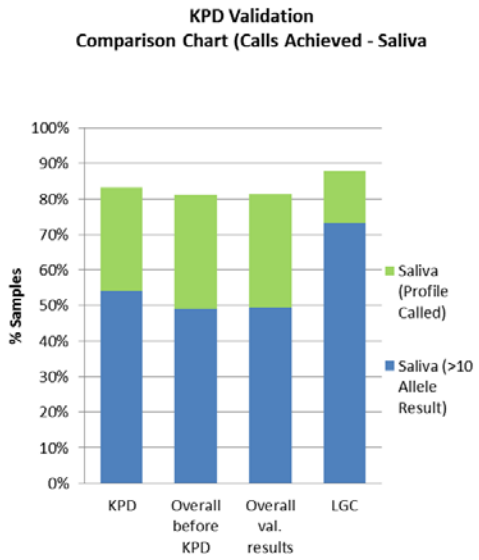
- Presumptive Test
- Mixture analysis
  - Can identify that a mixture exists and give some allele calls in Data Analysis software
- Low level touch samples
  - Currently we do not use this system on low level items in major cases
- Cannot interact with CODIS
  - Does house an on board database

Validation: Neat Samples





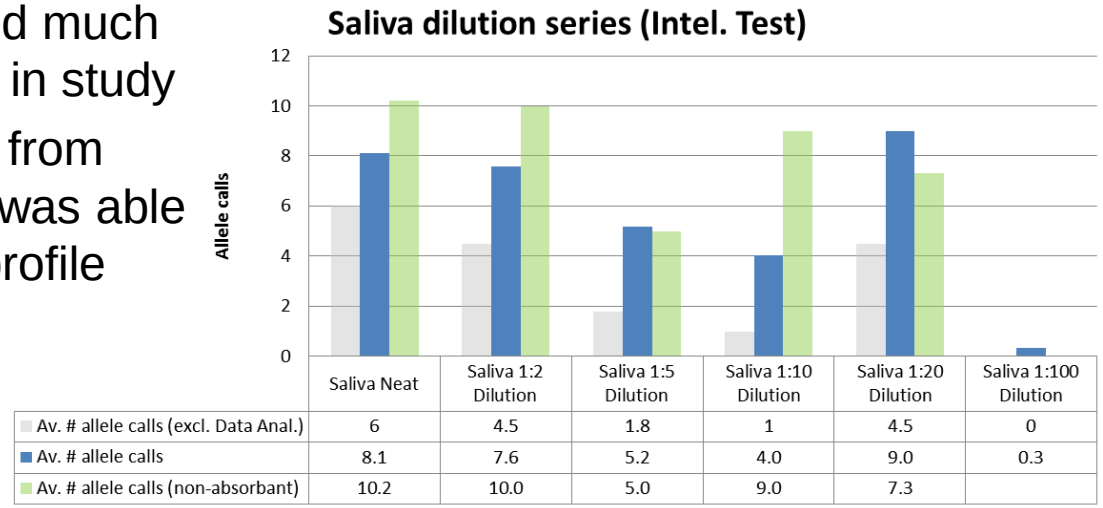




Validation: Sensitivity

- Data (grey/light blue bars) follows expected decreases in number of alleles called
- Introduction of weigh boat (non-absorbent, green bars) examination method coupled with experience gained much improved results later in study
- Estimated 100-200pg from 1:20 and1:10 dilution was able to generate useable profile information

Dilution	% Samples returning >7 (ParaDNA Data Anal.)	Equiv. amount
neat	90%	1.6µg
1:2	100%	800pg
1:5	50%	400pg
1:10	25%	200pg
1:20	100%	100pg
1:100	0%	16pg



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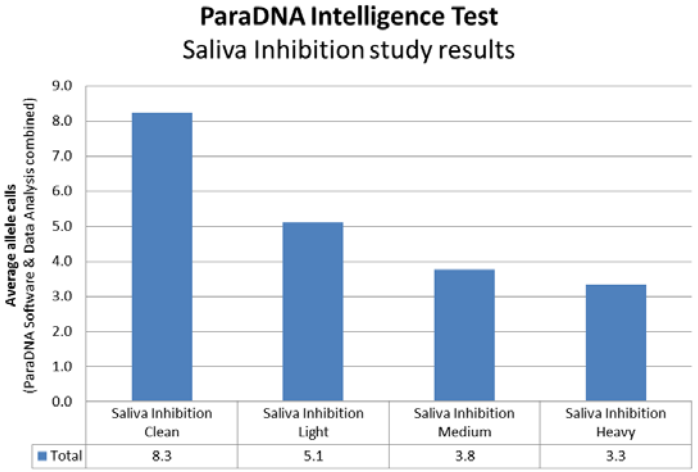
Validation: Mixture Detection

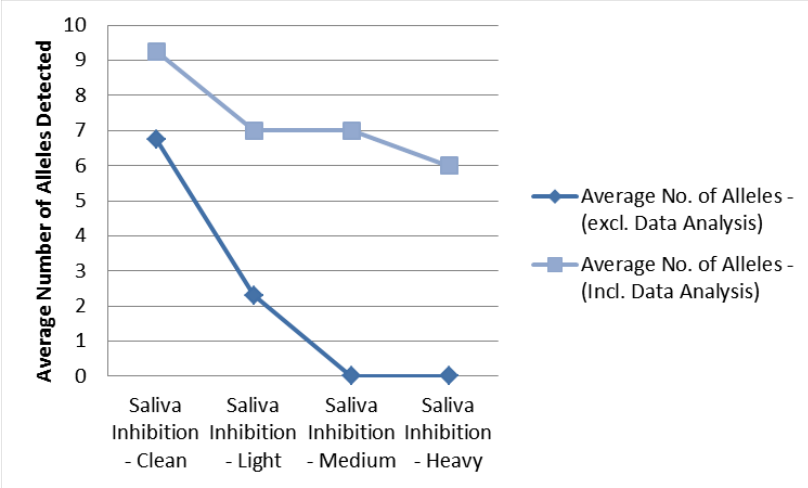
- Mixtures tested included Bood:Semen, Saliva, and Semen:Saliva
- Mixtures ranged from 1:1 to 1:9
- This includes initial samples with heavily overlapping profiles
- 81% of mixtures were detected with Data Analysis Software

Samples run	21	% detected
(i) Mixture detected	2	10%
(ii) Possible mixture detected + (i)	9	43%
(iii) Evidence of mixture in Data Analysis	17	81%
Evidence of minor contributor (if ref. known)	18	86%

Validation: Rust Inhibition

- ParaDNA employs direct PCR with no purification process
- Therefore, PCR inhibitors are not removed
- Increased amounts of rust (a known PCR inhibitor) did show a reduction in the efficacy of the system as expected
- Of note, even on heavy rust the system was able to determine allele calls and all calls were accurate





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Implementation Impact

- Each test costs under a hundred dollars a sample as opposed to up to one thousand for full analysis
  - Screening Test: $42
  - Intelligence Test: $54
- A wider array of cases have benefitted from analysis of DNA evidence, not just major crimes
  - Major crime samples run: 30 (42%)
  - Property crime samples run: 41 (58%)
- Results are returned within approximately 1 hour and 15 minutes after sampling
  - Allows actionable intelligence within hours or days of a crime being committed
  - Reduces the time focusing on false suspects or uninformative evidence
- Increases the strength of cases
  - Screening results have been utilized to obtain search and arrest warrants, therefore increasing the potential to find further evidence and locate stolen property

Early Success: ParaDNA

Benefits in property cases

- Utilize profiles determined by the ParaDNA Intelligence Test to obtain search warrants for the suspect's buccal sample
- Able to connect a suspect to a burglary of firearms case by a drinking can left behind and then turn around and see allele consistencies with multiple other area burglaries
- Blood left behind at a county building burglary was consistent with the suspect in multiple high cost burglaries in the area

Early Success: ParaDNA

Sexual Assault

- A cigarette found at the scene appeared similar to a cigarette which a witness noticed the suspect smoking earlier that night
- The two cigarettes were tested against each other using the ParaDNA Intelligence Test
- Results showed consistency between the cigarettes
- Search warrant was obtained for the suspects buccal samples
- Suspect arrested
- Buccal sample, cigarettes and the sexual assault evidence were sent out for private testing
- Still awaiting laboratory results

Early Success: ParaDNA

Missing Person / Unidentified Remains

- Victim was swept out to sea during bad rip currents (undertow) on Kauai's North Shore
- Unidentified remains were recovered a few days later on a near by beach
- A composite Intelligence Test profile was used to establish a presumptive link between the unidentified human remains and the recent missing person case
- Still awaiting laboratory confirmation

Early Success: ParaDNA

Fatal Hit and Run

- Fatal hit and run accident occurred with a stolen vehicle
- The vehicle involved was left at the scene, however, the suspect fled
- There was blood located in the drivers seat area of the abandoned vehicle
- Suspect was taken into custody with injuries consistence with vehicle damage
- ParaDNA Intelligence Test showed that the blood in the vehicle was consistent with the known profile obtained from the suspect
- Still awaiting laboratory results

Cost Analysis: ParaDNA

Example: Attempted Murder Blood Sample

- 3 samples were screened that would have otherwise been targeted for straight send out. The screening was able to determine further analysis was not necessary.
- Screening cost: $240
- Direct submission for full analysis would have cost approximately $1,600.
- **Total Cost Savings: $1,360**

Cost Analysis: ParaDNA

Example: Homicide Scene Cigarettes

- 12 cigarettes were found at the scene, where there were 3 persons of interest (suspects/victim).
- A screening cost of $630 was able to identify two cigarettes to triage for full STR profiling.
- Screening plus full STR confirmation of the screening results cost approximately $3,000.
- If we had to send out all of the cigarettes found and persons of interest control samples the cost would have been approximately $8,000.
- **Total Cost Savings: $5,000**

Cost Analysis: ParaDNA

Overview:

- Cost per sample: $42 screening test or $54 intelligence test
- We have screened a total of 71 items on the ParaDNA system.
- **Total cost: Approximately $5,850**
- To send the same 71 samples straight to a private lab for full STR testing, it would have cost approximately $44,000 - $70,000.
- **Total savings: Approximately $38,000-$64,000**
- **ParaDNA Screening Unit Cost: Approximately $42,000**

Special Thanks

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- Kaua'i Police Commission
- Kaua'i Police Department Investigative Services Bureau, Fiscal Section, Evidence Sections and Patrol Services Bureau

Questions?

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