



Validation and Incorporation of RapidHIT® Technology into Routine Forensic DNA Casework

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ABSTRACT

In December of 2013, The Richland County Sheriff's Department (RCSD) acquired a RapidHIT® (IntegenX®) instrument for fully automated sample-to-answer STR-based human identification. This system produces a DNA profile from swabs or cuttings in approximately 2 hours. The focus of this system in the scientific field has been on its use for DNA profiling of buccal swabs for a myriad of applications. Our laboratory validated and implemented this instrument for full integration into routine forensic DNA casework to include buccal swabs from suspects as well as evidence swabs and cuttings. During validation, a study was performed to assess usable sensitivity (ability to produce a profile for exclusion or inclusion) of the system for evidence samples. Of the twenty-eight different samples evaluated (drinking straw, gum, puller hair, cigarette butt paper, drink can, steering wheel, door handle, foam cup, bite mark, jacket collar, cell phone, et al) twenty-two produced full (16 of 16 loci) profiles, four produced partial profiles (11-15/16 loci), and two produced no profiles (whole cigarette butts were placed into the sample cartridge which resulted in interference of the extraction). Upon completion of validation, RapidHIT® was approved for casework and has been successfully utilized for several different case types.

A serial burglary (3 related burglary cases), a criminal sexual conduct case, an aggravated armed robbery/attempted murder case, and multiple suspect standards for the local data-base have been analyzed with RapidHIT®.

The burglary cases consisted of 2 blood swabs and a blood stained cutting from a leather pouch from the crime scenes as well as a buccal swab from a suspect. These were analyzed on a RapidHIT® utilizing PowerPlex® 16 HS chemistry using the "Other" protocol. Complete (16 of 16 loci) profiles were generated from the evidence and the suspect's buccal swab. Resulting DNA profiles were interpreted after the 2 hour run and the results were communicated to the investigator after technical review. The profiles generated from the three different crime scenes matched the suspect. As a result the suspect was arrested and charged with 2nd degree burglary and larceny.

Evidence from the attempted murder case consisted of swabs from the suspect's pants, shoes, and a victim's buccal swab. These were run on the RapidHIT® utilizing GlobalfilerEx-press kits with the "Other" protocol. Complete (22 of 22 STR loci) profiles were generated from the evidence and victim's standard. Profiles generated from the suspect's clothing matched the victim. After technical review, findings were communicated to the investigator and the suspect was arrested for attempted murder and armed robbery. The RCSD successfully renewed its ASCLD/LAB-International accreditation in June of 2014. RapidHIT technology was in place, reviewed, and memorialized during this assessment. Currently, the results generated from this system are used for investigative information. If the customer requires a laboratory report, samples are re-analyzed utilizing the conventional DNA profiling method. Once the quality standard requiring human quantitation is modified to accommodate this technology, any profile generated from this instrument could be considered eligible for The Combined DNA Indexing System. The RCSD DNA laboratory views this instrument as an evolution in DNA typing technology.

Materials and Methods

RapidHIT® instrument and GlobalFiler Express cartridges were obtained from IntegenX®, Pleasanton, California. All samples were from the Richland County Sheriff's Department.

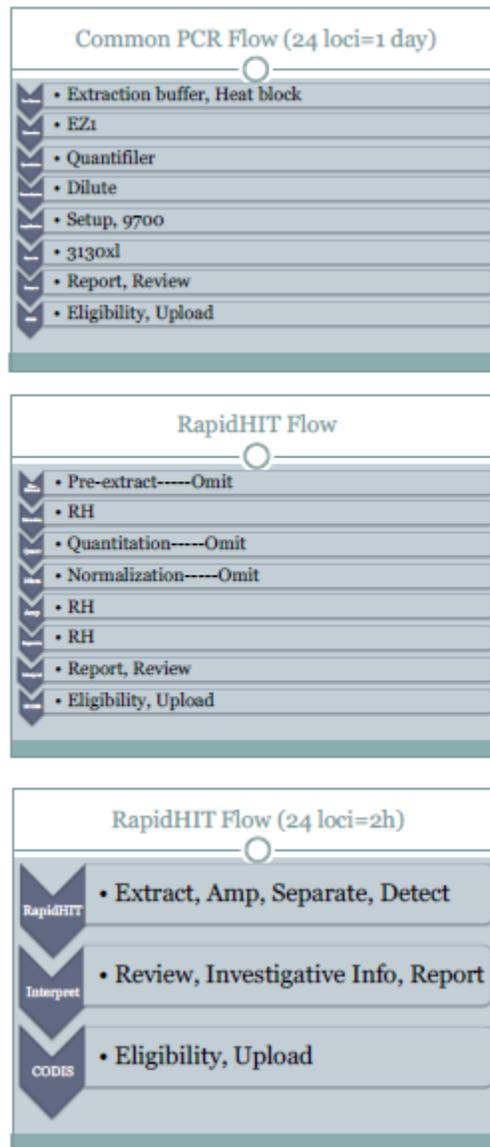
Run #	Samples type	Protocol	Usable Loci
1	Buccal	Buccal	16/16
13	1 x Punch 2mm (FTA saliva)	Other	16/16
3	2 x Punch 2mm (FTA blood)	Other	16/16
14	3 x Punch 2mm (FTA blood)	Buccal	16/16
14	4 x Punch 2mm (FTA blood)	Buccal	16/16
14	5 x Punch 2mm (FTA blood)	Buccal	16/16
4	1 x Punch 7mm (FTA blood)	Buccal	16/16
9	½ x Punch 7mm (FTA blood)	Buccal	16/16
16	Straw	Other	16/16
16	Gum	Other	16/16
19	Pulled hair	Other	16/16
19	Cigarette butt - whole butt	Other	0/16
19	Drink can swab	Other	11/16
19	Steering wheel swab	Other	16/16
19	Back door handle (of RCSD building) swab	Other	14/16
20	Foam coffee cup	Other	15/16
20	Styrofoam cup	Other	16/16
20	Cigarette butt - whole butt	Other	1/16
20	1 x 2mm Punch - semen standard	Other	16/16
22	Blood on leather	Other	16/16
24	Cigarette paper cutting 1	Other	16/16
24	Cigarette paper cutting 2	Other	16/16
24	Cell phone swab	Other	16/16^
24	Microwave button swab	Other	12/16^

25	Bite mark swab	Other	16/16
25	Jacket collar scrapping	Other	16/16^
25	Hairs from jacket	Other	16/16
26	Liquid semen	Other	16/16*

Table 1. Samples from various sources were extracted , ampli-fied (GlobalFiler® Express, Applied Biosystems), separated, and detected on a RapidHIT® (IntegenX®) instrument. Protocols (“buccal” or “other”) were selected based on sample type. Us-able profiles were defined as any allele present at a locus.

*-overloaded ^-mixture

Sample workflows for conventional PCR DNA and Rapid DNA



Attempted Murder Incident

The subject attempted to rob the victim at an apartment while getting out of his car. During a physical altercation the subject shot the victim in the leg and fled in a getaway car. Later the vehicle was involved in a traffic stop for a seatbelt violation. While the driver was being questioned, the passenger (suspect in the shooting) jumped in the driver's seat and sped away. After a vehicle chase, the suspect was eventually apprehended. In addition, there was a two-year old in the backseat without a car seat during the entire incident. The mother of the baby was the girlfriend of the suspect and cooperated with investigators by letting them search her apartment for possible evidence connecting the suspect to the shooting. The suspect's pants and shoes were located in her apartment and placed into evidence.

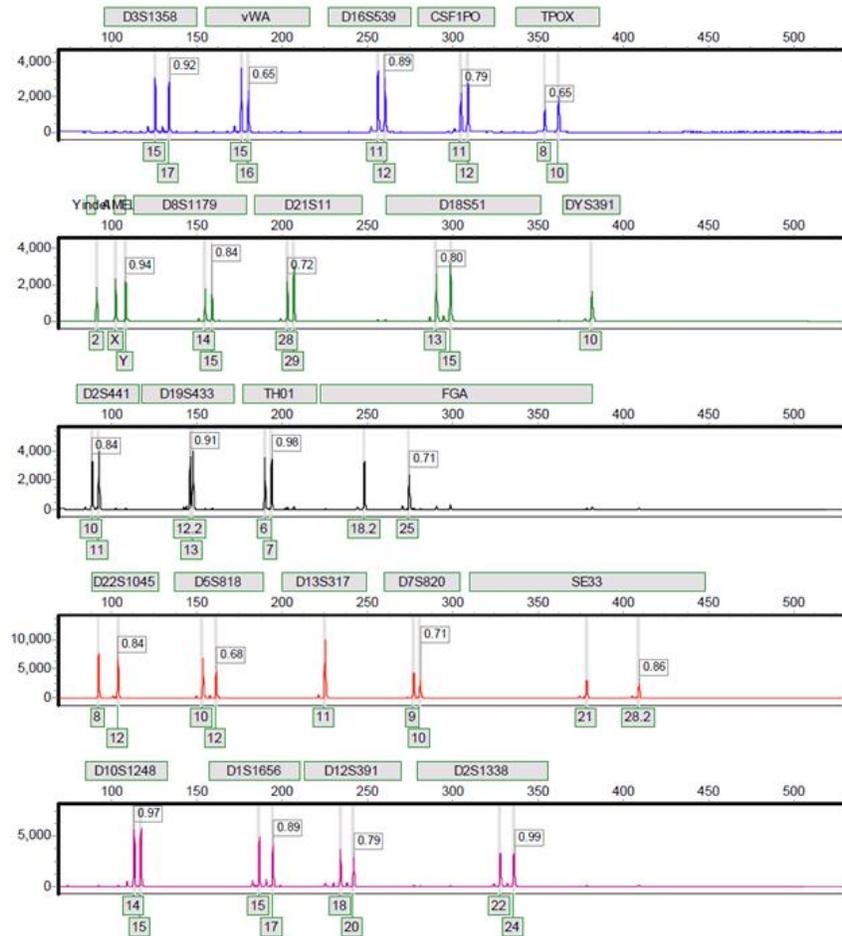
Timeline

- 7/29/14 0830hrs—Investigator assigned case
 - 1000-1255hrs—Investigator gathers statements
 - 1350hrs—Evidence collected
- 7/30/14 1123hrs—Evidence submitted to laboratory
 - 1400hrs—RapidHIT® analysis completed
 - 1500hrs—Investigator request jail to detain suspect
- 7/31/14 1000hrs—Investigator obtains arrest warrants
 - 1446hrs—Warrants served for attempted murder and armed robbery

Result

Blood for the suspect's clothing recovered at the girlfriend's apartment were subjected to RapidHIT® analysis utilizing GlobalFiler® Express cartridges. The DNA profiles developed from suspect's clothing matched the victim. This suspect was arrested the next day and charged with attempted murder and armed robbery.

Sample 1: Trace_A4_4_1407017729_25.fsa
Ref Ladder: XLadder_Run on 14_9.fsa Run date and time: 07/30/2014 - 13:37:42 -> 07/30/2014 - 14:05:50



Electropherogram of blood from suspect's shoe analyzed on the RapidHIT® utilizing GlobalFiler® Express.

Conclusion

IntegenX®'s RapidHIT® is a "swab in – profile out" process consisting of automated extraction, amplification, separation, detection and allele calling. This system has been validated and employed as a "Modified Rapid DNA Analysis" system to provide investigative information to detectives at the Richland County Sheriff's Department. It has been effectively incorporated into routine casework. Upon modification or addition to the "FBI's Quality Assurance Standards for Forensic Testing Laboratories" to accommodate results produced by the RapidHIT® (i.e. no human DNA quantitation performed), this system could reach its full potential (all profiles generated could be considered for CODIS upload). IntegenX®'s RapidHIT® system represents a system that can effortlessly and quickly produce DNA profiles from casework evidence (investigative information) and reference swabs for CODIS entry in forensic DNA laboratories.