B55 An Evaluation and Comparative Analysis of Rapid DNA Analysis and Direct Amplification

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Learning Overview: After attending this presentation, attendees will better understand the differences between Rapid DNA analysis and direct amplification for the swift development of investigative leads for law enforcement.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing forensic laboratories with the knowledge to determine if Rapid DNA analysis and/or direct amplification may be suitable for the swift development of investigate leads for law enforcement through an evaluation of the performance, efficiency, and cost of both systems.

Traditional forensic DNA analysis involves multiple steps and can be time consuming. In certain situations, it may be beneficial to speed up this process and obtain an interpretable DNA profile within a few hours. Rapid DNA workflows are optimized to produce DNA profiles in a relativity short amount of time, albeit from high-level, single-source DNA samples, such as buccal swabs. The application of these rapid DNA workflows for the processing of casework samples, which do not always offer a high quality and/or quantity of DNA, is of great interest to the forensic community as well as law enforcement.

Commercially available rapid DNA instruments have been marketed toward law enforcement agencies for the analysis of casework samples to generate investigative leads quickly. To provide law enforcement with options for more rapid and efficient processing techniques that lead to real-time investigative leads, the Houston Forensic Science Center launched a pilot project to potentially determine the most suitable rapid DNA workflow to integrate into an accredited Forensic Biology Section and undergo a more significant validation. To aid in this determination, this study evaluated the performance, efficiency, and cost of a single Rapid DNA Analysis system and several direct amplification kits. Samples (n = 450) of various types and concentrations, deposited on various substrates were processed using the Applied Biosystems® RapidHit™ ID system (RHID) utilizing INTEL cartridges and the following direct amplification kits: Applied Biosystems® GlobalFiler® Express PCR Amplification Kit lysed in Prep-n-Go™ Buffer, Promega® PowerPlex® Fusion 6C System lysed with Casework Direct System, QIAGEN® Investigator® 24plex QS and QIAGEN® Investigator® 26plex QS Kits lysed with Investigator® Casework GO! Kit.

The success rate of each rapid DNA system was measured by the percentage of complete and concordant genotypes generated at the 20 Combined DNA Index System (CODIS) core loci when compared to genotypes obtained from the traditional laboratory workflow. For GlobalFiler® Express, the success rate of obtaining a complete DNA profile was 95% for blood and 85% for semen. For PowerPlex® Fusion 6C, the success rate was 80% for blood and 95% for semen. For Investigator® 24plex QS, the success rate was 95% for blood and 95% for semen. For the Investigator® 26plex QS, the success rate was 100% for blood and 90% for semen. For RHID, the success rate was 100% for blood and 85% for semen. A failure rate of 3.3% due to instrument errors was observed with the RHID system. None of the systems produced full profiles with saliva or miscellaneous samples containing 1ng or less DNA. Concordance between rapid DNA systems was observed for 98.83% of the STR alleles compared. Five samples exhibited either a single drop-in event or multiple alleles, suggesting the presence of a contaminant.

The average analysis time for any of the direct amplification kits is approximately 3 to 3.5 hours regardless of the number of samples. The average analysis time for RHID analysis is approximately 1.5 hours per sample. The cost of the RHID system can range from $220/sample down to $90/sample. Considering only the cost of the chemistry and no overhead, supplemental reagents, or consumables, GlobalFiler™ Express is ~$18/sample, PowerPlex® Fusion 6C is ~$13/sample, Investigator® 24plex QS is ~$23/sample, and Investigator® 26plex QS is ~$22/sample.

Overall, both the RHID system and the direct amplification kits performed similarly. Both performed well with blood and semen samples, but variable results were obtained from saliva and miscellaneous samples containing ≤1ng DNA. Both workflows have benefits and drawbacks that should be considered. While the RHID instrument can be mobile, the direct amplification workflow is restricted to the laboratory, but has the added benefit of processing multiple samples simultaneously. Reprocessing is also possible with both workflows. Both workflows coupled with an internal database can be powerful resources for developing timely investigative leads for law enforcement.

Direct Amplification, Rapid DNA Analysis, Investigative Leads

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