



A84 Rapid DNA Analysis: Fully Integrated, Fully Automated Generation of STR Profiles From Buccal Swabs

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After attending this presentation, attendees will have learned how fully-automated STR profile generation from buccal swabs can be performed without a technical operator in the laboratory, police station, or field-forward settings.

This presentation will impact the forensic science community by offering a fully integrated, samples-in to answers-out Short Tandem Repeat (STR) analysis system that offers the potential for use in a wide range of out-of-laboratory settings, including police stations, borders and ports, military checkpoints, and the battlefield.

This presentation describes development of a Rapid DNA Analysis system consisting of a modular platform that allows customization to perform a wide range of nucleic acid analyses. Independent microfluidic modules developed include those for DNA purification, DNA quantitation, highly multiplexed amplification, DNA sequencing, electrophoretic separation and detection, and related control, analytical, signal processing, and expert system profile determination software. The system consists of a fully automated instrument and a single accompanying BioChipSet cassette that can be used by non-technical personnel in laboratory, office, or field-based settings while dramatically reducing the time required to perform STR analyses. This presentation summarizes the successful application of the methodology in generating CODIS-quality DNA profiles in 83 minutes from buccal swabs without human intervention.

The Field-Deployable Accelerated Nuclear DNA Equipment ("ANDE") is operated by inserting five buccal swab samples into a BioChipSet, placing the BioChipSet into the instrument, and pressing the start button. The instrument provides all the subsystems required for the completion of STR analyses, including the power, thermal cycling, pneumatic, optical, ruggedization, process control, and computer subsystems. The instrument interfaces to the BioChipSet using a number of features, including a pneumatic manifold to allow fluids to be driven, thermal features to maintain appropriate temperatures during PCR and electrophoresis, optical paths to allow excitation and detection of separated STR fragments, and electrical connections to support electrophoresis. Attendees will become familiar with several critical features of the instrument and BioChipSet including:

- The BioChipSet contains all reagents on-board, factory pre-loaded. The user does not load or otherwise handle reagents. Several reagents are lyophilized (e.g., amplification reaction mix) and others are in liquid form (e.g., purification reagents). All reagents are stable at room temperature.
- The BioChipSet is closed: each buccal sample is processed through its own sealed processing path and samples and reagents do not have any contact with the instrument itself.
- To limit handling requirements, the BioChipSet is a single disposable plastic component. The operator has nothing to connect. No opening, filling, or other handling of the disposable piece is required, minimizing the possibility of cross-contamination.
- Buccal swabs lock into separate purification positions so that once loaded they cannot be moved to another location. An RFID chip in the swab cap is detected by the instrument lid to identify the swab location within the BioChipSet.
- The instrument is ruggedized to MIL STD 810F for shock and vibration. This allows it to be moved within the forensic laboratory, transported for use outside of the laboratory, or used in a police station or field-forward setting. Instrument autocalibration readies the instrument for use within 15 minutes of setting it up.
- The instrument contains an on-board computer and touch screen monitor for interfacing with the operator, and the instrument's wireless, USB, and Ethernet connectivity options can be configured to user requirements. Also based on user requirements, the system includes an expert system for conversion of electrophoretic traces to CODIS/NDIS-compatible profiles and .cmf output, GPS-tagging of data products with time and location data, and an internal database to store instrument-generated profiles.

Description of the instrument design, the processes conducted in automated processing, and data characterizing the output generated from the fully integrated multiplex STR instrument-biochipset-expert system format will be presented.

Rapid DNA, Expert System, ANDE