



A Decade of Automated Differential Digestions

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Background

As forensic laboratories faced an increased demand for the timely analysis of sexual assault evidence kits (SAEKs), the Oakland Police Department Criminalistics Laboratory developed an efficient and effective solution to meet this demand.

Ten years ago, the Oakland Police Department Criminalistics Laboratory validated and implemented an automated differential digestion protocol that uses a selective degradation step.

With the help of the Aurora Biomed VERSA 1100 liquid handler, the Oakland Police Department Criminalistics Laboratory has processed over 25,000 sexual assault evidence kit samples in the last decade.

Impact of the VERSA 1100 at Oakland

High Throughput Capability

Ability to process up to 96 samples at once significantly increases sample handling efficiency.

Reduced Risk of Cross-Contamination

Instrument's design and automated features reduce the risk of cross-contamination between samples.

Customizable Protocols

Capability to create and modify protocols to meet lab-specific needs.

Backlog Elimination

Paramount in the elimination of our SAEK backlog in 2014. Over the course of 8 months, 343 SAEKs were processed between 8 analysts.

Time-saving

Resulted in a sixfold reduction in the processing time of SAEK samples. 96 SAEK samples takes approximately 5 hours to process on the VERSA 1100.

Labor-saving & Multi-tasking

Minimal manual intervention allows the analyst to use this time more efficiently for other tasks such as data interpretation, report writing, and reviews.

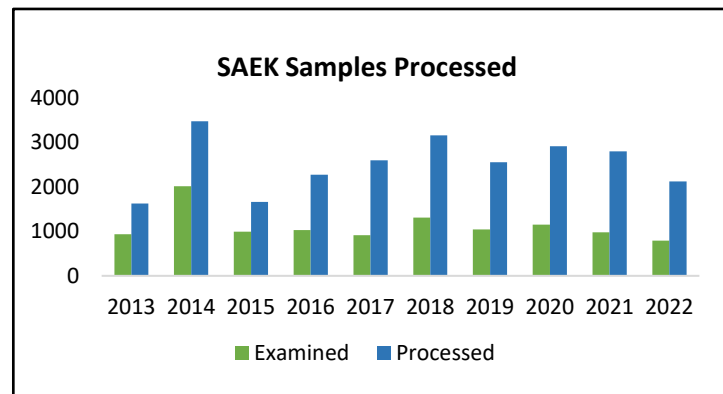


Figure 1. Total number of SAEK samples examined and processed (extracted) annually.

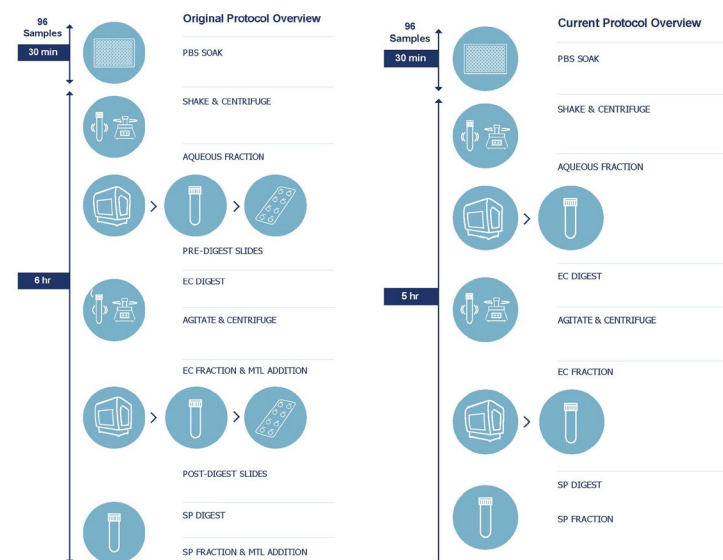


Figure 2. Overview of the original and current differential digestion using selective degradation protocols on the VERSA 1100.

Differential Digestion using Selective Degradation Protocol Highlights

Selective Degradation

Replaces the multiple wash and centrifugation steps. Uses DNase I to eliminate residual non-sperm DNA in the sperm cell fraction.

Use of a Non-Ionic Detergent

Ions in ionic detergents inhibit DNase I activity. Tween 80 selected due to its DNase I compatibility and cell lysis ability.

DNase I Activation & Inactivation

DNase I activity depends on the presence of Mg²⁺ and Ca²⁺ ions. EDTA chelates these ions, resulting in DNase I inactivation. Sperm cell fraction DNA yield is unaffected by DNase I.

EC Fraction Digestion Time

Reduced from 1 hour to 30 minutes without affecting epithelial cell fraction DNA yield.

Manual Toothpick Agitation

Maximizes the release of cellular material from the substrate. Incorporation of this step into the automated protocol resulted in comparable sperm cell fraction DNA yield for the manual and automated protocols.

Protocol Updates

Removed Pre & Post Digest Slide Preparation

Reduced SAEK sample processing time by approximately 40 minutes for 96 samples.

Forensic community is gradually moving away from lengthy screening methods.

Removed MTL Addition to the EC and SP Fractions

Reduced SAEK sample processing time by approximately 20 minutes for 96 samples.

MTL addition now performed by the QIAGEN E22 Connect Fx Instrument.

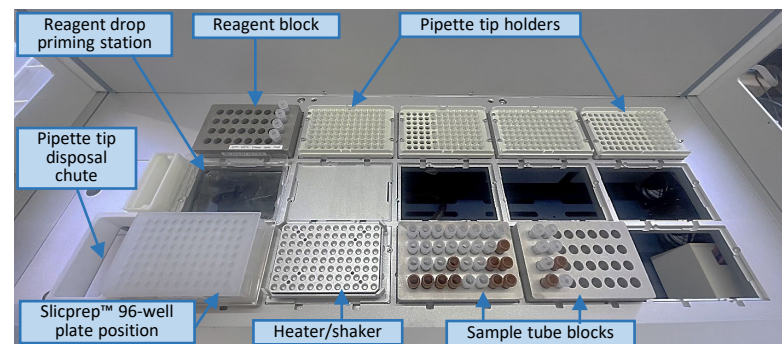


Figure 3. VERSA 1100 deck layout.



VERSA 1100 online

DNA fun fact: CRISPR genome-editing technology recognized by Science journal as "Breakthrough of the Year"

DNA fun fact: First female Viking warrior's remains determined using DNA sequencing

DNA fun fact: Mitochondrial DNA can be inherited from fathers

2013
Push to eliminate SAEK backlog

2014
2015
DNA fun fact: NASA astronaut Kate Rubins first to sequence DNA in space

2016
2017
DNA fun fact: Golden State Killer identified using genetic genealogy

2018
2019
2020
COVID-19 pandemic

2021
New VERSA 1100 instrument online
2022
Protocol updates
2023
Decade of automated differential digestions!



for more information

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