

## B53 Practical Applications of a Wet-Vacuum DNA Collection System

*Jessica M. McLamb, MS\*, Federal Bureau of Investigation Laboratory/ORISE, Garner, NC 27529; Mark F. Kavlick, PhD, Quantico, VA 22135*

**Learning Overview:** After attending this presentation, attendees will understand how a wet-vacuum is used for DNA collection in a forensic context as well as the results of five studies designed to evaluate its performance and potential case use.

**Impact on the Forensic Science Community:** This presentation will impact the forensic science community by describing a wet-vacuum system that could serve as an alternative DNA evidence collection method and its potential use at crime scenes and/or laboratories.

Crime laboratories routinely receive large, porous, and/or irregular evidence items, which are difficult to sample for DNA testing with simple swabbing, tapelifting, or cutting techniques. A DNA collection system which utilizes wet-vacuum technology, called the M-Vac<sup>®</sup>, was designed for in-lab or in-the-field sampling of such challenging materials. The wet-vacuum dispenses pressurized sterile solution onto a surface and simultaneously vacuums cellular material into a sample collection bottle. To collect and concentrate the cellular material, the sample is filtered through a 0.45 $\mu$ M Polyethersulfone (PES) membrane in a two-stage filter unit. The membrane filter is then cut from the unit and processed for DNA extraction.

The studies presented here explore practical forensic uses of the wet-vacuum system: (1) assessment of a five-foot versus 40-foot length hose/solution line for recovering diluted 1/100 blood on glass; (2) performance of wet-vacuum collection and DNA concentration when Bluestar<sup>®</sup> was applied onto bloodstained painted drywall and automotive carpeting; (3) evaluation of an alternative, yet similar, DNA extraction protocol against the wet-vacuum manufacturer's recommended protocol with the EZ1<sup>™</sup> DNA Investigator Kit; (4) comparison of a single- versus double-filtration method for DNA concentration; and (5) investigation of other filter membranes (i.e., 0.2 $\mu$ M nylon, 0.2 $\mu$ M cellulose nitrate, and 0.2 $\mu$ M surfactant-free cellulose acetate membranes, compared to the recommended 0.45 $\mu$ M PES membrane for recovery of cell-free and fragmented HL60 DNA). All samples were evaluated for nuclear DNA (nDNA) quantity and quality using the Quantifiler<sup>®</sup> Human Plus DNA Quantification Kit and total nDNA yields were assessed for each study.

Results indicated that total nDNA yields recovered from 1/100 blood on glass with the wet-vacuum were comparable, regardless of hose/solution line length. Yet the use of Bluestar<sup>®</sup> seemed to reduce DNA yields from blood spotted on automotive carpet, possibly because of increased application of Bluestar<sup>®</sup> due to the absorbent nature of the carpet, while DNA yields recovered from blood with and without Bluestar<sup>®</sup> applied onto painted drywall were similar. In addition, there were no significant differences in recovery yields using different extraction protocols or for single- versus double-filtration. Lastly, the 0.2 $\mu$ M cellulose nitrate filter membrane significantly captured more cell-free, unfragmented DNA compared to the other filter types; however, fragmented DNA was mostly present in the filtrate, rather than on the membrane surface, for all filter types.

The various studies demonstrated here highlight that the wet-vacuum system can be used as a DNA collection tool in several practical forensic applications. Results provided no evidence that hose length, extraction protocol, or the number of filtrations affected DNA recovery, negatively or positively. However, Bluestar<sup>®</sup> reduced DNA quantities when applied onto absorbent materials but not a smooth surface. The use of 0.2 $\mu$ M cellulose nitrate showed significant improvement over the recommended 0.45 $\mu$ M PES membrane for high molecular weight DNA, suggesting that this alternative filter membrane may be more suitable when cell-free DNA is suspected to be present. However, more research is warranted to improve the retention of low molecular weight, fragmented/degraded DNA.

---

### M-Vac<sup>®</sup>, Wet-Vacuum, DNA Collection