A172 Background Gunshot Residue — A Statistical Analysis

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After attending this presentation, attendees will have learned about the levels of gunshot residue in a population of detainees who have been arrested on non-firearms-related charges.

This presentation will impact the forensic science community by illustrating how the use of gunshot residue evidence can be enhanced with the statistical analysis.

Gunshot Residue (GSR) analysis is a forensic sub-discipline in Trace Evidence. The forensic utility of GSR evidence is to provide information as to whether there is a primary association of a person or surface with the discharge of a weapon or subsequent handling of a discharged weapon. There are many factors that can affect the persistence of GSR on a given surface which include, but are not limited to, time between the event and sampling, activity (cleaning), and environment (weather). Additionally, challenges may be raised suggesting that peace officers, who carry and use firearms, and their places of employment, can be a source of contamination.

GSR examiners concur with certain premises (e.g., that residues arising from the detonation of lead styphnate, barium nitrate, and antimony sulfide primers, PbBaSb, are characteristic of GSR and that the presence of GSR does not indicate that a person has fired a weapon), but there is no consensus on background levels of GSR. At the 2005 Federal Bureau of Investigation (FBI) Laboratory's Gunshot Residue Symposium, the attendees reported minimum thresholds ranging from one to fifteen PbBaSb particles, with a majority stating that a single GSR particle is a sufficient threshold.[1] The National Academy of Sciences Report of 2009, *Strengthening Forensic Science in the United States: A Path Forward,* did not directly address GSR evidence, but the report recommends that forensic reporting be standardized and uniform.[2] The wide range of reporting thresholds leads to confusion in the interpretation of GSR results.

Thresholds can be utilized to determine statistical significance of a result when compared to a population of interest. If the average number of PbBaSb particles on the hands of members of the general population were known, then the Poisson probability distribution function

$$P_n = \frac{\mu^n}{n!} e^{-\mu}$$

μ is the average number of PbBaSb particles

n is an experimentally determined number of particles

provides this statistical inference. Since the entire population cannot be evaluated, a suitable sample is needed to estimate it.

Efforts to determine the frequency presence of GSR particles in the population without recent, direct exposure to a shooting event have been reported in two studies.[3,4] The prevalence of GSR in samples from "non-shooting" populations have focused upon police officers that have not fired their weapons for lengthy periods of time (up to 90 days). A total of four PbBaSb particles were found on the hands of 124 police officers in the combined studies.

A third study focused on surfaces commonly encountered by suspects in police custody, e.g., rear seats of patrol cars, interview rooms, lock-ups, etc.[5] In this study, a total of 201 surfaces were analyzed and a total of 56 PbBaSb particles were found. There is a clear difference in the statistical inferences that can be made from this study when compared with the data from the hands of police officers who had not recently fired weapons. A fourth unpublished study of subjects appearing before magistrates after being in police custody yielded no PbBaSb particles on the dominant hands of 100 individuals. The widely varying results from these studies were the starting point for this work.

Hands of 175 detainees being processed into the Harris County Inmate Processing Center (IPC) were sampled. Consent was obtained and then samples were collected in the pre-trial services area of the IPC. The samples were analyzed by Scanning Electron Microscopy/Energy Dispersive X-Ray spectroscopy (SEM/EDX). No characteristic GSR particles were found on any of the samples.

These results indicate that the statistics require the use of inequalities. A combined average of the results of this study and those found in references three, four, and six will be used: μ=0.0126. The Poisson distribution for the mean leads us to infer that 98.4% of the "uninvolved" population would be expected to have no characteristic GSR particles. Given a suggested threshold of three particles for primary association, the odds of finding this number of characteristic particles on an uninvolved person are on the order of 1:3,000,000.

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recommendations expressed in this publication/program/exhibition are those of the author(s) and do not necessarily reflect those of the Department of Justice.

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Gunshot Residue, Statistics, Arrestees

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