

# Evaluating the Accuracy of Bloodstain Pattern Analysis Using Hemodynamic Properties

Paul Yount \*, Forensic Science, University of Providence, Great Falls  
Chrissie Carpenter, Chemistry, University of Providence, Great Falls  
Mykal Gernaat, Forensic Science, University of Providence, Great Falls  
John Baluyut, Chemistry, University of Providence, Great Falls  
Jessica Martin, Biology, University of Providence, Great Falls  
Meredith Hecker, Mathematics, University of Providence, Great Falls

\*Indicates Presenter

This comparative survey explores the relationships between the discipline of bloodstain pattern analysis (BPA) and hemodynamic blood properties, such as viscosity and hematocrit. In BPA, forensic scientists study the phase change of blood when in contact with air, but little forensic literature connects blood biomechanics, such as hematocrit levels to BPA. Red blood cell count, or hematocrit, in females (37-48% of blood volume) is slightly lower than males (45-52% of blood volume) from menstrual red cell loss, etc. Strong evidence suggests that erythrocytes influence blood viscosity because of their high concentration ( $4-6 \times 10^6$  RBC/mm<sup>3</sup> or 40-45% of blood volume in healthy individuals). When whole blood is altered by a disorder/disease or alcohol intake, hematocrit levels can be affected as well. With this knowledge, there is reason to believe that blood viscosity changes with individualistic hematocrit levels. Therefore, it is hypothesized that traditional BPA angle of impact tests can produce inaccurate results. Intravenous blood samples were drawn from 9 volunteers (all women, including 8 with blood disorders/alterations and 1 healthy control) at the University of Providence into collection tubes containing ethylenediaminetetraacetic acid as an anticoagulant. Each sample was tested for viscosity using a Canon-Fenske viscometer and for hematocrit levels using an LW Scientific ZipCombo centrifuge. Finally, each sample was used to make several blood stains at varying degrees of impact (10°, 30°, 60°, and 90°). A MANOVA was used to compare viscosity, hematocrit, and angle of impact variables against each other within the 8 participants. This survey connects hemodynamic properties to angle of impact tests in BPA by significantly showing how bloodstains can be inaccurately misinterpreted. By examining blood viscosity among several individuals, this research assesses the accuracy of BPA by comparing experimental and expected bloodstain angles and creating individualistic standards for future forensic methods.