

ADDENDUM

Research questions regarding the behavior of blood outside the body

OSAC Bloodstain Pattern Analysis Subcommittee

January 29, 2016

Introduction

This document serves as an addendum to the OSAC Research Needs Assessment Form entitled “*Behavior of blood outside the body*” approved by the Bloodstain Pattern Analysis Subcommittee on January 29, 2016. The BPA Subcommittee is of the opinion this addendum provides additional details not captured in said form.

What is the problem?

- 1) Blood is a complex mixture of components that exhibits natural variation and may be further affected by environmental conditions, such as temperature changes, and dilution in scenes where bloodstain pattern analysis is employed. The range of variation in blood properties and the resultant connection to the range of variation in observed patterns and stains is poorly understood.
- 2) There is unexploited potential for extracting more information than is currently available in BPA by studying the mechanisms of pattern and stain formation and developing predictive and interpretive models to connect observable characteristics to stain and pattern forming mechanisms.
- 3) Differences between fresh, whole, human blood and various substitutes for use in research, training, and case experimentation are poorly understood due to a lack of understanding of the detailed physical characteristics of blood and their relationship to the mechanisms of formation and resulting appearance of bloodstains and patterns.

Why do we care about these problems?

- 1) The wide variation in the range of appearance of patterns and stains can result in incorrect identification of the mechanism of formation.
- 2) Knowledge of the properties of liquid blood and the effects of these properties on the mechanisms of blood transfer, drop formation, travel of drops through the air, deposition on surfaces, and drying are fundamental to BPA. This fundamental knowledge is critical to understand the range of variation in bloodstain and pattern appearance and to the development of predictive or interpretive models.

What are the research questions?

- 1) How are blood drops affected by travel through the air? What experiments can be performed and models developed to understand and predict droplet break up and deceleration/acceleration during flight?
- 2) What are the observable and quantifiable characteristics of stains and patterns from the mechanisms of impact, cast-off, cessation, forward spatter, backspatter, expiration, projected blood, transfer stains, wipe patterns, swipe patterns, and drip patterns? Which initial conditions during drop formation affect the resulting observable and quantifiable characteristics of the corresponding pattern? What models of these mechanisms can be developed that predict the connections between initial conditions and observable characteristics based on the fluid dynamic behavior of blood?
- 3) How is the appearance of spatter stains and transfer stains affected by deposition on surfaces as a function of material characteristics and conditions, geometry, blood volume and velocity? What experiments can be performed and models developed that connect observable stain or pattern characteristics to these deposition conditions?
- 4) What are the effects of blood characteristics on the appearance, distribution, number and size of stains from the mechanisms listed in question 2? Blood characteristics to investigate include: temperature, species, age since removal from the body, hematocrit levels, lipid levels, presence of preservatives, defibrination, alcohol or other drugs (blood thinners), other clinical conditions, cell damage, evaporation, separation, and clotting.
- 5) Can blood substitutes be developed and/or enhanced that have the same properties as fresh human blood for the conditions of a particular pattern forming mechanism so that this substitute could be reliably used for training and research for that mechanism?