

### D3 Understanding the Difference Between Expired and Impact Bloodstain Patterns

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**Learning Overview:** After attending this presentation, attendees will understand that certain factors can provide a better indication of whether a spatter pattern occurred from impact and gunshot or expired events. Attendees will also understand the challenges in differentiating impact and gunshot patterns from expired spatter patterns.

**Impact on the Forensic Science Community:** This presentation will impact the forensic science community by providing new data that can be used to better understand the differences between expired and impact spatter patterns that can be used when performing crime scene investigations.

Correct classification of the mechanism causing a bloodstain pattern is of importance within Bloodstain Pattern Analysis (BPA). The characteristics of bloodstain patterns that have been created by expiratory mechanisms are not properly defined. Without mucus strands, oral bacteria, or vacuoles, it is difficult to distinguish these bloodstain patterns from other patterns that look very similar, such as patterns created as result of an impact event. This work aims to determine characteristics within bloodstain patterns created by expiratory mechanisms, which differ from characteristics in bloodstain patterns created as a result of an impact event.

A Blood-Mimicking Fluid (BMF) similar to that described by Stotesbury et al. comprised of liquid honey, pasteurized egg white, red dye, and de-ionized water was utilized in each mechanism investigated.<sup>1</sup> The expectorate mechanisms investigated were blowing, speaking (normal voice), speaking (raised voice), sneezing, involuntary coughing, voluntary coughing, and exhalation. Blunt force impact spatter patterns were created for comparison with the expired patterns by swinging a selection of typical blunt force impact weapons by hand into a pool of 2.5ml BMF. The weapons were a ballpeen hammer, baseball bat, claw hammer, crowbar, a piece of timber, a rubber mallet, and an iron tube. Gunshot patterns were generated by shooting a chicken breast wrapped in a BMF-soaked T-shirt with a .45 caliber projectile.

All BMF trajectories for each event investigated were recorded using a Photron FASTCAM SA5 high speed camera and a Tamron 25mm–75mm zoom lens recording at 10,000fps. Multiple 10,000-lumen LED lights provided the illumination. Target surfaces for the impact patterns were provided by sheets of card placed at different distances, dependent on the mechanism investigated. Impact patterns were photographed using a Canon® EOS 5D Mark III with a Nikon® 50mm lens. Analysis was performed using the software program ImageJ to determine the number of stains and the stain size. The velocities of the expiratory mechanisms were also measured using the same hotwire anemometry technique described by Geoghegan et al.<sup>2</sup>

Although it cannot be definitively stated that impact and gunshot patterns can be distinguished from expired spatter patterns, there are some indications that make a pattern more likely to be an impact, gunshot, or an expired spatter pattern. These indications were found in the shape of the pattern, the number of stains on the target surface, stain size distribution, downward-pointing directional-shaped stains, and linear-shaped stains. Expired spatter patterns that created less than 500 stains, typically low velocity mechanisms, and with an unrecognizable-shaped pattern were most likely to be confused with impact stains with less than 500 stains created using a ballpeen hammer.

#### Reference(s):

1. Theresa Stotesbury, Michael C. Taylor, Mark C. Jermy. Passive Drip Stain Formation Dynamics of Blood onto Hard Surfaces and Comparison with Simple Fluids for Blood Substitute Development and Assessment. *Journal of Forensic Sciences* 62, No. 1 (2017):74-82. <https://doi.org/10.1111/1556-4029.13217>.
2. Patrick H. Geoghegan, Albert M. Laffra, Nathan Hoogendrop, Michael C. Taylor, Mark C. Jermy. (2017). Experimental Measurement of Breath Exit Velocity and Expired Bloodstain Patterns Produced Under Different Exhalation Mechanisms. *International Journal of Legal Medicine* 131, No. 5 (2017): 1193-1201. <https://doi.org/10.1007/s00414-017-1545-2>.

#### Expired, Impact, Blood Pattern Analysis