

“Expired Bloodstain Patterns¹”

By

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Introduction:

Much dialogue has been spent arguing the definitive term used to describe blood that is propelled from the airway. Among bloodstain pattern analysts, *expired* blood has been the term primarily used to refer to this type of bloodstain pattern. Although others have used the terms exhaled, breathed, coughed, and expectorated to describe this specific pattern. At least one pulmonologist interviewed suggested the term hemoptysis to define the action that creates this type of bloodstain pattern. In an attempt to explore the issue of expired bloodstain patterns the following definitions were obtained from Dorland's Illustrated Medical Dictionary 26th ed.

Terminology:

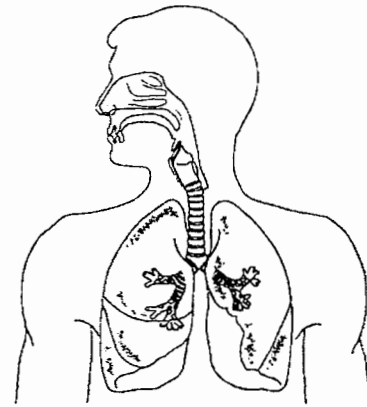
- **Inspirate** (in`spi rat) inhaled gas or air. p.670
- **Expirate** (eks`pi-rate) expired gas (or air); the gas expired in on expiration is called *single expirate*.
- **Exhalation** (eks`hah-la'shun) [L. *exhalatio*, from *ex* out + *halare* to breathe] 1. the giving off of watery or other vapor, or of an effluvium. 2. a vapor or other substance exhaled or given off. 3. the act breathing out.
- **Expectoration** (ek-spek'to-ra'shun) 1. the act of coughing up and spitting out materials from the lungs, bronchi and trachea. 2. sputum.

1 “Expired Bloodstain Patterns” to be published.

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Human Anatomy and the Breath:

The primary structures of the respiratory system are the nostrils or nares and the nasal cavity, the mouth, throat (pharynx and larynx), windpipe (trachea), the two lungs with their various airways and the muscular diaphragm. The respiratory system absorbs oxygen from the air that is breathed in, introducing it to the blood supply. Then the circulatory system, consisting of the heart and blood vessels, distributes this oxygen by pumping and carrying the blood around the body. At the same time, the circulatory system collects waste carbon dioxide and brings it to the lungs, where it is breathed out of the respiratory system into the air.



Composition of a Breath:

- Humans breathe in (inspire) ambient air, which is comprised of a mixture of gases. Air is about 78% nitrogen, 21% oxygen, 1% argon, 0.03% carbon dioxide and even smaller amounts of other gases. We need only the oxygen in the air.
- The air we breathe out (expire) contains less oxygen (about 16%) while its carbon dioxide content goes up nearly 4%.
- An infant inspires about 40 times each minute.
- A one-year old baby inspires about 24 times each minute.
- On average, an adult inspires about 14 times each minute.
- Following physical exertion, the breath rate can increase to over 100 breaths/minute.
- Each minute an adult inspires (and expires) some 15 - 21 pints (7 - 10 liters) of air. During inspiration, this air contains nearly four pints (2 liters) of oxygen. During expiration, it carries three pints (1.5 liters) of carbon dioxide.

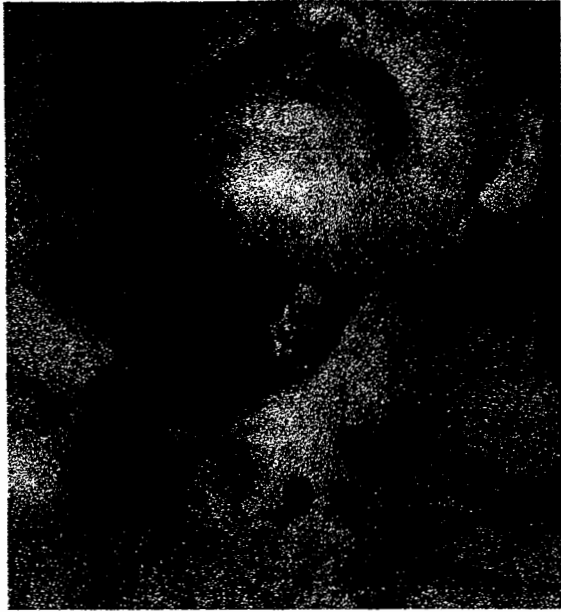
Coughing, and Sneezing:

A cough differs only from normal expiration in its ferocity (20-50 L/sec) The fast-moving wave of air, greatly accelerated by a huge contraction of the abdominal muscles, passes like a whirlwind up the airway and through a nearly closed epiglottis, sweeping up lumps of mucus, blood and other liquids in its wake.

Another variant of normal breathing is sneezing. Like coughing, it is a means of clearing irritants from the upper respiratory tract. Any irritation of the mucous membrane lining of the upper respiratory tract will induce coughing and/or sneezing.

Introduction of Blood into the Airway:

Generally speaking blood is not found in the airway. The exception to this is the introduction of blood to the airway due to trauma or in some cases a natural disease process. Gunshot trauma, stab and incise wounds, and blunt force injury to the chest and/or neck may cause blood to flow into the airway. Likewise, an unprovoked introduction of blood into the airway may occur following the rupture of an erosive pulmonary tumor or aspiration of blood from the stomach following regurgitation of bloody gastric contents. Long term alcoholics may present with a condition called esophageal varicies where the small vessels that line the esophagus break and hemorrhage into the stomach. When the individual vomits, the blood irritates the lining of the esophagus causing coughing and spitting of bloody gastric content (this bloody emesis often has the appearance of dark coffee grounds.) In the course of this coughing, the individual will often aspirate the bloody fluid causing further irritation, additional coughing, and a subsequent *expirated* bloodstain pattern. It is imperative the bloodstain pattern analyst obtain a copy of the pathologist's autopsy report when describing "expirated" bloodstain patterns. The absence of these injuries negates the possibility of "expirated" blood.



Two components are necessary to properly identify the “expired” bloodstain pattern:

1. Sufficient enough trauma to the mouth, neck or chest so the structures of the respiratory tract are compromised.
2. Sufficient enough trauma to the soft tissue and/or vessels to create ample blood flow into the airway, or aspiration of blood into the airway.

Expired Bloodstain Patterns

The *expired* bloodstain pattern is normally very chaotic in appearance. These patterns contain bloodstains that represent the low, medium and high velocity impact spatter groups. The multiplicity of these patterns can be attributed to the varied force which dispatch the blood from the mouth or nose. The smaller stains broken up by the more extreme blasts of air being exhaled. In some cases large volume collections of blood will occur in the mouth and can be “dumped” or projected onto target surfaces creating associated splash and ricochet stains. Victims may move about causing the appearance of multiple points of origin when in actuality the bloodstain pattern was created in one fluid motion as the victim fell to the floor. Also, the victim may lay in one geographic place creating bloodstain patterns laid over other bloodstain patterns. The resulting collective pattern will look much like a large volume “pool” of blood around the victim’s head, surrounded by peripheral intermittent bloodstains. Expired bloodstains can travel great distances. A victim supine on the floor, can produce an expired bloodstain pattern radiating greater than three feet away from the point of origin (the mouth/nose.)

These scenes are sometimes mistaken for blunt trauma bludgeoning deaths. When the victim has laid in one place the essential difference between a homicide and another

manner of death is the lack of voids around the victims head, where the perpetrator would be standing. The investigator should also expect to note an absence of altered stains where the perpetrator would have walked through wet bloodstains during the commission of the assault.

Reconstruction of "Expired" Bloodstain Patterns

These bloodstain patterns can be reconstructed using a simple device fashioned out of surgical tubing and a nylon "T" junction. A standard syringe, filled with a measured unit of whole blood is fixed to the vertical section of the "T". A piece of surgical tubing is fixed to the horizontal section of the "T". The investigator would blow through the horizontal tubing while forcing the blood through the vertical piece. The air travels across the top of the blood volume and projects it out of the end of the device. The resulting pattern is one that mimics that of "expired" bloodstains. This procedure can be fashioned to recreate specific scenes and scenarios.