

# BLOODSTAIN PATTERN IDENTIFICATION KEY

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Blood is one of the most common traces at Crime Scene or due to the use of violence.

Bloodstain Pattern Analysis (BPA) is the forensic field which interprets the bloodstains evidence in order to determine the most consistent and objective explanation regarding their presence.

To reach an explanation, bloodstains have to be classified. This step is called "Bloodstain Pattern Recognition". This is when the bloodstains studied become identified bloodstains (= Bloodstain patterns).

The "Osborne et al." work shows the importance of training and experience to increase reliability in classification, but expertise is not enough to prevent errors in pattern classification (1). **Their findings demonstrate that contextual information can influence the classification decision-making of some Bloodstain Pattern analysts.**

This behavior highlights a high degree of subjectivity in Bloodstain Pattern Analysis showing a high vulnerability to the bias.

The NRC report (2) first reached this conclusion and asked the Bloodstain Pattern Analysis to develop a scientific methodology to avoid subjectivity.

Following the definition of Bloodstain Pattern Analysis, **the analyst has to examine the size, shape, distribution and location of the bloodstain to classify it as a pattern.** This step named Bloodstain Pattern Recognition (BPR) precedes the analysis and it has to be reliable and without bias to avoid incorrect analysis most of the time related to awareness of the Police hypothesis and/or the statements of witness and suspect.

This Bloodstain classification is a real challenge due to the lack of a widely accepted and well-defined methodology and the ambiguity often associated with examining bloodstain patterns (3)

The use of physical characteristics for classification is well-known to each of us and especially to the Naturalists since Linnaeus (4).

The goal of this Swedish botanist was to solve the difficulties in classifying of Plants and, more generally, living beings. In his book "Systema Naturae", Carl von Linnaeus gave a list of visible physical characteristics for each living being and Plant.

Thereafter the scientists had simplified this identification based on a list of physical characteristics by the development of an identification key in which the characteristics are organized all together (5).

**The aim of this paper is to present an objective and scientific method to classify the bloodstains with only descriptive criteria including the physical characteristics of the bloodstain and the information about the target where the bloodstain was found.**

## GOALS

### a) Objective method

Considering a bloodstain as a graphic evidence allows us to highlight the characteristics of each defined bloodstain pattern (6).

**Developing an Identification key arrives at a classification based only of the examination of bloodstain and target characteristics without consideration of additional data such detective hypothesis, statements or other forensic analysis.**

### b) Criteria examination and not a descriptive examination

The best way to recognize bloodstain patterns is an accurate examination of the physical characteristics of the bloodstain without forgetting the target.

However, not the all physical characteristics are useful for the classification of the bloodstain studied. We have to focus on criteria (= specifications) which give us the information needed to be able to classify the bloodstain as a defined pattern.

WYSIWYG (What You See Is What You Get) is an acronym well-known to webmaster but could also be a reminder of the reality of the classification of the bloodstains. During our investigations, we see the bloodstain and the target where it is.

A technician trained in Bloodstain Pattern Recognition has to be able to answer dichotomous questions about visible criteria of the bloodstain and of the target to give a reliable classification of the bloodstain studied.

## KEY ISSUES

### a) Contextual information

We have to not take account of the contextual information (witness/suspect statements and detective hypothesis) for the classification of the bloodstains.

**We consider them only at the end of our Bloodstain Pattern Analysis to evaluate the veracity of the statements and the robustness of the detective hypothesis.**

### b) Identification by comparison using CRITERIA

BPA literature does not provide an atlas of each pattern defined by the BPA community.

So, the first step was to compile the bloodstain description buried in books and scientific papers, and to do many experiments to check the descriptive information useful to identify the bloodstain patterns.

An identification by comparison means that we focus on descriptive information allowing a differentiation between patterns. For example, reddish/brownish color is a descriptive information shared by most of the patterns so it is not useful for identifying them.

Then, the second step is to highlight, from the descriptive information specific to each pattern, the characteristics allowing a differentiation of a pattern from the others.

The target where is the bloodstain shows also information needed to classify the bloodstain as a pattern.

These fundamental characteristics from the bloodstain and of the target are what I call the criteria (one criterion, several criteria).

The last step is to tidy those criteria to allow the identification of each pattern through a dichotomous process, keeping in mind that various established patterns could share criteria.

For example an elliptic shape is shared by spatter and drip stain on vertical surface and linear arrangement is shared by cast-off and drip trail.

**So criteria and order of questions are crucial to develop an Identification Key.**

**c) Quantitative/Qualitative data**

Quantitative measures make no sense in the recognition of bloodstain patterns.

Most of the time, it is not feasible to give information about the number of bloodstain for a defined pattern. How many spatters are needed for a Impact Pattern? How many satellites stains defined a Drip Pattern?

Alike, we define a spatter as a minimum and maximum size, not by a specific size, and likewise for the passive stain.

**The only qualitative information from the bloodstain and from the target allows an effective comparison between the established patterns.**

Concerning bloodstain, qualitative information are shape, distribution and location .

Concerning target, qualitative information are its positioning (horizontal/non horizontal), its permeability (porous/non porous) and one time its nature (inside a weapon).

**d) Quality of the criteria used**

Labels using comparative adjectives (like bigger, smaller) have to be removed to avoid confusion and to improve the ease of use.

**e) Measurements**

The effects of the nature of the target and of the source of blood are so important regarding the shape and size of the bloodstains than accurate measures are too restrictive.

Using fixed measurements is questionable except those published following a large study and which have never been objected by the BPA community by another publication or letter to the Editor.

**f) Source & Target Effects**

Their effects on the bloodstain physical characteristics are well-known by the BPA community. For example a drip stain on horizontal surface is circular on glass or linoleum but it more looks to be circular on natural wood or on concrete.

Futhermore, we have to be aware of these effects before answering the questions on the Identification key. Each question allows some freedom of choice that we must restrict during training. This is what trainers do nowadays whatever the method used to classify the studied bloodstains.

**The rough surfaces limits the use of this method of identification.** In front of the effect of the roughness of the target, the technician can not answer a question on the Identification Key.

In this case, he has to stop at the problematic question and the bloodstain classification is all the patterns following the unanswerable question.

Following this classification work , the analyst (= expert) can expressed his opinion about the classification of the studied bloodstain by applying an inductive logic on the data available.

**g) Overlapping patterns Effects**

There are some investigated scenes with overlapping bloodstains on the same target. In these cases, determining specifically which bloodstain are associated with other may be difficult.

**An identification key may be difficult to employ under such circumstances.**

As for the rough surfaces, the BPR technician has to stop at the unanswerable question. The potential classification of the bloodstain are all the patterns following this question without answer.

Once again, following this classification work , the analyst (= expert) can expressed his opinion about the classification of the studied bloodstain by applying an inductive logic on the data available.

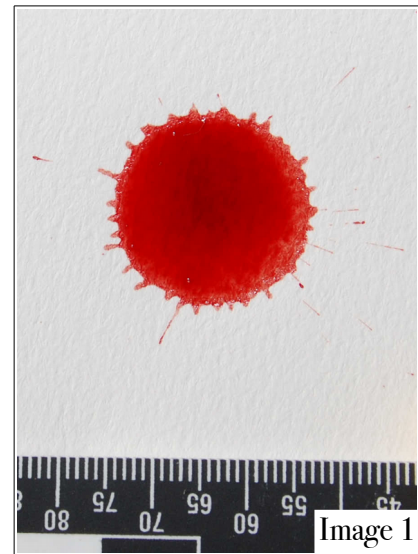
## WYSIWYG METHOD

First at all, without any confirmatory test we must put forward the hypothesis that we are studying blood-stain. At the end of the classification work, each identified pattern has to be sampled to confirm that it's blood.

### a) First example : Drip stain vs Drip trail

A quick description of the Image 1, is:

- Single stain
- Red color
- Spines present all around the stain
- Circular shape
- Diameter more than 3mm  
(according to a publication of Ross Gardner (7))
- A single stain so no distribution defined



This list of characteristics allows to identify the Image 1 as a Drip stain.



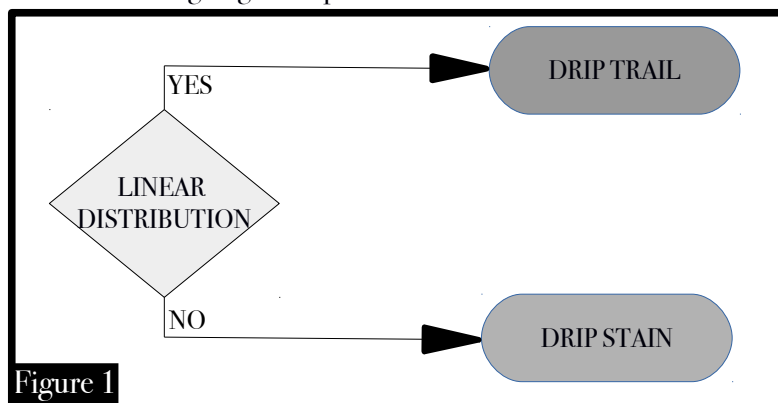
A quick description of the Image 2 is:

- at least 6 stains
- Red stain
- Spines present all around the stain
- Circular shape
- Diameter more than 3mm according to a publication of Ross Gardner (7)
- Linear distribution

This list of characteristics allows to identify the Image 2 as a Drip trail.

**"Linear distribution" appears to be a good criteria to identify "Drip trail" from "Drip stain".**

In the Figure 1, you can see the arrangement of this criterion where answering YES allows going to Drip trail whereas NO allows going to Drip stain.



b) Second example : Spatter vs Impact Pattern vs Expiration pattern

A quick description of the Image 3 is:

- 4 stains
- Red stain
- Elliptic shape
- width ~ 1 mm (less than 4 mm)
- No significant distribution
- the path is upward, left to right



This list of characteristics allows to identify the Image 3 as a Spatter.

**From the first example, the most significant criteria is the shape, elliptic vs circular.**

A quick description of the Image 4 is:

- Multiples stains
- Red stain
- Elliptic to circular shape
- Width ~ 1 mm (less than 4mm)
- Convergent distribution
- the path is upward, left to right



This list of characteristics allows to identify the Image 4 as a Impact pattern.

**From the last pattern, at least two differences exist but the most significant is the distribution.**

In the Figure 2, you can see the arrangement of this criterion where answering YES allows going to Impact Pattern whereas NO allows going to Spatter.

A quick description of the Image 5 is:

- Multiples stains
- Red stain
- Elliptic to circular shape
- Wide range of diameters
- No significant distribution
- Mist arrangement



This list of characteristics allows to identify the Image 5 as a Expiration pattern. The air bubbles within the stains, specific of the Expiration pattern, are not visible here.

**From the two previous patterns, "wide range of diameter" appears to be a significant criteria to identify expiration pattern.**

In the Figure 2, you can see the arrangement of this criterion where answering YES allows going to Expiration pattern whereas NO allows going to other question where the choice are Impact pattern or Spatter.

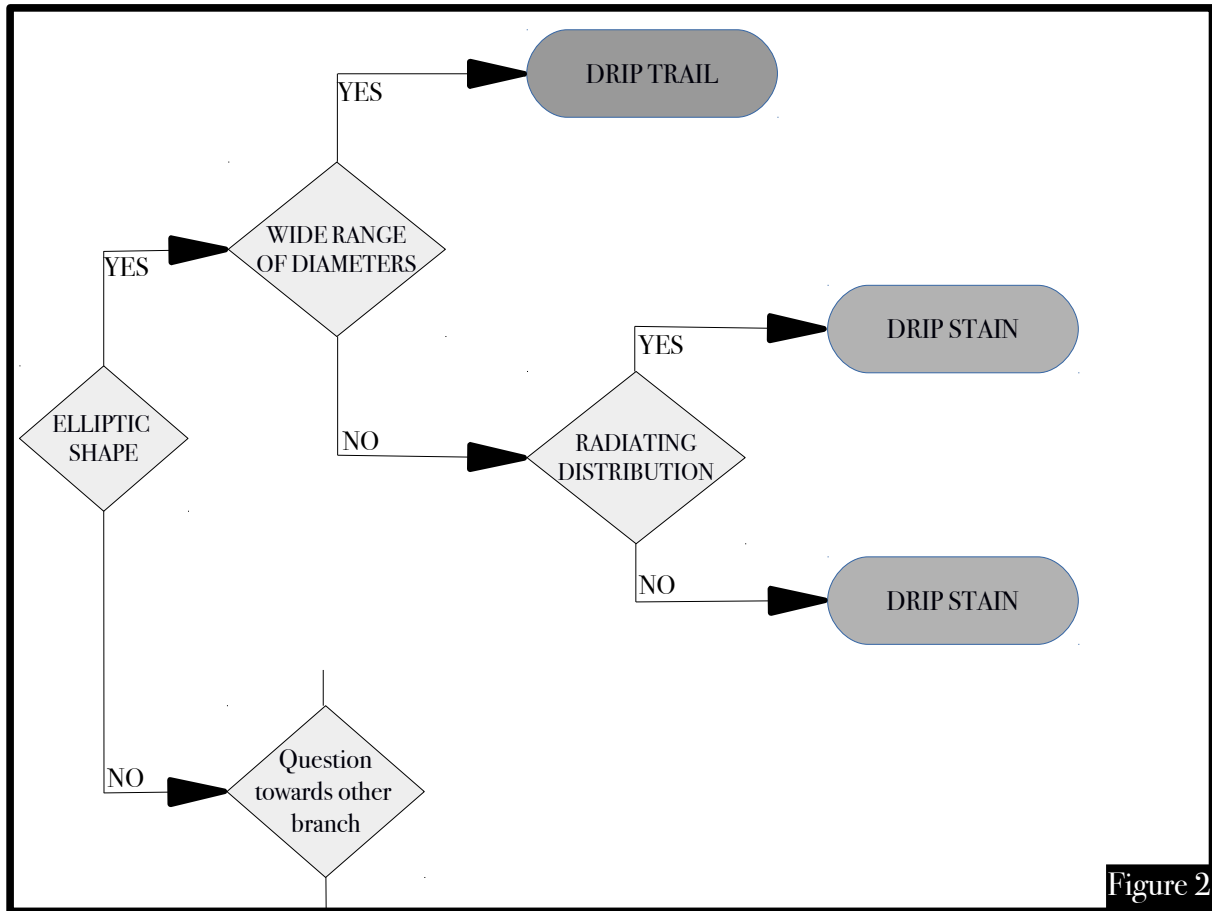


Figure 2

c) Third example : Wipe vs Swipe

A quick description of the Image 6 is :

- Single stain
- Red stain
- Irregular demarcation
- Internal striation
- Blood repartition heterogenous



Image 6

This list of characteristics allows to identify the Image 6 as a Wipe pattern.





A quick description of the Image 7 is :

- Single stain
- Red stain
- Irregular demarcation again
- Internal striation again
- Blood repartition heterogenous
- Connection to an altered circular stain which should be pre-existing the pattern

This list of characteristics allows to identify the Image 7 as a Swipe pattern.

**So, to differentiate a swipe from a wipe, using the criteria of the pre existing pattern is the best way.**

In the Figure 3, you can see the arrangement of this criterion where answering YES allows going to Wipe pattern whereas NO allows going to Swipe pattern.

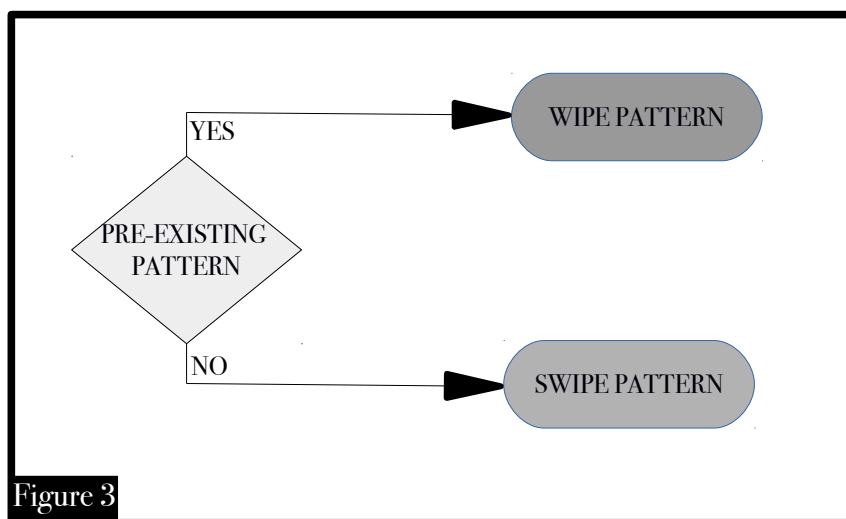


Figure 3

## IDENTIFICATION KEY

Everybody knows these differences between the patterns but nobody had the idea of arranging all these criteria one after the other to build an Identification Key<sup>1</sup>.

An identification key assists the BPR technician or the analyst to identify correctly bloodstains on horizontal and non horizontal smooth surfaces. The identification key avoids the bias related to the information coming from the detective hypothesis and/or witness statements.

<sup>1</sup>: I develop the Identification Key process since 2006. My first attempt of IK (with 17 patterns) participated to the creation of the Map decision of the chapter 4 of the 3<sup>rd</sup> edition of the Bevel & Gardner book in 2008

**There is not an only single IK chart. Many Identification Keys could be developed.**

**At least each IK has to:**

- 1. be based on descriptive criteria from the bloodstains and from the target**
- 2. only use closed questions (YES/NO answer).**

**Even if it follows these requirements, the Identification Key attempt has to be tested to check its robustness, repeatability between examiners and the reproducibility for each examiner.**

**These factors are ISO defined and crucial to demonstrate the good efficiency of a new procedure.**

The presented Identification Key (Fig. 4) follows the recommendations developed in this paper and had been tested. Obviously, This IK is a living tool which can be still improved by the comments of the users.

**The goal of this Identification Key is no more than classify the bloodstains studied. The IK does not provide a complete description of each pattern.**

To avoid writing too much information on the Figure 4, answering YES allows to go upwards whereas answering NO allows to go downwards.

Answering a question eliminates the path not chosen and all its' questions and patterns.

In the presented IK, there are more patterns than the recommended terminology published by SWGSTAIN (8). As French, I use the French BPA terminology (9) which included FOYER OF IMPACT PATTERN (circular spatters on the convergence area), GRAVITATIONAL SPATTER (spatters going downwards following the Gravity Force), TRANSFER ALTERATION (a shape without blood inside blood), NON IDENTIFIABLE STAIN (no classification possible) and DRAWBACK EFFECT (bloodstains inside a weapon resulting of the gaz effect).

This Identification Key is the results of many drafts since 2006. My first attempt with 17 patterns had participated to the development of the Map Decision published by Tom Bevel & Ross Gardner in the third edition of their book (10).

**If the Analyst (=Expert) has to know how using the Identification Key, the work could be done by a technician specifically trained to the use of Identification Key (BPR technician) who will give his results of classification (a list of patterns) to the analyst.**

**The following step is the analysis of those classified bloodstain (Bloodstain patterns analysis) to provide the most consistent explanation of what events could have, or not, created the patterns on the scene investigated which is the real job of the Bloodstain Pattern Analyst.**





## CONCLUSION

Last year, a study funded by the U.S. Department of Justice showed that case information influences the results of the bloodstain Pattern Analysis significantly (1).

At least the study demonstrated that most of the Bloodstain Pattern Analysts engaged in this study coming from all around the world takes the case information into account and those contextual information (detective hypothesis and witness/suspect statements) influences the results of the bloodstain pattern analysis.

**Futhermore, the study concludes that it should be better that the Bloodstain Pattern Analysts are not aware of the case information before doing the recognition of pattern to be bias-free as possible (1).**

Identify the bloodstain patterns without detective hypothesis or witness/suspect statements is essential to be bias-free. **What You See Is What You Get and you only can examine the stains and their targets (descriptive information).**

**The descriptive information concerning the bloodstains and their targets have to be the only source of information for an objective classification of the bloodstains studied as patterns.** Arranging those descriptive information in a chart builds a Identification Key.

**A classification key:**

- **provides a robust classification, the base for the development of the most consistent explanation** of what events could have or could not have created the patterns on the scene investigated .
- **demonstrates to the court that the bloodstain pattern analyst (= expert) uses a consistent and repeatable methodology for the evaluation of bloodstains.**
- **is accepted as a scientific method.**
- **is easy to use.**

This Identification Key is the base of an ISO 17020 accreditation in 2014 of all my Bloodstain Pattern Analysis procedures.

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