



The Effect of Cleaning Agents on Presumptive Blood Tests and DNA Analysis of Bloodstains

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Introduction

- Presumptive blood tests are used at crime scenes to examine suspicious stains or to detect the presence of blood.
 - Presence is indicated with fluorescence or a color change.
- Luminol, Bluestar, and Kastle-Meyer are the most commonly used.¹
- Attempts to remove bloodstains with household cleaners to destroy evidence are often made.
- Sodium percarbonate and sodium hypochlorite, common in household cleaners, affect the accuracy of presumptive blood tests.¹⁻³
- Cleaning agents can also degrade DNA and affect DNA analysis.³
- This review studies how household cleaners can affect presumptive tests and DNA analysis.

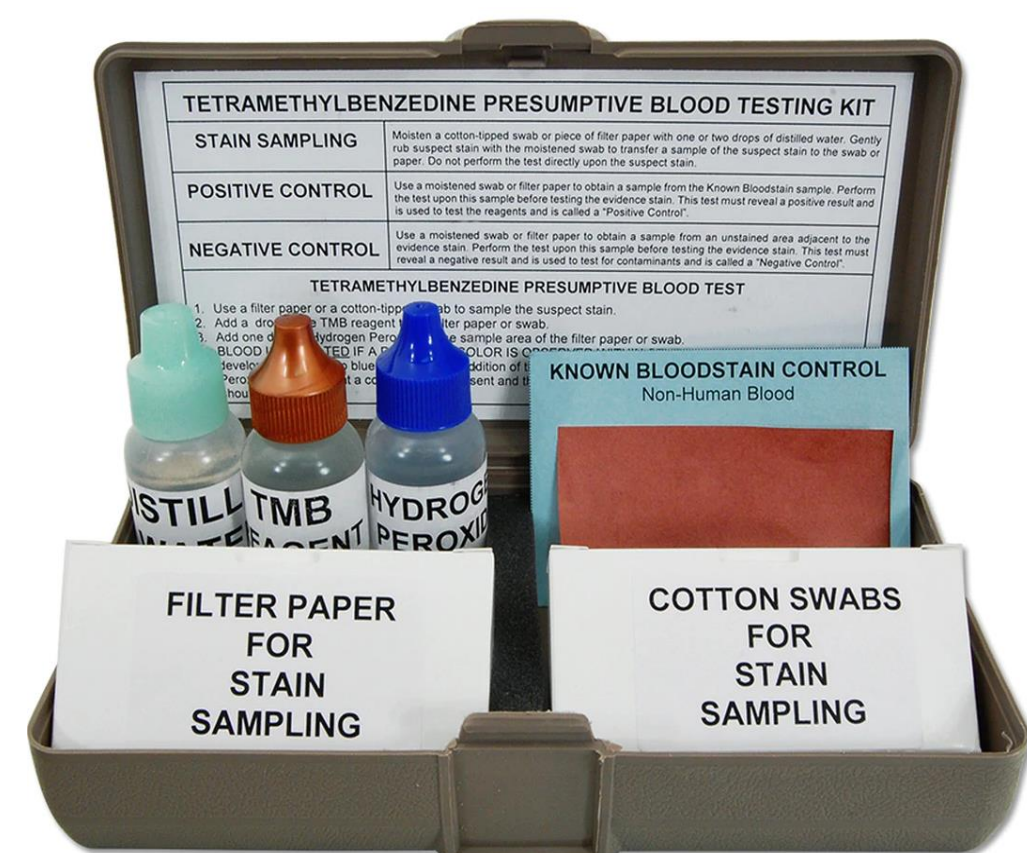


Figure 1. Presumptive blood test kits commonly come with a positive control, filter paper or swabs for collecting a sample, and reagents to apply to the sample.⁴



Figure 2. Detergent, bleach, and stain removers are common household cleaners that contain sodium hypochlorite and sodium percarbonate.⁵

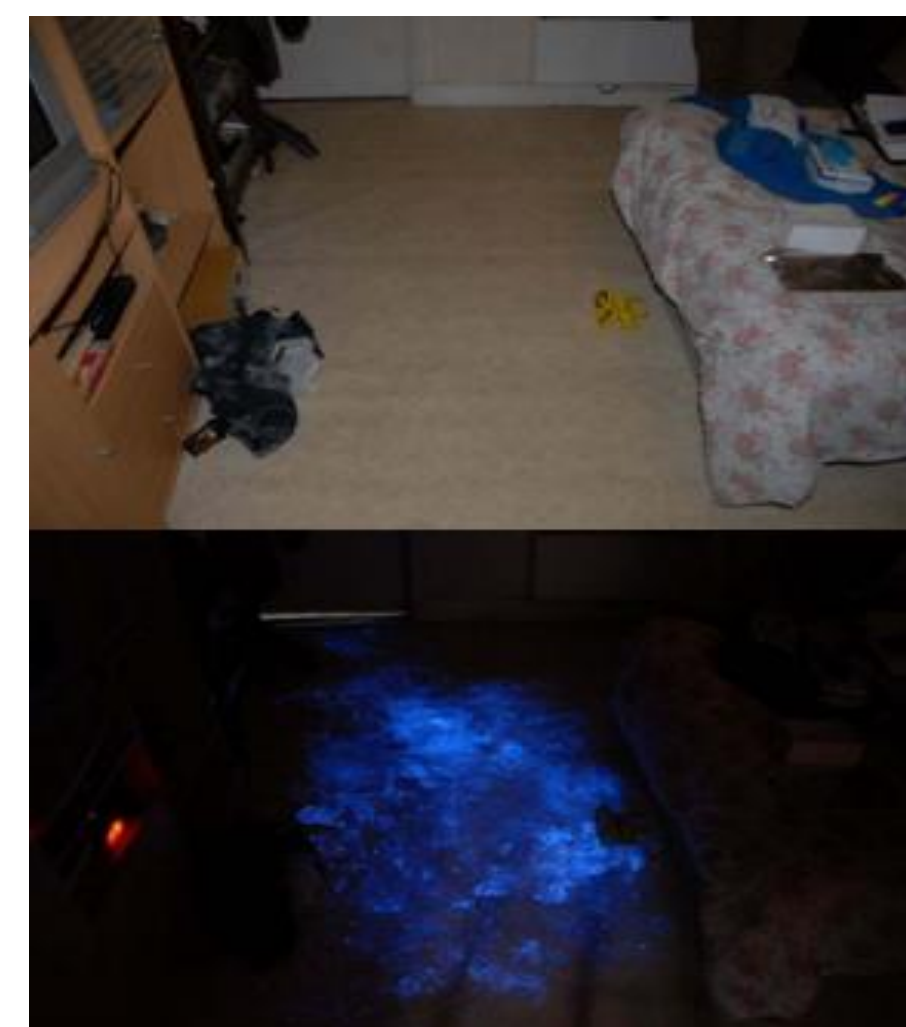


Figure 3. Luminol, a type of presumptive blood test, reacts with the iron in blood and produces a chemiluminescence to enhance unseen bloodstain patterns.⁶

Methods

- The study was divided into two concepts: The effects washed bloodstains have on presumptive blood tests and DNA analysis.
 - Focus on cleaners that utilize sodium hypochlorite or sodium percarbonate.
 - Focus on luminol, Bluestar, and Kastle-Meyer presumptive blood tests.

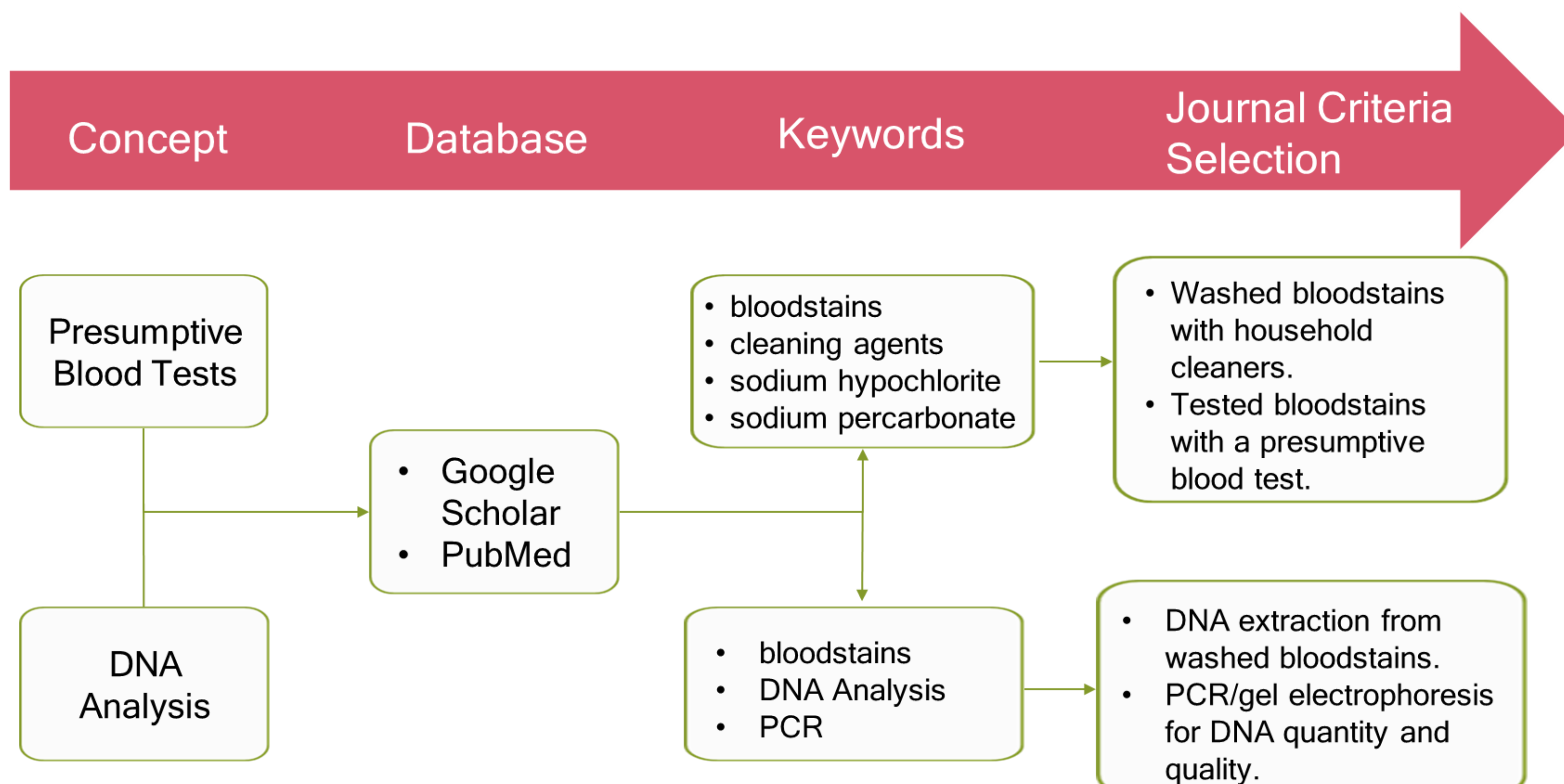


Figure 4. The databases, keywords, and criteria used to select journal articles for the study.

Results

- Sodium hypochlorite alone can produce false positives.⁷⁻⁸
- Sodium hypochlorite and sodium percarbonate on washed bloodstains diminishes the color of presumptive blood tests.^{2,8}
- Luminol, Bluestar, and Kastle-Meyer do not always detect bloodstains that are washed with sodium percarbonate.¹⁻²
 - Kastle-Meyer was the most sensitive.²
- Sodium hypochlorite and sodium percarbonate had some DNA degradation on porous and nonporous surfaces.⁹⁻¹⁰
 - DNA profiles could be obtained more often from porous surfaces than nonporous surfaces.¹⁰
 - Porous surfaces provided the highest DNA quantity and quality.⁹⁻¹⁰
 - Porous surfaces were able to retain more blood for better stain visualization and DNA extraction than nonporous surfaces.¹
- More DNA profiles were obtained from sodium hypochlorite treated bloodstains than sodium percarbonate bloodstains.⁹
 - Sodium hypochlorite provided the highest DNA quantity and quality.⁹

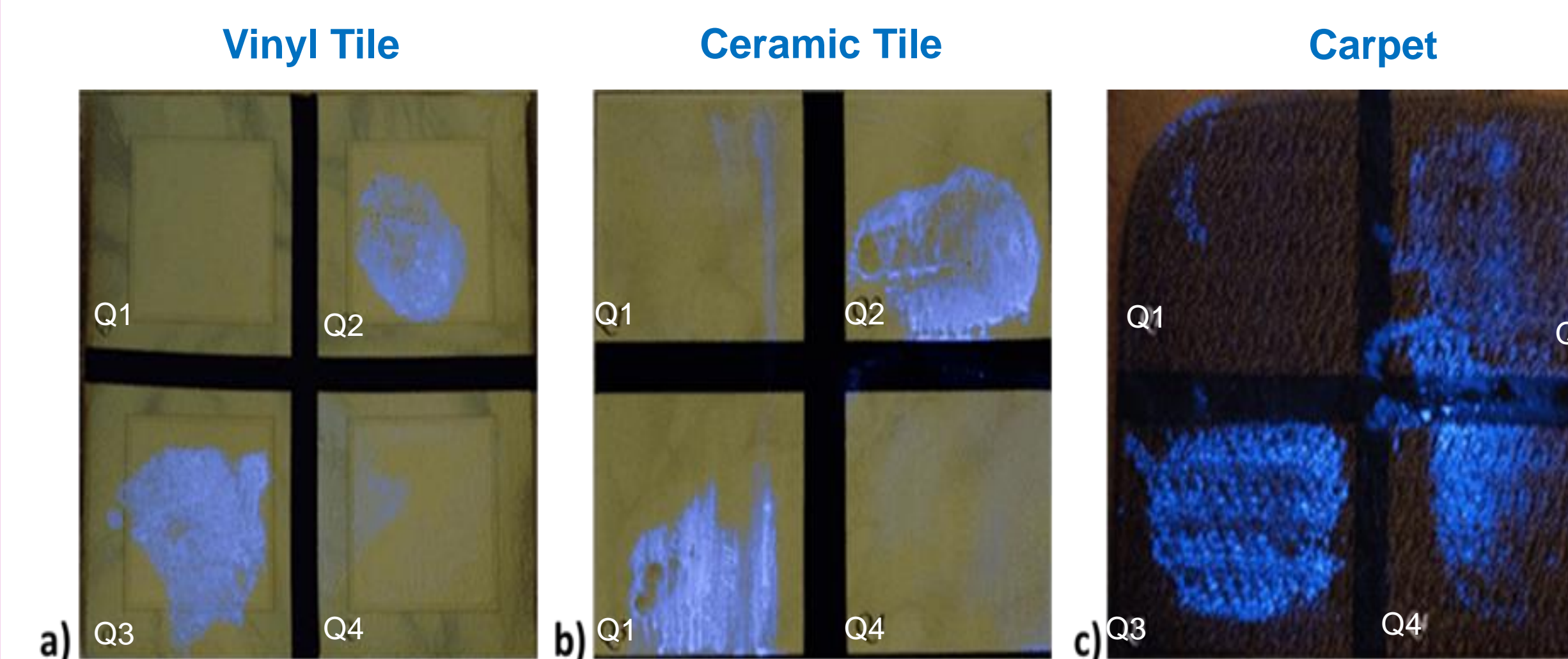


Figure 5. Bluestar sprayed on: a) vinyl tile, b) ceramic tile, and c) carpet, divided into four quadrants: Q1 was wiped with once with bleach, Q2 had blood, Q3 had blood and was wiped once with bleach, and Q4 had blood and was fully cleaned with bleach.⁸

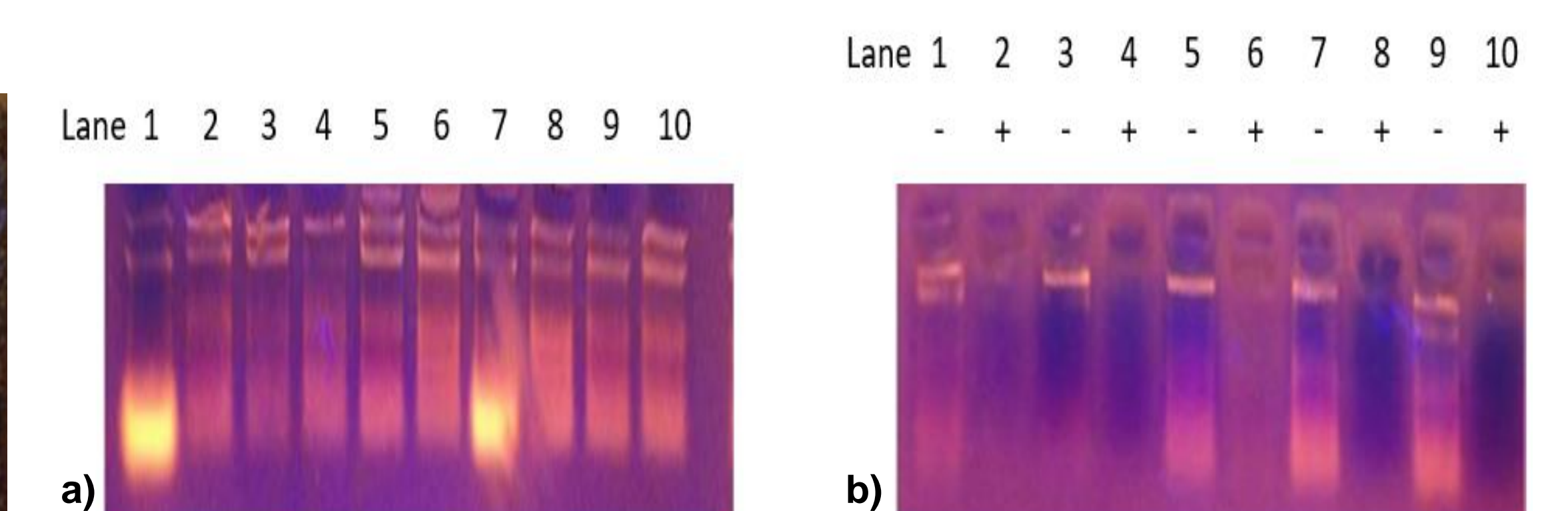


Figure 6. Photographs of agarose gel electrophoresis of DNA extracted from cotton cloth. Picture a) shows DNA bands of standard samples without any treatment. Picture b) shows DNA bands of bleach and luminol treated samples. In picture b), (+) indicates lanes with bleach treated DNA and (-) indicates lanes with luminol treated DNA. Standard and luminol treated samples showed intact DNA bands compared to the sheared DNA bands of bleach treated samples.³

Discussion/Conclusion

- Sodium hypochlorite reacts with hydrogen peroxide from presumptive blood tests and creates false-positives.⁷
- Catalase enzyme in blood converts sodium percarbonate into hydrogen peroxide to break down blood.^{9,11}
 - Presumptive tests will produce little to no chemiluminescence or color change.
- Visual examination is used to examine chemiluminescence.
 - Misinterpretations can lead to false positives or false negatives.
 - Diminished or absence of chemiluminescence of washed bloodstains can lead to misinterpretations.
- DNA quantity and quality is negatively affected by high concentrations of household cleaners and nonporous surfaces.
- Crime scene investigators should take into consideration that bloodstains could be washed with cleaners.
- Additional studies could explore using different cleaners, presumptive blood tests, washing techniques, and/or substrates.

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