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Recovering DNA from biological fluids: effects of surface, time and collection method

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Abstract

Background: The forensic value of bodily fluids depends on their detection and the recovery of DNA of sufficient quality for profiling [1]. This is influenced by pre-analytical factors (e.g., substrate type, environmental exposure, time since deposition) and collection methods, which affect the persistence and interpretation of traces [2,3]. **Objective:** To review literature on DNA recovery from bodily fluids, focusing on the influence of substrate, time, environmental conditions, and sampling strategies on DNA yield and profiling success. **Methods:** A systematic review following PRISMA guidelines was conducted using PubMed, Google Scholar, and ScienceDirect. Search terms included "*bodily fluids*", "*DNA recovery*", "*DNA transfer*", "*DNA persistence*", and "*forensic analysis*". Studies published between 2021–2026, in English, full-text, and using human samples were included. After screening, 63 studies were selected for qualitative analysis. **Results:** Substrate type was a major determinant of DNA persistence and recovery. Porous materials retained DNA longer, while non-porous surfaces allowed higher initial recovery but faster loss under environmental exposure. Surface features influenced deposition and persistence; challenging materials (e.g., brass, TiO_2-coated glass) were linked to reduced recovery and poorer profiles. DNA quantity and profile completeness declined over time, with variation by fluid and conditions. Blood and semen were more stable, whereas saliva and touch DNA were more variable and technique-dependent. Environmental factors consistently drove degradation and variability. Low or negative qPCR results did not always predict STR failure. Sampling strategy strongly affected recovery: swab type, technique, wetting, and operator performance influenced yield. No single method was optimal; swabbing suited many non-porous surfaces, while tape-lifting, cutting-out, or vacuuming were better suited to specific contexts. Substrate and environmental exposure were the most consistent factors affecting recovery and profiling success. **Conclusions:** DNA recovery is context-dependent, particularly with respect to substrate, environment, time, and sampling strategy. Evidence supports adapting collection methods rather than applying uniform protocols, though further validation is needed. Variability in study design limits comparisons, highlighting the need for standardisation and controlled studies to improve forensic interpretation.

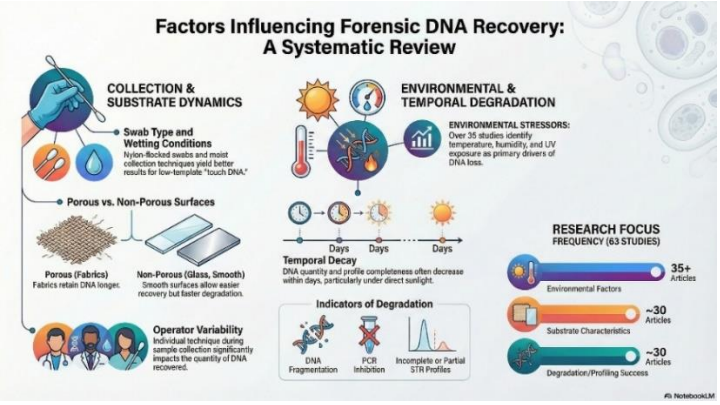

Figure 1. Overview of the main factors influencing forensic DNA recovery identified in this systematic review.

Keywords: body fluids; DNA persistence; DNA recovery; forensic genetics; surfaces

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