

# Artificial Intelligence (AI) in Forensic Science Use Case Explorer

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## Introduction

Using the Special Programs Office's broad forensic science experience and the ITL's deep expertise in AI/ML, the AI in Forensics project team is cataloging and characterizing specific challenges facing forensic science service providers that AI-enabled systems may solve. The catalog of use cases will describe complex real-world tasks and problems and transformative AI opportunities relevant to forensic science practitioners and researchers.

Each use case comprises:

- 1) a user story, 2) a description of current state without AI, and
- 3) the opportunities that AI has to transform the current state.

Each Use Case Can:

- Spark innovation in developers of AI-enabled solutions.
- Match with AI-enabled tools currently available in the marketplace.
- Provide the context needed to develop the standards, testing, and evaluation frameworks that are necessary for responsible adoption and use

## Examples In Use Case Inventory

- Rapid Drug Identification
- Orient Images
- Classify Objects
- Create Simulated Samples
- Simulate Complex DNA Samples
- Label Samples
- Authenticate Images
- Perform Moot Court Challenges
- Monitor Testimony
- Estimate Case Duration
- Blind Forensic Examinations

## Orient Footwear or Footprint Marks

### 1. USER STORY

As a footwear examiner, I want to correctly orient footwear or footprint marks for accurate feature assessment and comparison so that I can increase efficiency and enhance reliability.

### 2. DESCRIPTION OF CURRENT STATE

Footwear examiners currently manually orient footprint marks for comparison with reference prints.

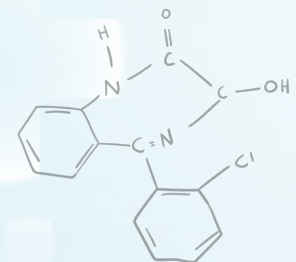
This involves:

- Determining initial orientation and adjusting manually or with image processing tools to align with reference prints.
- Ensuring tread patterns, wear marks, and unique identifiers are correctly positioned for comparison.
- Addressing issues like stretching or smudging that affect orientation.
- Checking alignment accuracy and keeping records of adjustments for transparency and reproducibility.

### 3. AI OPPORTUNITIES

AI has transformative potential if it can:

- Automatically detect and correct orientation, aligning prints with references.
- Improve visibility of key features like tread patterns and wear marks.
- Handle distortions such as stretching or smudging to ensure proper orientation.
- Verify orientation accuracy by comparing prints with known references.
- Provide real-time feedback and adjustments during the orientation process.
- Document and report the orientation process with detailed logs and visual representations.
- Integrate seamlessly with existing forensic tools to enhance print orientation and comparison workflows.



# Automatically Document Case Communications

## 1. USER STORY

As an investigator or forensic scientist, I want to automatically document all case-related communications so that all information exchanges, requests, and updates are accurately recorded, reducing manual effort and ensuring transparency and traceability.

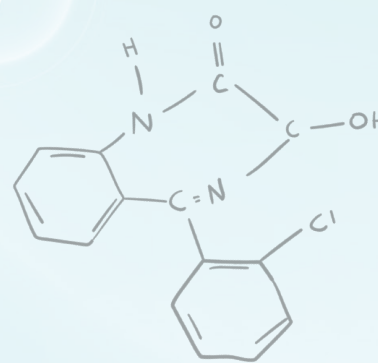
## 2. DESCRIPTION OF CURRENT STATE

Documenting communications often requires manual note-taking or transcribing details from phone calls, emails, and meetings into case management systems. This process is time-consuming, prone to errors, and diverts focus from analytical work, risking incomplete documentation and impacting the transparency and defensibility of forensic processes.

## 3. AI OPPORTUNITIES

AI has transformative potential if it can:

- Automate data interpretation, quickly matching chemical signatures to databases.
- Create a no-touch system for analysis.
- Improve detection accuracy, even for mixed or new substances.
- Identify patterns or anomalies indicating contamination or novel drugs.
- Provide real-time analysis feedback to guide further testing.
- Automate quality control, ensuring data integrity without manual checks.
- Generate detailed reports to streamline documentation.
- Integrate with laboratory systems, optimizing workflows



# Rapid Identification of Drug or Other Chemical Samples

## 1. USER STORY

As a forensic chemist or law enforcement agent, I want to rapidly identify drug or chemical samples from crime scenes or suspects so that I can access real-time information to inform next steps at a scene, traffic stop, or laboratory.

## 2. DESCRIPTION OF CURRENT STATE

**Forensic chemists currently identify drug or chemical samples using several manual and instrumental steps:**

- Extracting, purifying, or diluting samples for testing.
- Employing GC-MS, HPLC, or IR spectroscopy to detect compounds.
- Comparing results with reference libraries, requiring expertise.
- Addressing mixed, novel, or low-quality or quantity samples.
- Conducting quality checks and documenting results.

## 3. AI OPPORTUNITIES

**AI has transformative potential if it can:**

- Automate data interpretation, quickly matching chemical signatures to databases.
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- Automate quality control, ensuring data integrity without manual checks.
- Generate detailed reports to streamline documentation.
- Integrate with laboratory systems, optimizing workflows.

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