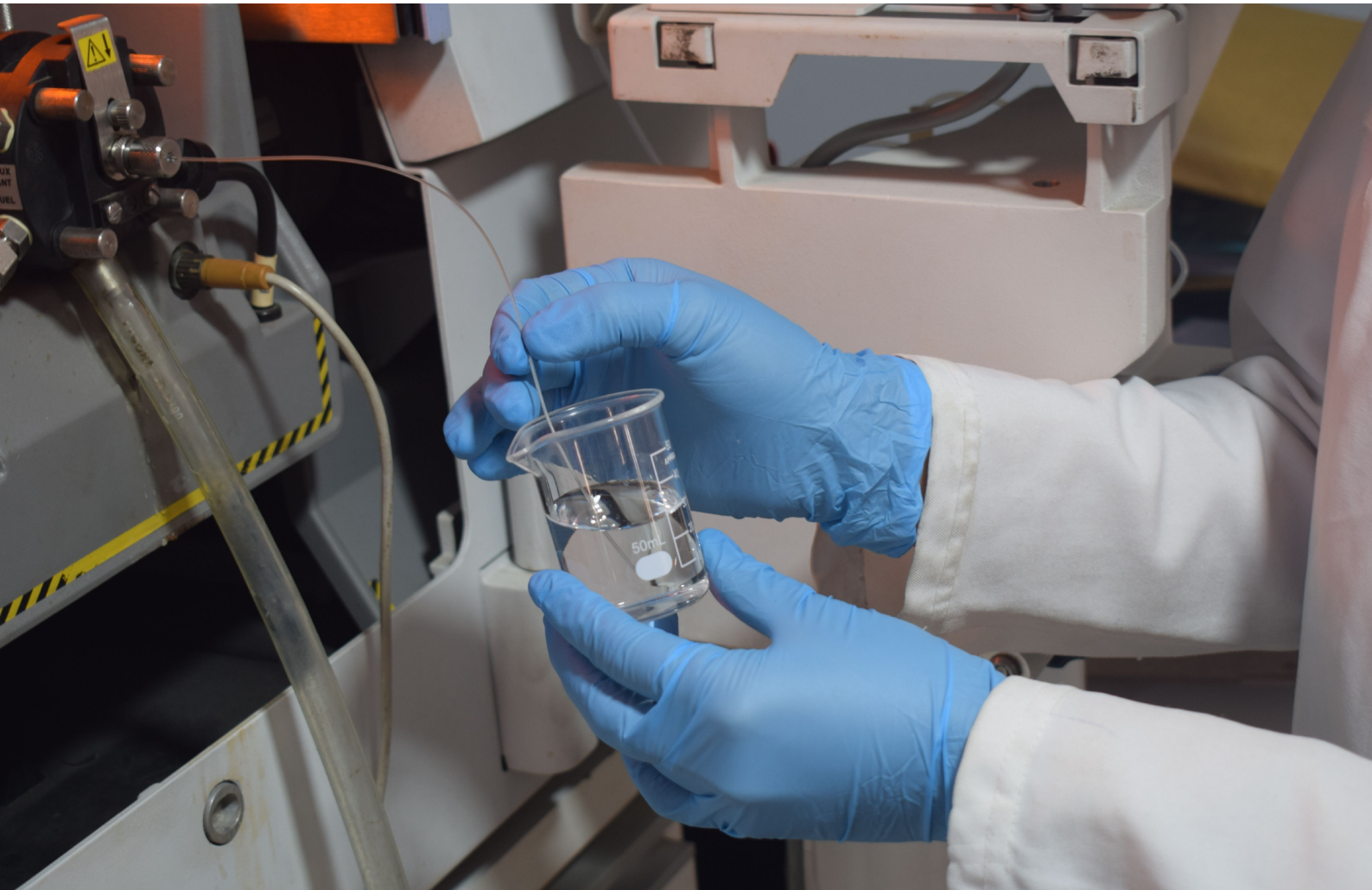




# Strengthening Forensic Measurement Reliability in Brazil to Support Public Health and Justice

INMETRO, with support from Senasp, has developed a national proficiency testing (PT) program and certified reference materials (CRMs) for blood alcohol and drug identification and quantification to strengthen forensic evidence

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## The Challenge

Brazilian forensic laboratories play a critical role not only in the criminal justice system but also in public health, particularly in cases involving drug use and blood alcohol concentration. Reliable measurements in toxicology and drug analysis directly impact road safety policies, prevention strategies, and health-related legal decisions.

Until 2020, Brazil lacked a national provider of proficiency testing (PT) schemes for forensic analysis, forcing laboratories to rely on costly, complex international providers. In addition, the absence of mandatory national standardization for analytical methods created challenges in ensuring the comparability and reliability of results across laboratories.

## The Solution

To address this gap, the National Institute of Metrology, Quality and Technology (INMETRO) implemented a national PT program in forensic chemistry and toxicology, supported by the National Secretariat of Public Security (Senasp). The PT program includes the following metrology-based components:

- Annual exercises (i.e., rounds) for drug identification and quantification (forensic chemistry) and blood alcohol determination (toxicology)
- Development and distribution of test samples, including increasingly complex matrices (e.g., transition from water simulants to human blood)
- Statistical evaluation and comparison of participant results to assess laboratory performance
- Provision of metrologically traceable measurements and structured feedback to participating laboratories
- Integration with existing metrological infrastructure, including certified reference materials (CRMs) used for instrument calibration, quantification, and confirmation of drug identity
- Nationwide logistics in collaboration with the Federal Police, ensuring sample distribution across all Brazilian states

The PT program also supports compliance with ISO/IEC 17025, ISO 17043, and ISO 17034 requirements, particularly regarding external quality assurance.

Implemented in 2021, the program has successfully completed five rounds to date. Future rounds are planned to continue annually, with forensic chemistry exercises scheduled for the first half of the year and forensic toxicology exercises for the second half.

## **A Quantifiable Impact**

The program has had wide national participation, with approximately 60 laboratories participating in drug analysis PT rounds and about 25 in alcohol testing annually, covering most official forensic laboratories across the 26 Brazilian states and the Federal District. These participants are geographically dispersed across the country, with distances reaching up to 4 300 km — for example, between Porto Alegre (in the south) and Boa Vista (in the north).

An improvement in measurement reliability has also been observed by regular participation, enabling laboratories to monitor performance, identify issues, and improve analytical procedures, as well as directly support public health policies and road safety enforcement. The PT report provides valuable information on participants' performance, including discussions of potential sources of bias, which support improvements in their quality systems.

With the implementation of this program, cost savings of approximately BRL 680 000 (USD 136 000) were estimated over five years compared to international PT providers, due to the elimination of import costs and PT fees. Furthermore, the logistics for distributing PT samples, supported by the Brazilian Federal Police, enable the nationwide dissemination of drug-based CRMs produced by INMETRO. Over the period 2021–2026, a total of 1 113 CRM units were distributed, comprising cocaine and its metabolites, benzodiazepines, amphetamines, and drug adulterants, at no cost to forensic laboratories. This initiative corresponds to an estimated cost saving of over BRL 4.4 million (USD 890 400).

An improvement in measurement comparability across forensic laboratories has been observed. The program ensures consistent results, supporting national databases and investigative processes. In the forensic chemistry PT program, participants receive three different samples annually (**Figure 1**), comprising drugs and adulterants controlled in Brazil. To date, PT items have included drugs such as cocaine, MDMA, flunitrazepam, clobenzorex, and fluoxetine; new psychoactive substances (NPSs), including N-ethyl pentylone and PMMA; adulterants such as caffeine, acetaminophen, benzocaine, lidocaine, phenacetin, and metamizole; and the amphetamine precursor piperonal (**Figure 2**). The diversity of substances included in the PT rounds enables comparison of participant performance across different chemical classes, thereby reflecting the challenges encountered in routine forensic practice. The option to report quantitative results (drug purity) was introduced from Round 3 onward, thereby providing an additional tool for more advanced laboratories. Blood alcohol PT samples (two samples per round) range from (1.5 to 34.8) dg/L, posing varying analytical challenges to toxicology laboratories. Additionally, the program promotes continuous technical development by progressively increasing test complexity and fostering knowledge



**Figure 1.** PT items from the PT for seized drugs (Round 5) in 2026. The three samples are labeled as “A”, “B”, and “C”. These contained: A) cocaine/phenacetin/lidocaine, B) MDMA/piperonal/microcrystalline cellulose, and C) blank control (microcrystalline cellulose only). Notably, the contents were not disclosed to participants.

exchange among laboratories, and facilitates compliance with ISO/IEC 17025, encouraging more laboratories to pursue accreditation.

As a result of this national forensic PT program, awareness of the value of this metrology-based national service has increased, thereby positively impacting the public policy sector. According to Mr. Rafael Friedrich Davet, a forensic expert at Senasp,

*“From Senasp’s perspective, the PT Program plays a strategic role in strengthening the quality, reliability, and comparability of forensic results across Brazil. I believe this initiative directly contributes to more robust forensic evidence and, consequently, to a stronger and more qualified criminal justice system.”*

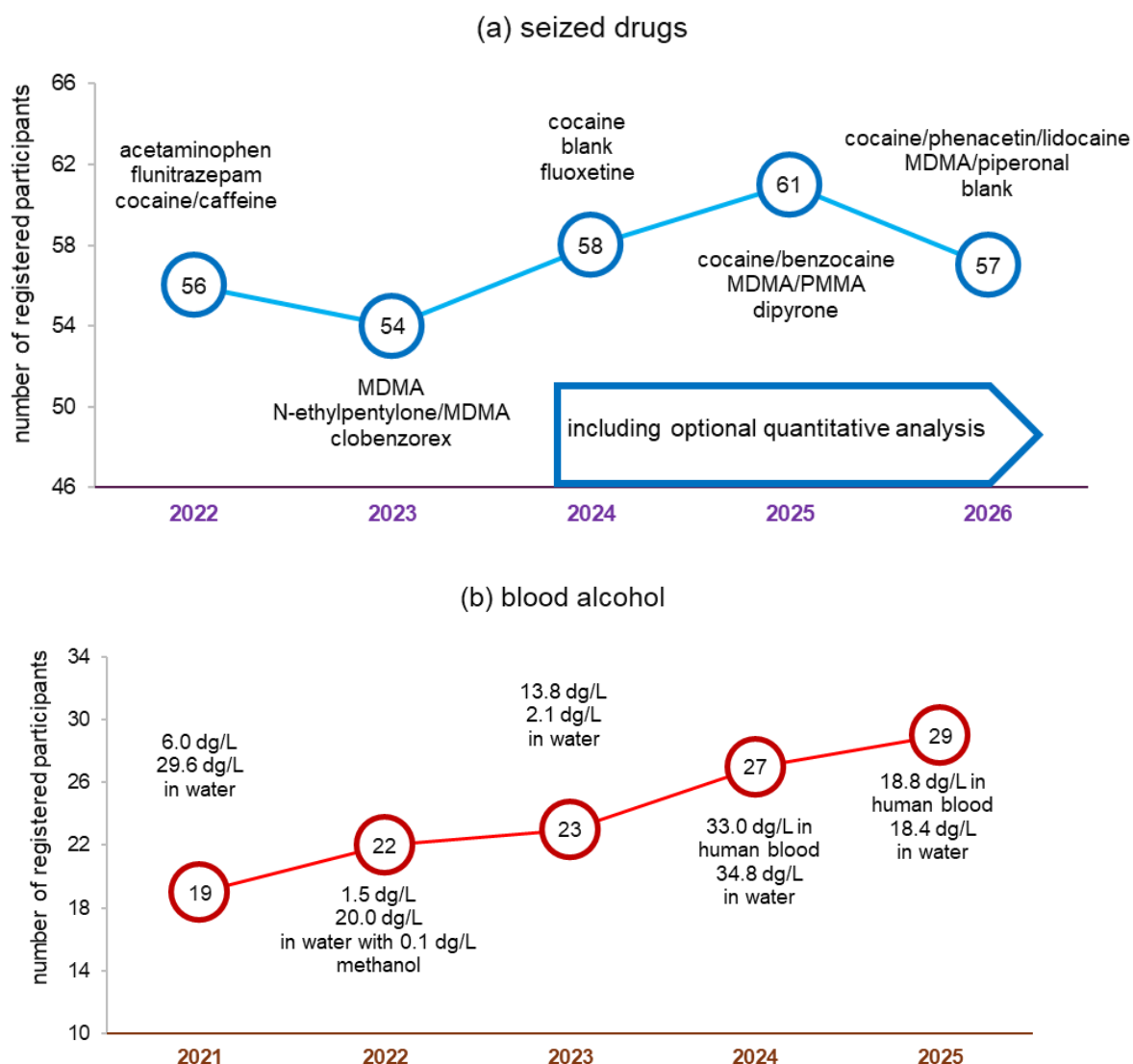


**Figure 2.** An overview of PT rounds and the number of registered participants between 2021 and 2026 for (a) seized drugs and (b) blood alcohol.

The PT program has also strengthened the scientific basis of forensic evidence, directly contributing to more reliable judicial decisions and improved public security outcomes. Participants' results are not publicly disclosed due to PT confidentiality requirements. However, senior management of public security agencies (Senasp and, where applicable, the Brazilian Federal Police) is granted access to the results to identify weaknesses in the forensic system (based on laboratory performance) and to develop public policies aimed at improving the quality of examinations.

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