National Academies Committee on Identifying the Needs of the Forensic Sciences Community

Standards for Drug Analysis and Identification

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U.S. Department of Homeland Security

United States Secret Service

Summary of Significant Experience

1. Laboratory Director, United States Secret Service: 2006 - Present
2. Drug Enforcement Administration: 1988 – 2006
3. Naval Criminal Investigative Service: 1981 – 1988
4. St. Louis County Police Department Laboratory: 1974 – 1981
5. Secretary: American Academy of Forensic Sciences 2007
6. Vice-President: American Academy of Forensic Sciences 2006
7. Scientific Work Group on Seized Drugs: 1997 - 2005

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Drug Analysis and Identification

1. What is the state of the art?
2. Where is the research conducted?
3. Where is the research published?
4. What is the scientific basis for the interpretation of the data and preparation of the results of analysis from the evidence?
5. What are the major problems in the foundation, methods and practices of forensic drug analysis?
6. What research questions need to be answered?

Overview of the Forensic Analysis and Identification of Drugs

1. Drug analysis cases make up the largest number of evidence submissions to law enforcement forensic science laboratories across the United States.

2. In some states, police officers can conduct a color ("presumptive") test for marijuana which may be used in court if the accused does not contest the identification.

3. Statistically based sampling issues and report writing are topical because they can impact how conclusions are formulated and presented.

Overview of the Forensic Analysis and Identification of Drugs

4. All samples are different; however, there are required protocols which can be followed in the handling of evidence packaging and the identification of drugs.

5. Drug types vary from the simplest of controlled substances, marijuana, to sophisticated designer drugs. The types of analyses vary accordingly.

6. No matter how simple or sophisticated the controlled substance, one fact remains – the data/documentation must support the conclusion.

What is the state of the art in forensic drug analysis and identification?

1. Within the limits of scientific certainty and beyond a reasonable doubt, it is possible to positively identify a drug to exclusion of all other substances.

2. There are cases where a drug cannot be positively identified because of concentration or quantity, and the data, while available, might not be adequate to positively identify the drug.

What is the state of the art in forensic drug analysis and identification?

3. Controlled substances should only be identified by comparing the data from the evidence (the unknown) to data generated by a traceable standard which has been analyzed by the same instrument under the same run conditions. The data from the known and the unknown must be comparable.

Where is forensic drug analysis research conducted?

There are laboratories which conduct research in enhancing the methods for identifying controlled substances, precursors, listed chemicals and chemical intermediates.

1. Universities with forensic science programs conduct relevant research
2. DEA laboratories conduct some research into the identification of these substances. There are also other federal, state and local laboratories which have published studies in the identification of controlled substances and other drugs.

Where is forensic drug analysis research presented?

There have been many papers presented at national, international and regional forensic science meetings dealing with the identification of controlled substances. These include the American Academy of Forensic Sciences (AAFS), the International Association of Forensic Sciences, the Mid-Western, Mid-Atlantic, Southwestern, Northeastern, Southern and Northwestern Associations of Forensic Scientists, as well as the California Association of Criminalists meetings.

Where is the research in forensic drug analysis published?

Significant publications describing research into forensic drug analysis include, but are not limited to:

1. Journal of Forensic Sciences
2. Journal of Chromatography
3. Science and Justice
4. Forensic Science International
5. Microgram
6. Forensic Science Reviews

Where are the standards for forensic drug analysis published?

1. Scientific Working Group for the Analysis of Seized Drugs Recommendations
2. ASTM Standards

What is the scientific basis for the interpretation of results?

1. The interpretation of reviewable data forms the basis for the identification of controlled substances.
2. In most instances the scientific data is in the form of mass spectrometer (mass selective detector), infrared spectroscopy, or nuclear magnetic resonance spectrometer data.

What is the scientific basis for the interpretation of results?

3. Microcrystal tests are used in some laboratories for identifications. However, there are requirements that when these crystals are viewed under a microscope, another analyst must confirm the identification and verify that the crystal is formed by a controlled substance. This remains a controversial area for discussion among drug analysts.

What is the scientific basis for the interpretation of results?

4. Tests can range from simple screening tests, where color changes occur, to nuclear magnetic resonance spectroscopy, where three dimensional, structural analyses of drugs samples are possible.
5. Chromatographic separation techniques which, while not specific provide information regarding the identity of a controlled substance, and can provide corroborating data.

What is the scientific basis for the interpretation of results?

6. The Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG) has established standards in the form of recommendations used by laboratories world-wide for the analysis and identification of drugs including controlled substances. These standards were vetted through practitioners in the United States, Canada, Europe, Asia, Australia and South America for approximately three to five years before they were adopted. The standards were then adopted by ASTM.

Instrumental Methods of Analysis

Gas Chromatograph/Mass Spectroscopy (GC/MS)

GC/MS is the most commonly used technique to identify controlled substances. The limitation is in its ability to identify the salt form from the base (distinguishing cocaine base from cocaine hydrochloride). This method also has limitations for compounds which degrade under high temperature such as gamma hydroxybutyrate (GHB). There are questions associated with identifying geometric isomers of some controlled substances (methamphetamine from phentermine) because of similar fragmentation patterns.

Instrumental Methods of Analysis

Fourier Transform Infrared Spectroscopy (FTIR)

FTIR is the most specific technique used to identify the salt form of a controlled substance (distinguishing cocaine base from cocaine hydrochloride); however, the technique requires a relatively pure sample. The methods works very well for pure drug samples where the drug of interest can be separated from the tablet, powder or liquid. This usually requires time and a knowledge of chemistry.

Instrumental Methods of Analysis

Nuclear Magnetic Resonance Spectroscopy (NMR)

1. NMR can be used to identify controlled substances; however, there are other challenges associated with the technique. NMR can identify the basic form of a controlled substance and distinguish it from the salt form. NMR cannot specify which salt form (hydrochloride, hydrobromide, sulfate, etc.) is present.

Instrumental Methods of Analysis

Nuclear Magnetic Resonance Spectroscopy (NMR)

2. The NMR is an expensive instrument and requires extensive resources to maintain operability (liquid nitrogen and liquid helium). Few laboratories have the instrument. There is a steeper learning curve associated with developing the expertise to operate the instrument and interpret the data. The NMR also provides a way to obtain a three dimensional picture of some parts of the molecule.

What are the major problems in the foundation, methods and practices?

1. Formulating a conclusion in the identification of controlled substance analogues or homologues where the spectra are similar
2. Requiring analysts to look at multiple data and not depend on a single technique
3. Placing the “chemistry” back into “forensic chemistry” when addressing the identification of controlled substances
4. Managing the backlog of drug cases

How can competence be maintained and improved?

1. While accreditation has become a pro-forma requirement for laboratories, certification of forensic drug analysts should become a requirement for individuals to issue results of analysis.
2. The ability to properly handle evidence, including, but not limited to drugs, can be measured by standardized proficiency and competency testing programs. There is a core knowledge of criminalistics which includes understanding significant legal decisions and the inter-relationships of forensic science specialties.

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How can competence be maintained and improved?

3. The American Board of Criminalistics (ABC) offers a certification program which requires a continuing education requirement which should be a part of any forensic scientist's qualification statement to testify as an expert witness.
4. There is a difference between retaining technical competence and retaining the ability to think analytically.

What research questions need to be answered?

1. There is a need for research to objectively identify commonality of sources in controlled substance seizures. The International Drug Profiling Conference (IDPC) meetings in 2002, 2003 and 2004 addressed this issue. The goals were to evaluate methodologies to identify impurity, by-product, precursor and intermediate ratios in heroin and cocaine seizure to link international seizures.

What research questions need to be answered?

2. In heroin profiling, it is possible to identify heroin processing methodologies which are geo-specific to four regions of the world:
    - § Southeast Asia
    - § Southwest Asia
    - § Mexico
    - § South America

    Specificity by a more narrow region is most desirable.

Conclusion

The forensic analysis of drugs is often termed one of the “most basic” forensic specialties to master. It may include on of the most routine analytical protocols where data is generated and a conclusion is formed. However, because the chemical compositions of drugs can be similar, and the analytical data can differ with subtleties required for evaluation and interpretation, the analyst must demonstrate care and expertise in formulating a conclusion. Standardized data generation techniques and demonstrated interpretation abilities are crucial to ensure the highest possible quality in reporting results.

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