Scientific Working Group for Forensic Toxicology (SWGTOX)
Guidelines for Research in Forensic Toxicology

Table of Contents

Document Revisions

Version	Date	Change Description
2	08/15/2014	Title revised from “Standard” to “Guideline” and subsequently changed language throughout document to reflect this change. Removed references to RDTE Committee in Title and Section 1. Clarifed scope in 1.5. Updated Section 4. Removed inoperable links from 5.3.

1. Introduction

1.1. The purpose of this document is to provide guidelines for research to support the underlying science on which the practice of forensic toxicology is based.

1.2. The impact of novel and systematic forensic toxicology research will improve public health and safety, inform public policy, support the criminal justice system, and generate greater understanding of the adverse effects of drugs and toxicants with medicolegal or other punitive consequences.

1.3. Evidence-based knowledge of the mechanisms, risks, and dangers of drugs and toxicants are derived from academic, industrial, clinical and forensic laboratory innovations throughout the world, yielding scholarly publications and readily accessible resources (*e.g.*, analytical, case-specific, and/or drug databases) advancing forensic toxicology technology, testing, methodology, and interpretation.

1.4. Forensic toxicology researchers and practitioners continue to make seminal contributions to the scientific foundation of the field, yet significant critical gaps still exist. These gaps should be priorities for research in forensic toxicology (Section 4). Research in forensic toxicology spans bench-level laboratory methodologies to basic and clinical science investigations.

1.5. This document describes the areas of research focus, priorities and practices in forensic toxicology, and provides guidelines to advance the science of forensic toxicology. While development, testing and evaluation are not specifically detailed in these guidelines, they are critical components to support the underlying science for the practice of forensic toxicology and evidence-based knowledge.

1.6. The intended audience for this document includes investigators, laboratory managers, policymakers, governing bodies, and others who would benefit from a better understanding of research efforts in forensic toxicology.

2. Definitions

2.1. *Research* - A hypothesis-driven systematic investigation of forensic toxicology, including the generation and analysis of data, that advances the field and scientific knowledge base. Categories include basic, translational,

clinical, epidemiological, applied, and organized review and analysis of existing literature-based data.

2.2. *Development* - Improvement and enhancement of forensic toxicology methodology prior to testing, evaluation and implementation.

2.3. *Testing* - A systematic investigation and validation using forensic toxicology methodology, including data generation and reproducibility, which advances scientific reliability.

2.4. *Evaluation* - A systematic investigation of forensic toxicology methodology, including data analysis and interpretation, which advances scientific validity.

2.5. *Validity* - The extent to which a conclusion, inference or proposition is accurate.

2.6. *Analysis* - The measurement of analyte and/or evaluation of data.

3. Focus of Forensic Toxicology Research

This list of focus areas for research topics in Forensic Toxicology is not exhaustive; it will be reviewed and updated as necessary.

3.1. Characterization of Toxicants

Research studies elucidate chemical structure, mechanisms of action, pharmaco- and toxico-dynamic effects (*e.g.*, cognitive, psychomotor, physiological, subjective) and pharmaco- and toxico-kinetics. This research includes analytical method development.

3.2. Factors Affecting Interpretation of Forensic Toxicology Data

Research studies address biological, chemical, analytical, and other relevant factors that influence interpretation of forensic toxicology and/or clinical chemistry data. Research approaches include laboratory, field, animal, epidemiological, and clinical studies of these factors to further understand their relevance to forensic toxicology.

3.3. Novel Technology for Forensic Toxicology Analysis

Applications of innovative approaches to forensic toxicological analyses, including alternative biological matrices provide a foundation for advancement of the discipline.

3.4. Utilization of Existing Data and Knowledge

Enhance utilization of existing data and knowledge through data mining strategies, access to peer-reviewed literature, and database development to facilitate laboratory and informatics studies. Prior to implementation, existing data should be thoroughly scrutinized to avoid unsupported or uncertain statements.

4. Priorities for Research in Forensic Toxicology

This list of priorities for research topics in Forensic Toxicology is not exhaustive; it will be reviewed and updated as necessary. All focus areas of Forensic Toxicology Research (Section 3) should be considered for each of the listed priorities. Priorities are listed in alphabetical order and are not ranked.

4.1. Blood and Breath Alcohol

4.2. Building, Mining and Disseminating Forensic Toxicology Databases

4.3. Chemical Terrorism

4.4. Drug Interactions

4.5. Drug Metabolism and Parent-to-Metabolite Relationships

4.6. Environmental Toxicants (*e.g.*, metals and non-metallic elements, plasticizers, pesticides, flora and fauna)

4.7. Emerging Drugs of Abuse

4.8. Herbal and Dietary Supplements

4.9. Impact of Accreditation and Certification in Forensic Toxicology

4.10. Forensic Result Interpretation (*e.g.*, measurement uncertainty of the analytical result; use of toxicological findings to reach conclusions and offer expert opinions)

4.11. Matrices (*e.g.,* alternative, decomposed, embalmed, non-preserved)

4.12. Non-traditional Forensic Toxicology Analyses (*e.g.*, endogenous and exogenous markers, siRNA, peptides, proteins)

4.13. Novel Analytical Techniques

4.14. Pharmacodynamics and Pharmacokinetics (*e.g.*, tolerance, relationships)

4.15. Pharmacogenetics and Pharmacogenomics

4.16. Population-based Toxicology (e.g., sex, race, disease states, pregnancy, elderly, pediatric, toxic concentration ranges)

4.17. Postmortem Distribution and Redistribution of Drugs and Metabolites

4.18. Prevalence-based Toxicology (*e.g.,* reducing prevalence of drug use, drug-related deaths, drugged driving studies)

4.19. Toxicodynamics and Toxicokinetics

5. Research Practices in Forensic Toxicology

Forensic research draws upon many scientific disciplines and is hypothesis-driven or exploratory in nature. Effective use of experimental design, controls, valid methods of analysis, statistical and interpretive evaluation of results are essential components for successful research, preferably leading to peer-reviewed publication. Experimental design will be dependent on the specific research objective and is subject to appropriate oversight.

5.1. Areas of Practice

Research is conducted to elucidate and quantify physiological and behavioral effects and the relationship between concentrations of drugs, other toxicants, their metabolites, or other biomarkers of exposure, with respect to:

5.1.1. Human performance toxicology (*e.g.*, drug facilitated crimes, driving under the influence of alcohol or drugs)

5.1.2. Postmortem forensic toxicology

5.1.3. Non-regulated employment drug testing

5.1.4. Court ordered toxicology (*e.g.*, probation and parole, drug courts, child services)

5.1.5. General forensic toxicology - other toxicology performed for legal purposes in a variety of biological specimens (*e.g.*, non-lethal poisonings or intoxications).

5.2. Oversight of Forensic Toxicology Research

Forensic toxicology research may require institutional, organizational, or regulatory oversight. Investigators should consider guidance of national and international standards. Investigators should consider the relevance of the following to their research and incorporate these procedures during the early stages of their work:

5.2.1. Institutional Review Board (IRB) - The ethical use of human subjects or their biological specimens must be reviewed and approved by an IRB prior to initiation of research. This review includes evaluation of scientific merit, experimental design, risk-benefit assessment, justification of subject inclusion, informed consent, and safety.

5.2.2. Health Insurance Portability and Accountability Act (HIPAA) - The privacy of individually identifiable health information must be protected.

5.2.3. Institutional Animal Care and Use Committee (IACUC) - Protocols for animal experimentation must be reviewed and approved by the IACUC. This review includes elements such as evaluation of scientific merit, experimental design, justification of species and number of animals, and animal welfare and safety.

5.2.4. Local and private IRB and IACUC organizations are available to investigators.

5.3. Selected Resources for Responsible Research

The standards and legal requirements for responsible research are defined by multiple government and private agencies. These resources are available to provide further clarification regarding the responsible and ethical conduct

of research. All researchers and practitioners should be knowledgeable of institutional and local, state and federal requirements.

5.3.1. Responsibilities of the Research Investigator

Human Research Protections Frequent Questions (hhs.gov)

Responsibility of Applicants for Promoting Objectivity in Research for which PHS Funding is Sought (nih.gov)

Principal Investigator's Responsibilities (healthcare.partners.org)

Guidance for Industry. Investigator Responsibilities - Protecting the Rights, Safety, and Welfare of Study Subjects (fda.gov)

5.3.2. Special Obligations in Human Subject Research

International Compilation of Human Research Standards (hhs.gov)

Human Research Protections Program (nih.gov)

Human Subjects Research and IRBs, Bioethics Resources on the Web (nih.gov)

Guidelines for the Conduct of Research in the Intramural Research Program at NIH (nih.gov)

5.3.3. Laboratory Animals in Research

Office of Extramural Research Animals in Research Web Site (nih.gov)

Intramural Animal Care and Use Program (nih.gov)

Laboratory Animal Care and Use, Bioethics Resources on the Web (nih.gov)

Methods and Welfare Considerations in Behavioral Research with Animals (nih.gov)

Office of Laboratory Animal Welfare (nih.gov)

5.3.4. Data Use, Integrity, Ownership, Storage, and Retention

Guidelines for Responsible Data Management in Scientific Research (hhs.gov)

5.3.5. Authorship and Publication

Ethical Considerations in the Conduct and Reporting of Research: Authorship and Contributorship (icmje.org)

5.3.6. Conflict of Interest

Ethical Considerations in the Conduct and Reporting of Research: Conflicts of Interest (icmje.org)

Financial Conflict of Interest: Objectivity in Research - NIH Review of Institutional Conflict of Interest Policies (nih.gov)

Conflict of Interest in Peer-Reviewed Medical Journals (wame.org)

5.3.7. Ethics and Obligations to Report Interference, Misconduct, and Errors

Integrity and Misconduct in Research (hhs.org)

Publication Ethics Policies for Medical Journals (wame.org)

5.3.8. Intellectual Property

Intellectual Property Policy (nih.gov)

What You Should Know About Intellectual Property, Research Collaborations, Materials Transfers, Consulting, and Confidential Disclosure Agreements (hhmi.org)

Intellectual Property Rights: an Overview and Implications in Pharmaceutical Industry (Saha et al, J Adv Pharm Technol Res. 2011 Apr-Jun; 2(2): 88–93.)

6. Applying Research to Advance the Science of Forensic Toxicology

6.1 Perform research to improve the quality, timeliness and practice of forensic toxicology, including interpretation of laboratory data.

6.2 Encourage reference material producers to make available reference materials and internal standards (*e.g.,* native and stable isotope labeled compounds) for drugs, toxicants, and metabolites.

6.3 Develop a research assistance program to promote publication of forensic toxicology data generated by the practitioner community.

6.4 Develop and maintain on-line, curator-managed databases on specific forensic toxicology topics from multiple investigators or laboratories for interpretation (*e.g.*, spectral libraries, case specific, special populations, alternative matrices, drug interactions).

6.5 Develop and disseminate training materials and structured opportunities to promote professional growth (*e.g.*, technical writing, research responsibility and design, ethics, expert witnessing skill) and growth of forensic toxicology (*e.g.*, case studies, scientific research, collaboration, networking, outreach and dissemination).

6.6 Develop mentoring, award and incentive programs for forensic toxicologists to perform and publish research findings.

6.7 Advocate diverse funding opportunities for research in forensic toxicology.

6.8 Encourage laboratory leadership to prioritize research as a necessary part of Forensic Science by devoting time and resources for this purpose.

6.9 Participate in translational research initiatives including “from laboratory to courtroom”. This would include sharing of case studies including history, investigational findings, analytical results, and interpretations.

6.10 Promote collegial interactions between forensic toxicologists and other forensic disciplines (*e.g.*, drug chemistry, pathology, anthropology, veterinary) to seek resolution of common problems and challenges.