

TENNESSEE BUREAU OF INVESTIGATION

Forensic Services Division

Toxicology Quality Assurance and Procedures Manual

6.20 Training Procedures for Forensic Scientists



6.20 Training Procedure for Forensic Scientists

The following section ensures that Forensic Scientists in the Toxicology Unit have a documented training program. This program shall be used to develop the knowledge, skills, and abilities required to perform forensic examinations.

6.20.1 Training of New Personnel

The Tennessee Bureau of Investigation Toxicology Unit training program was developed to train individuals in the examination of evidence for the presence of ethyl alcohol (volatiles) and/or other intoxicating substances. This program seeks to combine rigorous independent laboratory exercises/activities, observations, discussion questions, presentations, scientific articles and books, competency and/or proficiency testing, and culminating in a mock trial. The training will be divided into two phases, alcohol (volatiles) and drug testing disciplines. It is suggested that alcohol training occur first.

6.20.1.1 Program Coordination

A Forensic Scientist Supervisor will assign a Training Officer to coordinate all training for each trainee. The Training Officer will be a trained Forensic Scientist Toxicologist. The Training Officer facilitates the overall training activities but may delegate certain duties and instruction to other Forensic Scientist Toxicologists.

Due to similarities in the instrumentation of alcohol (volatiles) and the drug testing discipline areas, a training program shall be customized to fit each trainee Forensic Scientist and shall be established prior to the beginning of the official training. Laboratory activities and exercises in the appendices are only a guideline for weekly activities and can be arranged to meet the needs of the analyst in training.

6.20.1.2 Training Period

Prior to training any trainee Forensic Scientist, an assessment should be done to identify his/her specific training needs. This assessment may include a review of his/her knowledge and skill level. The length of the training period is variable and is at the discretion of the Forensic Scientist Toxicology Technical Leader or his/her designee. Certain individuals may require less time than others, depending on experience and education. Generally, the alcohol (volatiles) training phase is completed in 16 weeks, and the drug testing phase is completed in 12 months. If the trainee is failing to meet training milestones, the trainer may add additional presentations, evaluations, or written assignments.



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6.20.1.3 Minimum Requirements for Orientation

The following shall be included in all of the Toxicology Unit training programs:

- TBI Policies
- Ethics, including *The Guiding Principles of Professional Responsibility for Forensic Services Providers and Forensic Personnel*
- Quality Assurance Manual
- TBI Safety Manual
- Toxicology Policies and Procedures
- Evidence Management and Evidence Policies
- Introduction to the technical capabilities of the Forensic Toxicology Laboratory
- Explanation of the purpose of the training program including an insight into the course of events and what the trainee is expected to accomplish
- Introduction to the Laboratory Information Management System (LIMS)

6.20.1.4 Training Records/Files

Each trainee Forensic Scientist will maintain a training record. These records/files shall document the successful completion of the trainee's training and contain at least the following:

- Quarterly memorandums
- Training program outline
- Repeat analyses and data
- Documentation of presentation/evaluations
- Competency and/or proficiency tests and data
- Mock Court Testimony Evaluation forms
- Records of studies and experiments performed

6.20.1.5 Quality Control Competency

Each trainee Forensic Scientist shall complete a Quality Control Competency for each testing method prior to participating in repeat analysis, supervised casework, or any training component requiring direct interaction (i.e. pipetting or testing) with case samples. The purpose of the Quality Control Competency is to demonstrate the trainee's understanding of the use of proper personal protective equipment, good pipetting technique and general understanding of the function of the instrument. At a minimum the Quality Control Competency will consist of a successful analysis of a set of calibrators and controls. Acceptability of the Quality Control Competency will be evaluated by the Training Officer or designee and recorded in the trainee's training records/files. Previously analyzed samples from completed cases may be used in the training program only after the completion of the Quality Control Competency. See Training Appendix for additional information.



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6.20.1.6 Method Competency

A competency will be given to show the trainee's competence of each testing method. A satisfactory competency test will produce qualitative and quantitative results within the testing method's quality control acceptance criteria for the expected target value of the prepared competency sample. The competency samples should mimic as closely as possible those encountered in casework. Results will be recorded and maintained in the trainee's training records.

Competency samples may be either previously analyzed samples from completed cases or samples made by the Training Officer/designee. If case samples are used, they must be past their scheduled destruction date. The sample should be reanalyzed by the Training Officer/designee due to possible changes in drug levels over time. The target range for these samples shall be plus or minus the QC criteria for the method based on the average result of the Training Officer and the trainee's result. See Training Appendix for specific information on each of the method competencies.

6.20.1.7 Mock Trial

After the conclusion of each training discipline a mock trial will be conducted. During the mock trial, the trainee Forensic Scientist will present direct testimony concerning a DUI toxicology case examination. The trainee will also defend his/her results and opinions during cross-examination. In preparation for the mock trial, practice/training sessions will be conducted. The trainee shall demonstrate thorough knowledge and understanding of all material covered in either the alcohol (volatiles) or toxicology drug testing training program through testimony to a non-technical audience. Any deficiencies identified through practice sessions shall be corrected by the trainee through further review, study, and practice sessions prior to the formal mock court.

6.20.1.8 Evaluation of Training

Training shall be evaluated by means of observations, presentations, laboratory exercise/activities, competency and/or proficiency testing, and mock trials.

6.20.1.9 Completion of Training

Upon satisfactory completion of the final mock trial and training program, the Forensic Scientist Technical Leader or his/her designee will forward a memo to the TBI Quality Assurance Manager, the Crime Laboratory Regional Administrator, and appropriate section supervisor stating that the trainee has met all qualifications required by TBI.



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Final approval of the trainee's records/files from all the above listed personnel and a written Employee Authorization form must be obtained prior to the analyst starting independent casework. These documentations will be retained in their training records/files and on Ensur.

Forensic Scientists who have successfully completed training in a Toxicology Unit subdiscipline, (either alcohol/volatiles or drug testing) are authorized to perform, report and review casework, and are authorized to develop, modify, and validate methods under the direction of the technical leader.

6.20.2 Continuing Education and Training

It is recommended that all Forensic Scientists in the Toxicology Unit participate in continuing education including professional meetings or scientific workshops/classes as available. Each scientist shall document the training on Ensur which shall contain the records of at least the following:

- Work Authorization(s)
- Educational Compliance Memo
- Training Records
- Proficiency Test(s) Results Summary
- Testimony Evaluation/Testimony Evaluation Memos

6.20.3 Remedial Training

If a deficiency is detected in a Forensic Scientist's casework or proficiency test, the scientist may be subject to a remedial training period and/or removed from casework. The QA Manager and Toxicology Supervisor/Technical Leader shall determine the course of action. The remedial training shall be conducted under the direct supervision of a qualified scientist/technician. The supervisor of the regional toxicology unit will keep documentation recording the progress of the scientist and upon successful completion of the required training, the scientist will be permitted to resume normal casework.

6.20.4 Phase 1: Alcohol (Volatiles) Training

6.20.4.1 Evidence Receiving and Handling:

6.20.4.1.1 Learning Objectives:

- Understand evidence handling procedures used by TBI as detailed in the TBI Quality Assurance Manual
- Understand evidence handling procedures pertinent to the Forensic Toxicology Unit

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- Understand the importance of safety regarding the handling of biological evidence
- Receive, inventory, and itemize TBI blood alcohol collection kits, alcoholic content cases, drug facilitated sexual assault (DFSA) cases, and postmortem cases for analysis

6.20.4.1.2 Literature Review:

See required readings and discussions in training appendix.

6.20.4.1.3 Laboratory Exercises and Activities:

See exercises and activities in training appendix.

6.20.4.2 Blood Alcohol Analysis

6.20.4.2.1 Learning Objectives:

- TBI Toxicology Unit policies and procedure dealing with ethyl alcohol determination in biological samples
- Comprehend the function, theory, and operation of the headspace gas chromatograph mass spectrometer (HS-GCMS/FID)
- Prepare case specimens for analysis and analyze by HS-GCMS/FID
- Operate the HS-GCMS/FID
- Generate, evaluate, and interpret data using acceptance criteria
- Uncertainty of measurement and uncertainty of measurement calculations

6.20.4.2.2 Literature Review:

See required readings and discussions in training appendix.

6.20.4.2.3 Laboratory Exercises and Activities:

See exercises and activities in training appendix.

6.20.4.2.4 Presentation/Evaluation: Alcohol Instrumentation Presentation

A presentation will be performed over knowledge obtained on the Headspace GC/FID and MS instrumentation to verify that the learning objectives were met. The Alcohol Instrumentation Presentation should cover the above learning objectives and the requirements listed in the training appendix. Multiple presentations may be given in order to adequately cover the material.



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6.20.4.3 Alcoholic Beverage and Additional Volatile Analysis

6.20.4.3.1 Learning Objectives:

- TBI Toxicology Unit policies and procedures dealing with volatiles and alcoholic beverage content determination
- Prepare samples for analysis by HS-GCMS
- Analyze samples and determine the concentration of ethanol in the beverage
- Other volatiles that are tested and their properties
- Additional Volatile Compound Procedure
- Necessary equations for converting from gm% to v/v%

6.20.4.3.2 Literature Review:

See required readings and discussions in training appendix.

6.20.4.3.3 Laboratory Exercises and Activities:

See exercises and activities in training appendix.

6.20.4.4 Pharmacology and Toxicology of Alcohol:

6.20.4.4.1 Learning Objectives:

- Metabolism, absorption, distribution, and elimination of ethanol
- Back extrapolation (retrograde extrapolation) and Widmark equation
- Acute and functional tolerance
- List and describe the major pharmacological effects of ethanol
- Describe the dose-effect relationship for ethanol
- List and describe some of the cognitive and psychomotor effects of alcohol
- Fermentation

6.20.4.4.2 Literature Review:

See required readings and discussions in training appendix.

6.20.4.4.3 Laboratory Exercises and Activities:

See exercises and activities in training appendix.

6.20.4.4.4 Presentation/Evaluation: Ethanol Pharmacology Presentation

A presentation will be performed over the knowledge obtained on the understanding of ethanol pharmacology to verify that the learning objectives were met. The Ethanol Pharmacology Presentation should



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cover the above learning objectives, those listed in the Alcohol (Volatiles) Training Appendix and common defense tactics/questions/arguments.

6.20.4.5 Technical and Administrative Reviews of Alcohol (Volatiles) Cases

6.20.4.5.1 Learning Objectives:

- Understand and discuss technical review requirements
- Observe an analyst complete technical and administrative reviews
- Review and verify information on the submittal form
- Documentation of technical and administrative reviews in LIMS
- Review chain of custody for completeness
- Documentation of changes made during technical review

6.20.4.5.2 Laboratory Exercises and Activities:

See exercises and activities in training appendix.

6.20.4.5.3 Presentation/Evaluation: Tech/Admin Review Evaluation

An evaluation will be performed to verify the learning objectives were met. A review of the cases the trainee has technically and administratively reviewed must meet the approval of the Training Officer, Toxicology Supervisor, Technical Leader or designee. Documentation of this training shall be maintained in the training record including a list of the types of findings discovered in the reviewed casework. See training appendix for additional information.

6.20.4.6 Mock Trial:

6.20.4.6.1 Learning Objectives:

- Present the following to a jury:
 - Description of methods of analysis used for alcohol identification and quantitation
 - Purpose and operation of analytical instrumentation
 - Effects of alcohol on human performance especially driving ability
- Understand basic court processes
- Learn common defense tactics
- Read and understand the applicable TCA codes

6.20.4.6.2 Literature Review:

See required readings and discussions in training appendix.



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6.20.4.6.3 Laboratory Exercises and Activities:

See exercises and activities in training appendix.

6.20.4.6.4 Mock Trial Competency:

Per section 5.2 of the TBI Laboratory Quality Assurance Manual, TBI Laboratory Examiners will undergo mock court training in their respective discipline(s) or sub-discipline(s). The mock trial will be performed to verify the overall learning objectives of alcohol testing have been met.

6.20.5 Phase 2: Toxicology Drug Testing Training

6.20.5.1 Evidence Receiving and Handling

6.20.5.1.1 Learning Objectives:

- Understand evidence handling procedures used by TBI as detailed in the TBI Quality Assurance Manual
- Understand evidence handling procedures pertinent to the Forensic Toxicology Unit
- Understand the importance of safety regarding the handling of biological evidence
- Receive, inventory, and itemize TBI blood specimen collection kits, alcoholic content cases, drug facilitated sexual assault (DFSA) cases, and postmortem cases for analysis

6.20.5.1.2 Literature Review:

See required readings and discussions in training appendix.

6.20.5.1.3 Laboratory Exercises and Activities:

See exercises and activities in training appendix.

6.20.5.2 Enzyme-Linked Immunosorbent Assay

6.20.5.2.1 Learning Objectives:

- Understand the theory and application of enzyme-linked immunosorbent assay (ELISA)
- Understand what is happening in each step of the testing procedure
- Generate, evaluate, and interpret data using acceptance criteria
- Perform routine maintenance on the TECAN EVO 75

6.20.5.2.2 Literature Review:



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See required readings and discussions in training appendix.

6.20.5.2.3 Laboratory Exercises and Activities:

See exercises and activities in training appendix.

6.20.5.2.4 Presentation/Evaluation: ELISA Presentation

A presentation will be performed over the knowledge obtained on the understanding of ELISA testing and the instrumentation to verify that the learning objectives were met. The ELISA presentation should cover the above learning objectives and those listed in the training appendix.

6.20.5.3 Qualitative and Quantitative GCMS/FID Analysis

6.20.5.3.1 Learning Objectives:

- Understand the theory of gas chromatograph mass spectrometer flame ionization detector (GCMS/FID) instrumentation
- Understand the extraction methods used to prepare the sample for testing
- Comprehend the principles behind liquid-liquid extraction (LLE)
- Generate, evaluate, and interpret data using method acceptance criteria
- Perform routine maintenance on the GCMS/FID instrument

6.20.5.3.2 Literature Review:

See required readings and discussions in training appendix.

6.20.5.3.3 Laboratory Exercises and Activities:

See exercises and activities in training appendix.

6.20.5.3.4 Presentation/Evaluation: GCMS/FID Presentation

A presentation will be performed over the knowledge obtained on GCMS/FID testing and the instrumentation to verify that the learning objectives were met. The GCMS/FID presentation should cover the above learning objectives and the training appendix requirements. Multiple presentations may be given in order to adequately cover the material.

6.20.5.4 Qualitative and Quantitative LCMSMS Analysis

6.20.5.4.1 Learning Objectives:

- Understand the theory of liquid chromatography (LC)



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- Understand the theory of tandem mass spectrometry (MS-MS)
- Understand the extraction methods used to prepare the sample for testing
- Understand the criteria for acceptance of qualitative and quantitative liquid chromatography tandem mass spectrometry (LC/MS/MS) data
- Perform routine maintenance on the LC/MS/MS instrument
- Comprehend the use of data analysis software to prepare calibration curves
- Understand the use and theory of the solid phase extraction (SPE)

6.20.5.4.2 Literature Review:

See required readings and discussions in training appendix.

6.20.5.4.3 Laboratory Exercises and Activities:

See exercises and activities in training appendix.

6.20.5.4.4 Presentation/Evaluation: Triple Quad LCMS Presentation

A presentation will be performed over the knowledge obtained on the understanding of LC/MS/MS testing and the instrumentation to verify that the learning objectives were met. The LC/MS/MS presentation should cover the above learning objectives and the training appendix requirements.

6.20.5.5 Principles of Pharmacology and Drug Effects:

6.20.5.5.1 Learning Objectives:

- Establish familiarity with the classes of drugs encountered in the Toxicology Unit
- Comprehend the pharmacology of major drug classes
- Comprehend the effects of major drug classes on human performance, especially driving ability

6.20.5.5.2 Literature Review:

See required readings and discussions in training appendix.

6.20.5.5.3 Laboratory Exercises and Activities:

See exercises and activities in training appendix.

6.20.5.5.4 Presentation/Evaluation: Drug Pharmacology Discussion



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The trainee will prepare a document outlining the major types of effects (especially those associated with the ability to drive a car) of each of the following categories of drugs: CNS stimulants, depressants, marijuana, and opioids, and list common examples of each of these categories. This document will be included in the training documentation.

6.20.5.6 Technical and Administrative Reviews

6.20.5.6.1 Learning Objectives:

- Understand and discuss technical and administrative review requirements
- Observe an analyst complete technical and administrative reviews
- Review and verify the information on the submittal form
- Review the chain of custody for completeness
- Document technical and administrative reviews in LIMS
- Document changes to casefiles during review

6.20.5.6.2 Laboratory Exercises and Activities:

See exercises and activities in training appendix.

6.20.5.6.3 Presentation/Evaluation: Tech/Admin Review Evaluation

An evaluation will be performed to verify the learning objectives were met. A review of the cases the trainee has technically and administratively reviewed must meet the Training Officer, Toxicology Supervisor or Technical Leader's approval. Documentation of this training shall be maintained in the training record including a description of the types of technical and administrative errors discovered in the reviewed casework. See training appendix for additional information.

6.20.5.7 Mock trial:

6.20.5.7.1 Learning Objectives:

- Present the following to a jury:
 - Description of methods of analysis used for drug identification and quantitation
 - Purpose and operation of analytical instrumentation
 - Effects of selected drugs on human performance especially driving ability
- Understand basic court processes
- Learn common defense tactics
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6.20.5.7.2 Literature Review:

See required readings and discussions in training appendix.

6.20.5.7.3 Laboratory Exercises and Activities:

See exercises and activities in training appendix.

6.20.5.7.4 Mock Trial Competency:

Per section 5.2 of the TBI Laboratory Quality Assurance Manual, TBI Laboratory examiners will undergo mock court training in their respective discipline(s) or sub-discipline(s). The mock trial will be performed to verify the overall learning objectives for toxicology drug testing have been met.