Advanced Toxicology at Hennepin County Medical Center

This advanced rotation will provide the resident with additional intensive training in clinical and forensic toxicology. The rotation will cover the following areas: therapeutic drug monitoring, general emergency department and in-patient drug screening, forensic toxicology regarding drug testing in the workplace, and forensic toxicology regarding drug testing for a Medical Examiner’s office. Drugs of abuse, over-the-counter medications, therapeutic medications, and volatiles will be addressed from both a clinical and analytical (laboratory) perspective.

Institutional Site Director
Stuart E.H. Cameron, MD

Coordinating Teaching Faculty Member
Fred S. Apple, PhD Work Phone: 612-873-3324

Lead support and Technical Personnel:
RoseAnn Carlsen, MBA, Laboratory Manager
Julie Kloss, MBA, Core (Toxicology) Laboratory Supervisor
Hennepin County Medical Examiner’s Medical and Support Staff Members

Training Site:
Hennepin County Medical Center, Clinical Laboratories, P4

Duration of Rotation:
A trainee, who has entirely completed the appropriate core rotation series for their specific training program, may elect to spend up to 12 months of their fifth year (AP/CP Combined Program) or third/fourth year (AP/FP or CP only Programs) on the advanced toxicology service.

Post Graduate Level of Residents Involved
PGY levels 3 - 5 and satisfactorily completed the 4-month Clinical Chemistry rotation

Supervisory Guidelines for Patient Care and Specimen Handling
Specimen handling in the laboratories is the direct responsibility of the laboratory technologists. Resident decision making in the laboratory is under the direct supervision of the teaching faculty. The on service teaching faculty members are physically present during standard operating hours; faculty members not physically present are rapidly available by phone or pager.

Overview of Daily Duties and Responsibilities
The resident will have service, teaching, and research responsibilities.
Service - The resident will be expected to provide daily clinical consultation with the hospital medical staff, outside clients using Hennepin County Medical Center services, and the hospital technical staff for issues regarding forensic toxicology.

Teaching - The resident will be responsible for presenting cases at both the Clinical Pathology Conference and Medical Examiner Toxicology Rounds. These are weekly conferences, and the resident will be responsible for presenting at each conference twice per month, 15-20 minute presentations.

Weekly Activities - The advanced resident will meet with Dr. Apple for 3 hourly sessions per week to discuss predetermined topics, readings, literature cases, and technical issues. Laboratory projects and assignments are to be completed concurrent with their being discussed.

Goals and Objectives

The depth covered for each of the following topics, as outlined in the general statement, will be determined based on the length the advanced rotation.

1. Always be familiar with where, how, and when assay/test is performed. Also be familiar with back-up procedures; assay down policies, etc.
2. Describe the principles of the following techniques: describe their advantages and disadvantages.
   a. Extraction and thin layer chromatography (TLC): toxi lab A & B
   b. High performance liquid chromatography (HPLC)
   c. Gas chromatography (GS): FID, EC, NP detectors
   d. Immunoassays (serum and urine) for drug testing: Cedia, EMIT, fluorescence polarization.
   e. GS MS technology: SIM and full quantification
   f. LC MS technology
3. Describe the various components including the various detectors of a high performance liquid chromatography (HPLC)
4. Describe the various components including 4 useful detectors of a gas chromatograph (GC)
5. Describe the operation, utility, and components of a gas chromatography/mass spectrometer (GC-MS) in a toxicology laboratory
6. Define or describe the following pharmacokinetic concepts for a specific therapeutic drug, pick an in-patient and do the following calculations: Compute a new dose and the peak and trough concentrations at the new dose:
   a. Elimination half-life (t1/2)
   b. Volume of distribution (Vd)
   c. Clearance
   d. Steady state
   e. Peak and trough
   f. Free drug concentration (example: phenytoin)
7. Describe screening and quantitative methods for the following. Review all policies and memos regarding test result interpretation.
   a. Volatiles: Ethanol, Methanol, Isopropanol, Acetone, Ethylene Glycol
   b. Pentobarb
   c. Anticonvulsants, specifically Phenytoin (Total/Free)
   d. CO
   e. Lithium
   f. Thiocyanate, cyanide
   g. Tricyclic antidepressants
   h. Chloramphenicol
   i. Aminoglycosides (gent, tobra, vanco, amikacin)
   j. Arsenic
   k. Caffeine
   l. Cyclosporine
   m. Digoxin
   n. Drugs of abuses including:
      i. Amphetamines
      ii. Methadone
      iii. Cocaine
      iv. Cannabinoids
      v. Morphine
      vi. LSH
      vii. Benzodiazepines
      viii. PCP
      ix. Opiates
8. Describe the mechanism of toxicity, relevant serum concentrations, and treatment for salicylate and acetaminophen overdose.
9. Explain the pathophysiology of alcohol (ethanol) with respect to (NEJM 319:1639-1650, 1988):
   a. Absorption, metabolism, elimination
   b. Blood, urine, breath analyses
   c. Forensic use of vitreous
   d. Review calculations in dram shop ethanol case (forensic)
10. Know pathway of iron metabolisms; Iron OD-chronic vs. acute.
11. Review specimen handling/screening/quantitation in forensic cases.
12. Become familiar with NIDA and CAP-TOX guidelines for drugs of abuse screening and confirmation, and what quality control procedures must be maintained.
13. Review the mechanism for lead intoxication. Describe the methods used to measure lead and review the need for requested state lead levels. How are ZnEP and FEP used to screen for lead intoxication. Understand problems involved with collections.

Opportunities to Function as a Consultant to Other Physicians
Residents have the responsibility, under faculty supervision, of discussing the interpretive consultative reports and laboratory results with appropriate members of the hospital medical staff, outside clients using Hennepin County Medical Center services, and the hospital technical staff for issues regarding forensic toxicology. Through their discussions with the clinical team members, the residents have the opportunity to directly impact patient care.

**On-Call Duties**

Residents will be on pager call to answer questions that arise in the toxicology laboratory that require test approval, stat assays, clinician interaction, etc. In an urgent situation, the resident is to contact the laboratory supervisor and Dr. Apple. During the on-call period, the resident is responsible for handling clinical requests that arise during off hours at Hennepin County Medical Center. A call schedule will be completed and given to Linda Moyer for Hospital circulation. Arrangements for coverage for off time should be discussed with Dr. Apple. While on-call, residents are supervised by Dr. Apple or another Hennepin County Medical Center Clinical Pathology Faculty Member, who is available at all times, either via their office phone, pager, or home phone. On-call activities are reviewed with the residents on an on-going basis and weekly at the call review conference.

During this rotation the residents will on average have one out of every seven days free of hospital duties. Due to the at-home nature of call and the limited number of calls, the call duties are constructed in the following fashion. The residents are on at-home/pager call every other week. The on-call periods last from 7:00 a.m. on Monday morning through the following weekend, ending at 7:00 a.m. on the subsequent Monday.

**Prompt and Reliable Communication with On-duty Faculty**

During general working hours, the on service teaching faculty is available in person; other faculty members are available by scheduled appointment, by phone or by pager. During the on call hours, the teaching faculty is continuously available either at home by phone or by pager.

**Education in the Management of this Laboratory Area**

The resident attends the weekly chemistry toxicology call rounds at which management and other laboratory issues are discussed. The resident also becomes involved in management issues, as they arise during the course of the workday. These issues are further discussed in the multiple weekly tutorial sessions with the Laboratory Director.

**Required Conference/Seminars**

- **Laboratory Medicine Grand Rounds**, weekly, residents attend conferences on a variety of basic science and clinical topics. Conference is held on the University of Minnesota Medical School Campus.
- **Clinical Pathology Conference**, at HCMC, Pathology Conference Room (Basement North Block). Residents present current clinical laboratory topics based on real patient cases.
Three cases are presented per conference and provide a weekly forum for trainee and faculty discussion of difficult and unusual cases. This conference provides trainees with the opportunity to correlate and discuss pathologic and laboratory findings and a regular avenue for trainee peer teaching.

- **Toxicology ME Rounds** - ME Conference Room; the resident will present articles at this journal club meeting as per schedule. This clinical conference provides trainees with the opportunity to correlate and discuss toxicology findings.

- **Rosai/Sinard Conference**, weekly, residents present a variety of real cases on a theme related to a recent or up-coming faculty Resident's Conference. This conference provides a regular avenue for trainee peer teaching with feedback given by the Chief Resident's Subcommittee.

- **Resident's Conference**, weekly, residents attend conferences on a variety of scheduled pathology topics given by the faculty.

- **Chem/Tox call rounds (QA Monitor)** - residents’ presentation of all beeper calls and cases followed up during the week by the resident and staff on call. Following this portion of the conference, the residents discuss, review and follow up on cases concerning interesting problems related to the previous week's teachings and discussions with laboratory supervisors and managers. This conference provides a weekly forum for trainee and faculty discussion of difficult and unusual toxicology cases. This clinical conference provides trainees with the opportunity to correlate and discuss pathologic findings and provides a regular avenue for trainee peer teaching.

**Scholarly Activities/Research Available During and After Rotation**

Depending on the length of time for each advanced rotation, the resident will take on an applied research project that hopefully will result in an abstract submission and/or publication. For example, the following projects currently have resident participation: determination of kinetics for clearance of ethanol in men and women; review of medical examiner cases involving opiates to determine the role of free vs. total opiate concentrations as a cause of death.

**Basis, Method and Criteria for Resident Evaluation**

Dr. Apple will evaluate each resident based on their performance regarding their service, teaching, research, and participation activities. The residents are provided with continuous feedback on their performance during the rotation. In general, only deficiencies are noted in writing. Residents are evaluated on their demonstrated ability to provide informative consultation to the clinical service teams, their medical knowledge, their application of this knowledge to efficient/quality patient care, and their diagnostic, technical and observational skills. Residents are also evaluated on their interpersonal skills, professional attitudes, reliability, and ethics with members of the teaching faculty, peers, laboratory staff, and clinicians. They are further evaluated on their initiative in fostering quality patient care and use of the medical literature, as it relates to their assigned cases. Their timely completion of
assigned interpretive reports is another component of the evaluation. Residents on probation receive a written mid-rotation evaluation.

**Educational Resources Available**

An extensive reading list of literature papers and textbooks is available for review.


**Computer Information Systems Available for Resident Education and Service Duties**

The resident is provided with a password in order to access both the Clinical Laboratory and Anatomic Pathology data bases. The laboratory has installed a Cerner Laboratory and Anatomic System which is highly integrated and makes acquisition of both clinical laboratory and anatomic information easy and straight forward. In addition, the resident computer is hardwired for access to the IRIS clinical data base, which provides up-to-date medical record data for individual patients. This computer is located in the Clinical Laboratory Residents’ Office and is available for resident use at all times.