

# Medical Toxicology

*Updated June 2022*

Medical Toxicology (Medical Student Elective Rotation)

Length of Unit: 4 weeks

Learners: MSIII and MSIV students

Program: Emergency Medicine

## Goals

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1. Introduce medical students to the fundamentals of medical toxicology.
2. Reinforce and solidify students' understanding of key concepts in pharmacology.
3. Introduce medical students to the fundamentals of addiction medicine.

## Objectives

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1. Students will demonstrate understanding of core topics in medical toxicology:
  - a. The primary toxidromes
    - i. Sympathomimetic
    - ii. Antimuscarinic
    - iii. Cholinergic
    - iv. Opioid
    - v. Sympatholytic
    - vi. Sedative-hypnotic
  - b. Gastrointestinal decontamination in toxicology
  - c. The history and physical examination in toxicology
  - d. Pharmacology and clinical effects of common street drugs
    - i. Cocaine
    - ii. Amphetamines
    - iii. Cannabis
    - iv. Phencyclidine
    - v. Novel psychoactive substances (cathinones and synthetic cannabinoids)
  - e. Acetaminophen poisoning
    - i. Pathophysiology
    - ii. Clinical presentation
    - iii. Mechanism of N-acetylcysteine
    - iv. Treatment with N-acetylcysteine
    - v. Treatment with other therapies
      1. Fomepizole
      2. Hemodialysis
  - f. Salicylate poisoning

- i. Pathophysiology
  - ii. Clinical presentation
  - iii. Treatment with sodium bicarbonate
  - iv. Treatment with activated charcoal
  - v. Treatment with hemodialysis
- g. Tricyclic antidepressant (and related agent) poisoning
  - i. Pathophysiology
  - ii. Clinical presentation
  - iii. Treatment with sodium bicarbonate
  - iv. Treatment with other therapies
    - 1. Lidocaine
    - 2. Intravenous lipid emulsion
- h. Toxic hyperthermias
  - i. Malignant hyperthermia
    - 1. Pathophysiology & inciting agents
    - 2. Clinical presentation
    - 3. Treatment
  - ii. Neuroleptic malignant syndrome
    - 1. Pathophysiology & inciting agents
    - 2. Clinical presentation
    - 3. Treatment
  - iii. Serotonin syndrome
    - 1. Pathophysiology & inciting agents
    - 2. Clinical presentation
    - 3. Treatment
- i. Beta-blocker and calcium channel antagonist poisoning
  - i. Pathophysiology
  - ii. Clinical presentation
  - iii. Treatment
    - 1. Intravenous fluids and calcium
    - 2. Glucagon
    - 3. Vasopressors and inotropes
    - 4. Hyperinsulinemic-euglycemic therapy
    - 5. Other treatments:
      - a. Intravenous lipid emulsion
      - b. Methylene blue
      - c. VA-ECMO
- j. Ethanol intoxication, ethanol withdrawal, and alcoholic ketoacidosis
  - i. Ethanol intoxication
    - 1. Clinical presentation
    - 2. Indicated laboratory testing
    - 3. Management

- ii. Alcoholic ketoacidosis
  - 1. Pathophysiology
  - 2. Expected lab findings
  - 3. Treatment
    - a. Glucose/thiamine myths
- iii. Ethanol withdrawal
  - 1. Pathophysiology
  - 2. Clinical presentation
  - 3. Treatment
    - a. Selecting a benzodiazepine
    - b. Role of barbiturates, propofol, and ketamine
- k. Toxic alcohol poisoning
  - i. Pathophysiology
  - ii. Clinical presentation and lab findings
  - iii. Treatment
    - 1. Fomepizole
    - 2. Hemodialysis
- l. Digoxin poisoning
  - i. Pathophysiology
  - ii. Clinical presentation and lab findings
  - iii. Treatment with DigiFab
- m. Selective serotonin reuptake inhibitor (and related antidepressant) poisoning
  - i. History of antidepressant development
  - ii. SSRI poisoning—clinical presentation
  - iii. Atypical modern antidepressants—clinical presentation
  - iv. Dangerous modern antidepressants—clinical presentation and treatment
    - 1. Citalopram
    - 2. Venlafaxine
    - 3. Vilazodone
    - 4. Bupropion
- n. Use of common antidotes
  - i. N-acetylcysteine
  - ii. Naloxone
  - iii. Physostigmine
  - iv. Flumazenil
  - v. Sodium bicarbonate
  - vi. Crotalid antivenom
- o. Snake envenomations
  - i. North American elapid envenomations
    - 1. Clinical presentation
    - 2. Treatment (antivenom, cholinesterase inhibitors, supportive care)
  - ii. North American crotalid envenomations

1. Distinction between rattlesnakes and *Agkistrodon*
  2. Toxic effects of crotalid venom
  3. Approach to laboratory testing
  4. Treatment with antivenom
2. Students will demonstrate mastery of the toxicologic history and physical examination by performing it on a real and/or simulated patient.
3. Students will demonstrate understanding of core topics in addiction medicine:
  - a. Interpretation of urine drug screens
  - b. Opioid use disorder, opioid intoxication, and opioid withdrawal
  - c. Medications for opioid use disorder: pharmacology, indications, cautions, and dosing
    - i. Buprenorphine
    - ii. Methadone
    - iii. Naltrexone
  - d. Pharmacologic management of alcohol use disorder
4. Students will complete online modules and receive a certificate which can be used to obtain a DEA X-waiver for the prescription of buprenorphine for opioid use disorder.
5. Students will demonstrate understanding of key concepts in pharmacology:
  - a. Pharmacokinetics
    - i. Absorption
    - ii. Distribution
    - iii. Metabolism
    - iv. Elimination
  - b. Pharmacodynamics
  - c. Toxicokinetics
  - d. Toxicodynamics
6. Students will observe, discuss, and understand a humanistic approach to patients with substance use disorders and acute suicidality.
7. Students will discuss and understand the impact of race, sex, class, and socio-economic status on the risk for, presentation of, and treatment of toxic exposures and substance use disorders.
8. Students will explore, research, and present on advanced topics in toxicology of their choosing.

## **Description of Activities**

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1. Participation in rounds, clinical consultations, and outpatient clinic:
  - a. Students will participate in daily rounds and see clinical consultations with the physician team. When possible, they will be assigned patients to follow longitudinally. They will present patients on rounds, communicate with primary teams, and assist with clinical documentation.
  - b. Students will participate in bedside clinical consultations. When possible, they will be given the opportunity to evaluate a new consultation independently and then report back to the physician team with their assessment and plan.

- c. Students will attend at least one day of outpatient Toxicology/Addiction Medicine clinic during their rotation.
2. Toxicology call:
  - a. While not required, students may request to be included on after-hours home call.
    - i. If the resident or fellow comes into the hospital to evaluate a patient in person when a student is on call, the student may elect to come into the hospital as well. If the resident or fellow performs a consultation by phone, the student can be included on the line (via 3-way calling) for the phone consultation.
    - ii. We suggest that if the student would like to be included on call that it not go past 23:00.
3. Weekly Toxicology didactics:
  - a. Students will attend and participate in weekly Toxicology didactics.
  - b. Participation will include reading all assigned material (textbook chapters, journal articles, etc.), actively participating in discussions during the didactics, and in some cases presenting or summarizing material for the group (for example, an assigned chapter or article).
  - c. Participating will also include preparing and presenting picture projects and end-of-rotation projects (see below).
4. Weekly EM Residency Conference:
  - a. Students will attend EM residency conference sessions that are relevant to Medical Toxicology (as determined by the rotation director or the attending physician on service)
5. Daily "chalk talks" and ad hoc teaching:
  - a. Students will participate in focused educational sessions daily.
  - b. These may include "chalk talks" about core toxicology content, group discussions of toxicologic diagnosis and management, and/or didactic presentations on selected topics by fellows or attending physicians.
6. Toxicology core content educational modules:
  - a. Students will complete a set of assigned online educational modules during their Medical Toxicology rotation.
  - b. Educational modules are available online via PEAC. The full list of assigned modules can be found below.
7. X-Waiver training:
  - a. Students will complete all training necessary to obtain their DEA X-waiver for the prescription of buprenorphine for opioid use disorder.
  - b. Training is available for free online, and in some circumstances may also be available by video or in person.
8. Poison Control Center visit:
  - a. Students will make at least one visit to the Missouri Poison Center with the residents and fellows.
  - b. Students will participate in case review and learn about the operations of the Missouri Poison Center, the qualifications and training of its personnel, and its role in evidence-based triage and management of toxicologic exposures and emergencies.

## **Evaluation of Students**

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1. Assessment of participation in rounds & consultations:
  - a. Students' clinical acumen, fund of knowledge, professionalism, and work ethic, as demonstrated in the course of their clinical responsibilities (rounds, consultations, clinic), will be continuously assessed by residents, fellows, and attending physicians on the Medical Toxicology service.
  - b. These assessments will be collected, reviewed, and collated by the rotation director.
2. Completion of required educational content:
  - a. Students are expected to complete all required educational content listed above, including online educational modules and X-waiver training.
  - b. No student who fails to complete all required educational content will be eligible for an Honors grade.
3. Weekly picture project presentations:
  - a. Students' picture presentations will be evaluated for accuracy and completeness by residents, fellows, and attending physicians attending Toxicology didactics.
  - b. These evaluations will be collected, reviewed, and collated by the rotation director.
4. End of rotation presentation:
  - a. Students' end-of-rotation presentations will be evaluated for accuracy, completeness, and overall skill of execution by residents, fellows, and attending physicians present at Toxicology didactics.
  - b. These evaluations will be collected, reviewed, and collated by the rotation director.
5. End of rotation exam:
  - a. Students will take an end-of-rotation exam covering the core toxicology and addiction medicine content listed above.
  - b. Students' performance on this examination will be factored into their overall course grade.
  - c. No student scoring less than 70% on the examination will be eligible for an Honors grade.
6. Simulated patient cases:
  - a. Students will participate in simulated cases of toxicologic emergencies. These may be conducted in the simulation laboratory or in an oral boards style format.
  - b. Students' performance on simulated cases will be assessed by the resident, fellow, and/or attending physicians conducting or observing the cases. Assessment will be based on their overall clinical acumen, the performance of predetermined critical actions, and the performance of predetermined unacceptable actions.
  - c. These evaluations will be collected, reviewed, and collated by the rotation director, and will be factored into their overall course grade.

## **Assessment**

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1. Formative feedback:

- a. Ad-hoc “just in time” feedback from residents, fellows, and attending physicians.
  - b. Brief meeting with the rotation director (or their designee) at the midpoint and end of the rotation to review feedback, check in on progress towards completion of educational content, address areas of strength and areas for continued improvement, and discuss goals.
2. Summative feedback:
- a. End of rotation meeting with the rotation director (or their designee) to review final feedback and highlight areas for continued improvement.
  - b. Provision of formal written summative feedback to the student and to the Office of Medical Student Education for incorporation into the Dean’s Letter.
  - c. Assignment of a grade (Honors, High Pass, Pass, Fail).

## Evaluation

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1. Informal feedback:
  - a. Students will be encouraged to provide informal feedback regarding the rotation and the fellows and attending physicians throughout their time on the Toxicology service.
  - b. Students may provide this feedback directly to fellows or attending physicians, to the rotation director, or to the section head.
  - c. If students would prefer to provide anonymous feedback or are not comfortable communicating their feedback directly to the physicians listed above, they may send feedback by email to Andrea Ramirez (Administrative Coordinator, Toxicology/EMS), and she will de-identify the feedback and forward it to the appropriate party.
2. Formal end-of-rotation feedback:
  - a. Students will complete the attached evaluation form.
  - b. Students will return the evaluation form to Andrea Ramirez, who will remove students’ identifying information and forward it to the rotation director.
  - c. At the discretion of the rotation director, Andrea Ramirez may also hold back all evaluation forms until the end of the academic year before forwarding them, to avoid unintentionally identifying students with their feedback by association with the dates of their rotation.
3. Grave concerns:
  - a. If students have grave concerns, including but not limited to mistreatment, abuse, harassment (sexual or otherwise), discriminatory conduct, or the creation of a hostile learning environment, they should:
    - i. Follow established WUSM procedures for reporting such concerns to the Office of Medical Student Education and/or the deans.
    - ii. Report these concerns directly to the rotation director and/or the section head, **only if they are comfortable doing so.**