Poisoning

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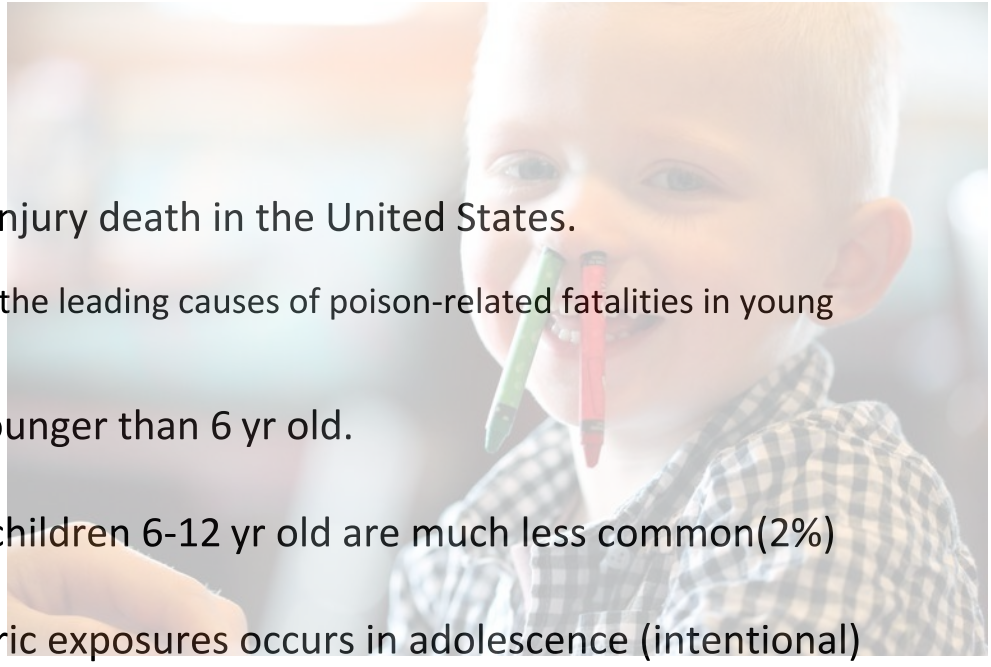
Objectives

- Epidemiology
- Approach to the poisoned child
  - Hx
  - Physical exam
  - Lab/Diagnostic tests
- Toxidromes
- Principles of management

Epidemiology

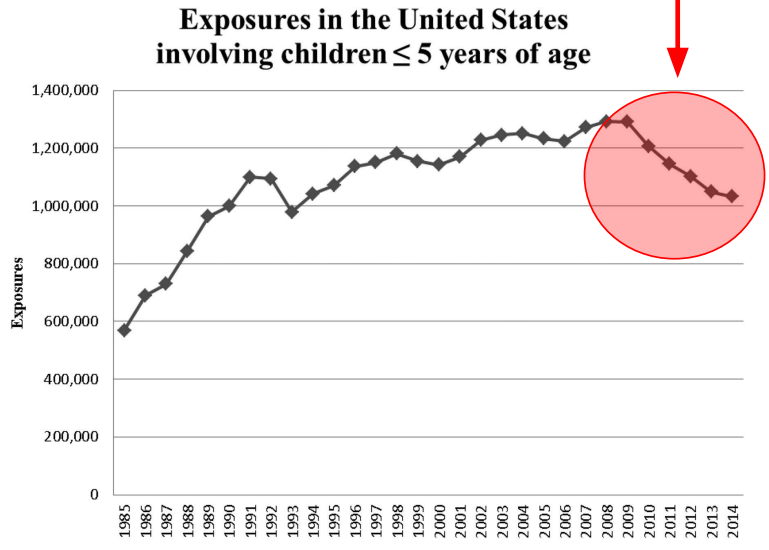


- The number 1 cause of injury death in the United States.
  - Mostly unintentional.
  - CO and analgesics were the leading causes of poison-related fatalities in young children
- 50% occur in children younger than 6 yr old.
- Poisoning exposures in children 6-12 yr old are much less common(2%)
- A second peak in pediatric exposures occurs in adolescence (intentional)
- Children younger than 6 yr account for <2% of all poisoning fatalities

Epidemiology – Where/how/what

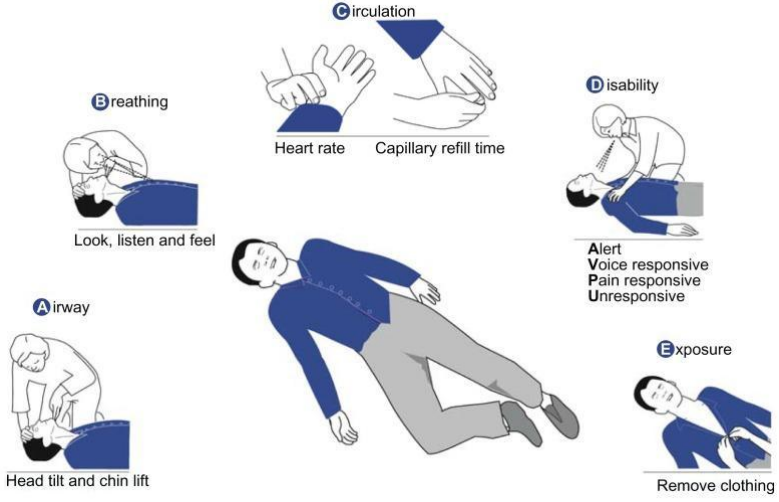
- 90% of toxic exposures in children occur in the home.
- Most involve only a single substance
- Ingestion most common rout
- 50% of cases involve are nondrug
- Household cleaning products and cosmetics represent the majority of calls to poison centers

? Related to newly designed safety packages



Approach

- Should be no different than that in any other sick child.
- Stabilization and ABCDEs
- Targeted history and physical examination



Approach – History

- Very important
- Some features may suggest poisoning
  - Acute onset
  - No prodrome
  - Sudden change in LOC
  - Multiorgan failure
- Description of the exposure:
  - When, how much , where , why
  - What (household product vs medical)
  - List of meds in house
  - Did the family brought it the product with them?
  - immediate- versus extended-release preparation

Approach – History

- Details of the symptoms
  - When did the symptom start in relation to time of ingestion
  - Progression
- Past Medical History:
  - Underlying diseases can make a child susceptible to the effects of a toxin.
  - Current medication list (Drug-Drug interaction)
  - Psychiatric illness (more prone to substance abuse, misuse, intentional ingestions, and polypharmacy complications)
  - A developmental history (a report of a 6 mo old picking up a large container of laundry detergent and drinking it should raise a red flag)
- Social History

Approach –Physical Exam

- Targeted aiming to identify potential toxin and assess the severity.
- Findings might suggest a toxidrome and help to build a DDx
- Initial effort should be directed to ABCs
- Key features of the physical exam:
  - V/S
  - LOC/GCS
  - Pupils
  - Nystagmus
  - Skin
  - Bowl sounds
  - Odor

Overview of some physical findings

ODOR	
Bitter almonds	**Cyanide**
Acetone	Isopropyl alcohol, methanol, paraldehyde, salicylates
Alcohol	Ethanol
Wintergreen	Methyl salicylate
Garlic	**Arsenic**, thallium, **organophosphates**, selenium

OCULAR SIGNS	
Miosis	**Opioids** (except propoxyphene, meperidine, and pentazocine), **organophosphates** and other **cholinergics**, clonidine, phenothiazines, sedative–hypnotics, olanzapine
Mydriasis	**Anticholinergics** (e.g., antihistamines, TCAs, atropine), **sympathomimetics** (cocaine, amphetamines, PCP) postanoxic encephalopathy, opiate withdrawal
Nystagmus	**Anticonvulsants**, sedative–hypnotics, alcohols, PCP, **ketamine**, dextromethorphan
Lacrimation	**Organophosphates**, irritant gas or vapors
Retinal hyperemia	Methanol

CUTANEOUS SIGNS	
Diaphoresis	**Cholinergics** (organophosphates), sympathomimetics, withdrawal syndromes
Alopecia	Thallium, arsenic
Erythema	Boric acid, elemental mercury, cyanide, carbon monoxide, disulfiram, scombroid, anticholinergics, vancomycin
Cyanosis (unresponsive to oxygen)	**Methemoglobinemia** (e.g., benzocaine, dapsone, nitrites, phenazopyridine), **amiodarone**, silver

ORAL SIGNS	
Salivation	Organophosphates, salicylates, corrosives, ketamine, PCP, strychnine
Oral burns	**Corrosives**, oxalate-containing plants
Gum lines	Lead, mercury, arsenic, bismuth
GASTROINTESTINAL SIGNS	
Diarrhea	Antimicrobials, arsenic, iron, boric acid, cholinergics, colchicine, **opioid withdrawal**
Hematemesis	Arsenic, iron, caustics, NSAIDs, salicylates

CARDIAC SIGNS	
Tachycardia	**Sympathomimetics**, **anticholinergics**, antidepressants, antipsychotics, methylxanthines (theophylline, caffeine), salicylates, cellular asphyxiants (cyanide, carbon monoxide, hydrogen sulfide), **withdrawal** (ethanol, sedatives, clonidine, opioids), serotonin syndrome, neuroleptic malignant syndrome
Bradycardia	**β Blockers**, **calcium channel blockers**, **digoxin**, **clonidine**, organophosphates, opioids, sedative–hypnotics
Hypertension	**Sympathomimetics**, **anticholinergics**, monoamine oxidase inhibitors, serotonin syndrome, neuroleptic malignant syndrome, clonidine withdrawal
Hypotension	**β Blockers**, **calcium channel blockers**, cyclic antidepressants, iron, antipsychotics, barbiturates, clonidine, opioids, arsenic, amatoxin mushrooms, cellular asphyxiants (cyanide, carbon monoxide, hydrogen sulfide), snake envenomation

RESPIRATORY SIGNS	
Depressed respirations	**Opioids**, sedative-hypnotics, alcohol, clonidine, barbiturates
Tachypnea	**Salicylates**, sympathomimetics, caffeine, metabolic acidosis, carbon monoxide, hydrocarbon aspiration
CENTRAL NERVOUS SYSTEM SIGNS	
Ataxia	Alcohols, anticonvulsants, sedative–hypnotics, lithium, dextromethorphan, carbon monoxide, inhalants
Coma	Opioids, sedative–hypnotics, anticonvulsants, antidepressants, antipsychotics, ethanol, anticholinergics, clonidine, GHB, alcohols, salicylates, barbiturates
Seizures	Sympathomimetics, anticholinergics, antidepressants (especially TCAs, bupropion, venlafaxine), cholinergics (organophosphates), isoniazid, camphor, lindane, salicylates, lead, nicotine, tramadol, water hemlock, withdrawal
Delirium/psychosis	Sympathomimetics, anticholinergics, LSD, PCP, hallucinogens, lithium, dextromethorphan, steroids, withdrawal
Peripheral neuropathy	Lead, arsenic, mercury, organophosphates

Toxidromes

- Definition:
  - A group of signs and symptoms constituting the basis for a diagnosis of poisoning.

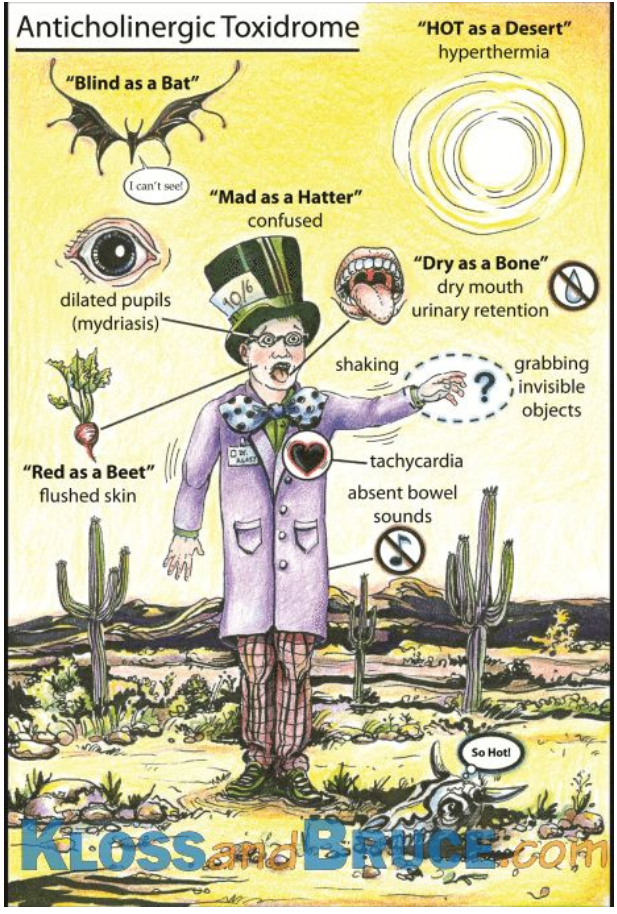
Sympathomimetic

TOXIDROME	SIGNS						POSSIBLE TOXINS
	VITAL SIGNS	MENTAL STATUS	PUPILS	SKIN	BOWEL SOUNDS	OTHER	
Sympathomimetic	Hypertension, tachycardia, hyperthermia	Agitation, psychosis, delirium, violence	Dilated	Diaphoretic	Normal to increased		Amphetamines, cocaine, PCP, bath salts (cathinones), ADHD medication

Anticholinergic

TOXIDROME	SIGNS						POSSIBLE TOXINS
	VITAL SIGNS	MENTAL STATUS	PUPILS	SKIN	BOWEL SOUNDS	OTHER	
Anticholinergic	Hypertension, tachycardia, hyperthermia	Agitated, delirium, coma, seizures	Dilated	Dry, hot	Diminished	Ileus urinary retention	Antihistamines, tricyclic antidepressants, atropine, jimson weed

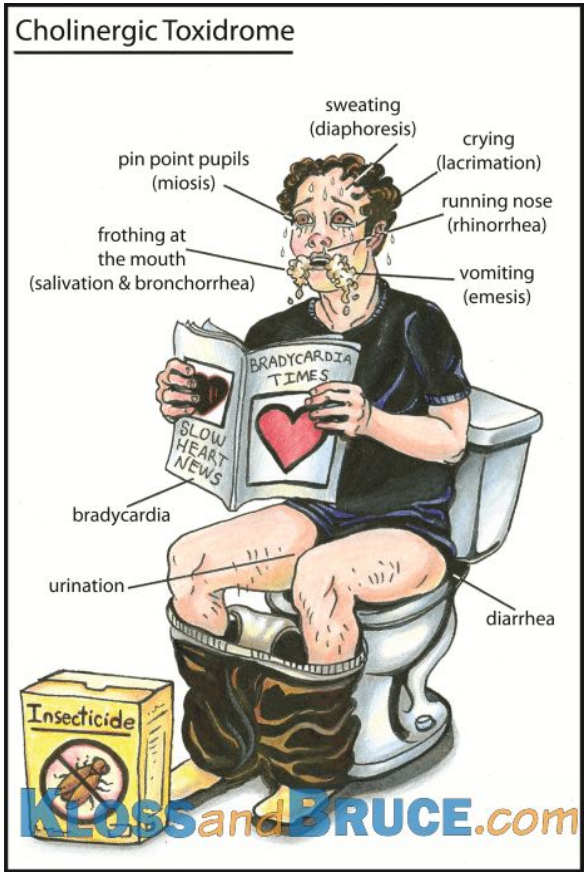
Anticholinergic



Cholinergic

TOXIDROME	SIGNS						POSSIBLE TOXINS
	VITAL SIGNS	MENTAL STATUS	PUPILS	SKIN	BOWEL SOUNDS	OTHER	
Cholinergic	Bradycardia BP and temp typically normal	Confusion, coma, fasciculations	Small	Diaphoretic	Hyperactive	Diarrhea, urination, bronchorrhea, bronchospasm, emesis, lacrimation, salivation	Organophosphates (insecticides, nerve agents), carbamates (physostigmine, neostigmine, pyridostigmine)

Cholinergic



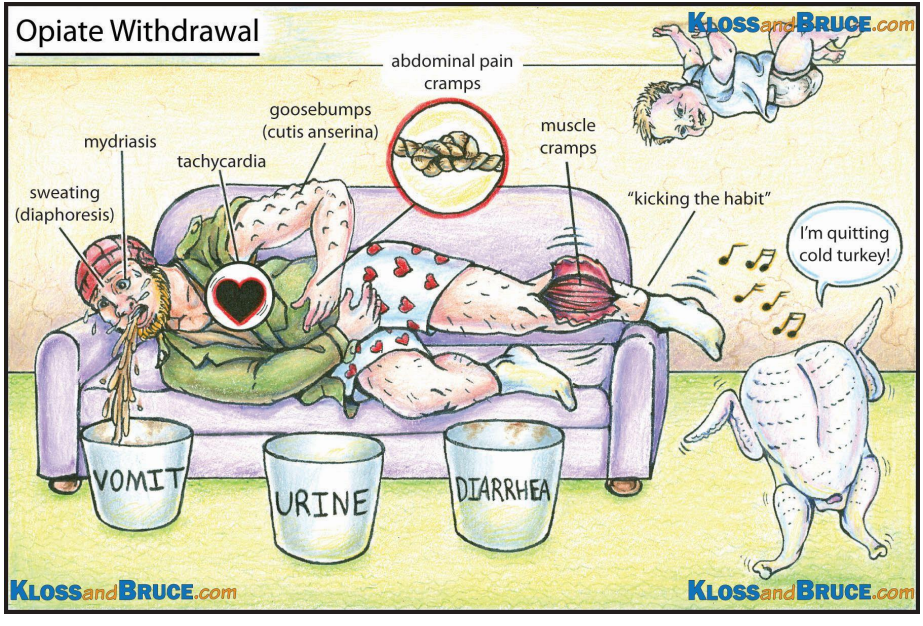
Opioids

TOXIDROME	SIGNS						POSSIBLE TOXINS
	VITAL SIGNS	MENTAL STATUS	PUPILS	SKIN	BOWEL SOUNDS	OTHER	
Opioids	Respiratory depression bradycardia, hypotension, hypothermia	Depression, coma, euphoria	Pinpoint	Normal	Normal to decreased		Methadone, buprenorphine, morphine, oxycodone, heroin, etc.

Opioids Withdrawal

TOXIDROME	SIGNS						POSSIBLE TOXINS
	VITAL SIGNS	MENTAL STATUS	PUPILS	SKIN	BOWEL SOUNDS	OTHER	
Withdrawal (opioid)	Tachycardia	Restlessness, anxiety	Dilated	diaphoretic	Hyperactive	Nausea, vomiting, diarrhea	Lack of access to opioids or excessive use of naloxone

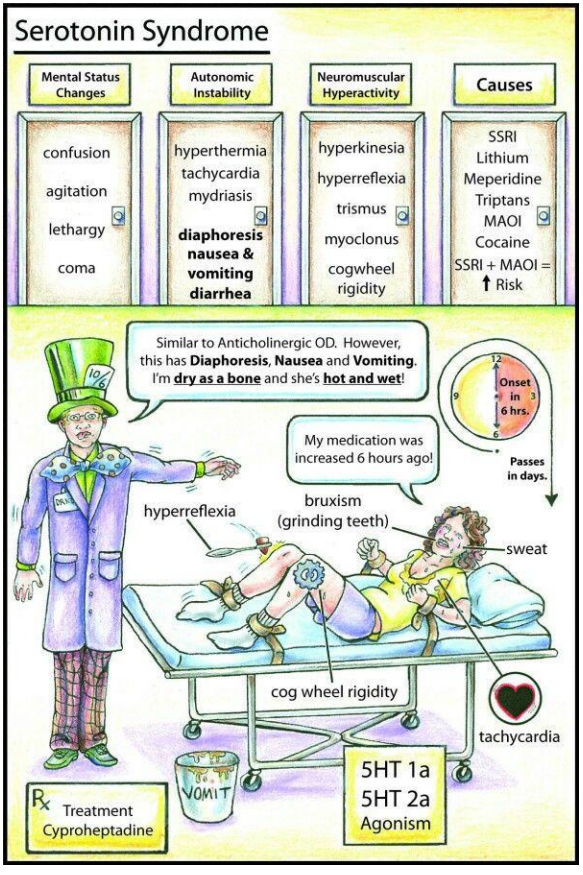
Opioids Withdrawal



Serotonin Syndrome

TOXIDROME	SIGNS						POSSIBLE TOXINS
	VITAL SIGNS	MENTAL STATUS	PUPILS	SKIN	BOWEL SOUNDS	OTHER	
Serotonin syndrome	Hyperthermia, tachycardia, hypertension or hypotension (autonomic instability)	Agitation, confusion, coma	Dilated	Diaphoretic	Increased	Neuromuscular hyperexcitability: clonus, hyperreflexia (lower extremities > upper extremities)	SSRIs, lithium, MAOIs, linezolid, tramadol, meperidine, dextromethorphan

Serotonin Syndrome



Lab/Diagnostic Testing

- Drug Levels
- Tox-Screen
- U&E
- Blood Gas
- LFTs (Acetaminophen)
- Serum Osmolality (Alcohol)
- CK (prolonged down time)
- ECG (Dig, Amiodaron, SSRI)

Drug levels

- For some drugs quantitative blood concentrations are integral to confirming the diagnosis and formulating a treatment plan.
  - SAS, Acetaminophen, dig, iron and methanol.

- For most exposures, quantitative measurement is not readily available and is not likely to alter management.

- All intoxicant levels must be interpreted in conjunction with the history.
  - Chronic vs acute use
  - Time of ingestion
  - Co-ongestion

Acetaminophen Level

- Very helpful.
- Acetaminophen is a widely available medication and a commonly detected co-ingestant with the potential for severe toxicity.
- There is an effective antidote to acetaminophen poisoning that is time-dependent.
- Patients might initially be asymptomatic and might not report acetaminophen as a coingestant, an acetaminophen level should be checked in all patients who present after an intentional exposure or ingestion

antidote NAC

Tox-Screen

- Varey from lab to lab :
  - What it tests for?
  - Cutoff for +
  - False + /Fales –
  - Eg Synthetic opioid are not detected with urine tox-screen
- Helpful in patients with altered mental status of unknown etiology, persistent, unexplained tachycardia, acute myocardial ischemia or stroke at a young age

KUB

RADIOPAQUE SUBSTANCE ON KUB (MNEMONIC = CHIPPED)
•**C** hloral hydrate, calcium carbonate •**H** eavy metals (lead, zinc, barium, arsenic, lithium, bismuth) •**I** ron •**P** henothiazines •**P** lay-Doh, potassium chloride •**E** nteric-coated pills •**D** ental amalgam, drug packets

Principles of Management

1. ABCDs (supportive care)
2. Antidots
3. Decontamination
4. Enhanced elimination

ABCDs (supportive care)

- Airway: Patent and maintainable
- Breathing: Spontaneous with GABL ,RR, SpO2 and WOB
- Circulation: HR, BP, Cap refill, Rhythm and Liver edge in infants
- Disability: Pupils ?equal and reactive . GCS Glucocheck
- Exposure , check the skin for any contamination

Antidots

- Definition = a medicine taken or given to counteract a particular poison.

- Only a small proportion of poisoned patients are amenable to antidotal therapy

- Only a few poisoning is antidotal therapy urgent (e.g., CO, cyanide, organophosphate and opioid intoxication)

POISON	ANTIDOTE	DOSAGE	ROUTE	ADVERSE EFFECTS, WARNINGS, COMMENTS
Acetaminophen	*N* -Acetylcysteine (Mucomyst)	140 mg/kg loading, followed by 70 mg/kg q4h	PO	Vomiting (patient-tailored regimens are the norm)
	N -Acetylcysteine (Acetadote)	150 mg/kg over 1 hr, followed by 50 mg/kg over 4 hr, followed by 100 mg/kg over 16 hr	IV	Anaphylactoid reactions (most commonly seen with loading dose) (Higher doses of the infusion are often recommended depending upon the acetaminophen level and the degree of injury)
Anticholinergics	Physostigmine	0.02 mg/kg over 5 min; may repeat q5-10min to 2 mg max	IV/IM	Bradycardia, seizures, bronchospasm *Note:* Do not use if conduction delays on ECG
Benzodiazepines	Flumazenil	0.2 mg over 30 sec; if response is inadequate, repeat q1min to 1 mg max	IV	Agitation, seizures; **do not use for unknown ingestions**
β Blockers	Glucagon	0.15 mg/kg bolus followed by infusion of 0.05-0.15 mg/kg/hr	IV	Hyperglycemia, vomiting

POISON	ANTIDOTE	DOSAGE	ROUTE	ADVERSE EFFECTS, WARNINGS, COMMENTS
Carbon monoxide	Oxygen	100% F_{io_2} via non–rebreather mask (or ET if intubated)	Inhalational	Some patients may benefit from hyperbaric oxygen (see text)
Cyanide	Cyanide kit:			
	Amyl nitrate	1 crushable ampule; inhale 30 sec of each min	Inhalation	Methemoglobinemia
	Sodium nitrate	0.33 mL/kg of 3% solution if hemoglobin level is not known; otherwise, based on tables with product	IV	Methemoglobinemia Hypotension
	Sodium thiosulfate	1.6 mL/kg of 25% solution; may be repeated q30-60min to max of 50 mL	IV	If inducing methemoglobinemia is contraindicated; consider only using the thiosulfate component of the kit
	Hydroxocobalamin (Cyanokit)	70 mg/kg (adults: 5 g) given over 15 min	IV	Flushing/erythema, nausea, rash, chromaturia, hypertension, headache
Digitalis	Digoxin-specific Fab antibodies (Digibind; DigiFab)	1 vial binds 0.6 mg of digitalis glycoside; #vials = digitalis level × weight in kg/100	IV	Allergic reactions (rare), return of condition being treated with digitalis glycoside

POISON	ANTIDOTE	DOSAGE	ROUTE	ADVERSE EFFECTS, WARNINGS, COMMENTS
Opioids	Naloxone	0.01-0.1 mg/kg; adolescents/adults: 0.04-2 mg, repeated as needed; may give continuous infusion	IV	Acute withdrawal symptoms if given to addicted patients May also be useful for clonidine ingestions (inconsistent response)
Organophosphates	Atropine	0.05-0.1 mg/kg repeated q5-10min as needed	IV/ET	Tachycardia, dry mouth, blurred vision, urinary retention
	Pralidoxime (2-PAM)	25-50 mg/kg over 5-10 min (max: 200 mg/min); can be repeated after 1-2 hr, then q10-12hr as needed	IV/IM	Nausea, dizziness, headache, tachycardia, muscle rigidity, bronchospasm (rapid administration)

POISON	ANTIDOTE	DOSAGE	ROUTE	ADVERSE EFFECTS, WARNINGS, COMMENTS
Ethylene glycol, methanol	Fomepizole	15 mg/kg load; 10 mg/kg q12h × 4 doses; 15 mg/kg q12h until EG level is <20 mg/dL	IV	Infuse slowly over 30 min; If fomepizole is not available, can treat with oral ethanol (80 proof)
Iron	Deferoxamine	Infusion of 5-15 mg/kg/hr (max: 6 g/24 hr)	IV	Hypotension (minimized by avoiding rapid infusion rates)
Isoniazid (INH)	Pyridoxine	Empirical dosing: 70 mg/kg (max dose = 5 g) If ingested dose is known: 1 g per gram of INH	IV	May also be used for *Gyromitra* mushroom ingestions

Decontamination

- The goal of decontamination is to minimize absorption of the toxic substance.
- Decontamination should not be routinely employed for every poisoned patient.
- **Dermal and ocular decontamination** remove any contaminated clothing and particulate matter, followed by flushing of the affected area with tepid water or normal saline.
  - 10-20 min of washing is recommended for most exposures.
  - Dermal decontamination, especially after exposure to **adherent or lipophilic** (e.g., organophosphates) agents, should include thorough cleansing with soap and water .
  - Avoid water with highly reactive agents.

GI Decontamination:

- GI decontamination strategies are most likely to be effective **in the 1st hour after an acute ingestion.**

- GI decontamination at more than 1 hr after ingestion may be considered in patients who ingest toxic substances with these properties:

  - GI absorption may be delayed after ingestion of agents that slow GI motility (anticholinergic medications, opioids or TCA).
  - massive pill ingestions.
  - sustained-release preparations.
  - ingestions of agents that can form pharmacologic bezoars (e.g., enteric-coated salicylates).

Methods of GI Decontamination:

- Syrup Ipecac:
  - Risk is more than benefit (no evidence)

- Gastric Lavage:
  - in most clinical scenarios, the use of gastric lavage is no longer recommended.

Single dose Activated Charcoal:

- It has an extensive network of pores that provides a very large adsorptive surface area.
- 1g/kg or 50-100 g in adolescents and adults
- A repeat dose of activated charcoal may be warranted in the cases of ingestion of an extended release product or, more commonly, with a significant salicylate poisoning as a result of its delayed and erratic absorption pattern.
- Not effective in :
  - Charged molecules (i.e., heavy metals lithium, iron)
  - liquids do not bind well to activated charcoal
  - Caustic agents

Table 63-9	Substances Poorly Adsorbed By Activated Charcoal
Alcohols Caustics: alkalis and acids Cyanide Heavy metals (e.g., lead) Hydrocarbons Iron Lithium	

Single dose Activated Charcoal:

- 20% of pt will vomit → must ensure that the patient's airway is intact or protected and that the patient has a benign abdominal exam.

- In the awake, uncooperative adolescent or child who refuses to drink the activated charcoal, there is relatively little utility and potential morbidity associated with forcing activated charcoal down a nasogastric tube, and such practice should be avoided.

- Constipation is a common side effect. (consider lactulose)

Enhanced Elimination:

- Urinary Alkalinization
- Hemodialysis
- Multiple-Dose Activated Charcoal
- Intralipid Emulsion Therapy

Urinary Alkalinization

- Making a molecule charged and hydrophilic → difficult to be absorbed through fat membrane Thus, the molecule is trapped within the renal tubules

- Accomplished via a continuous infusion of sodium bicarbonate–containing intravenous fluids, with a goal urine pH of 7.5-8.

- Alkalinization of the urine is most useful in managing **salicylate and methotrexate toxicity.**

Hemodialysis

- Enhance the elimination of the toxin itself
- Also be useful to correct severe electrolyte disturbances and acid–base derangement
- Toxins that are amenable to dialysis have the following properties:
  - low volume of distribution (<1 L/kg).
  - low molecular weight.
  - low degree of protein binding.
  - high degree of water solubility.
- **eg methanol, ethylene glycol, salicylates, theophylline, bromide, lithium, and, potentially, valproic acid.**

Acetaminophen

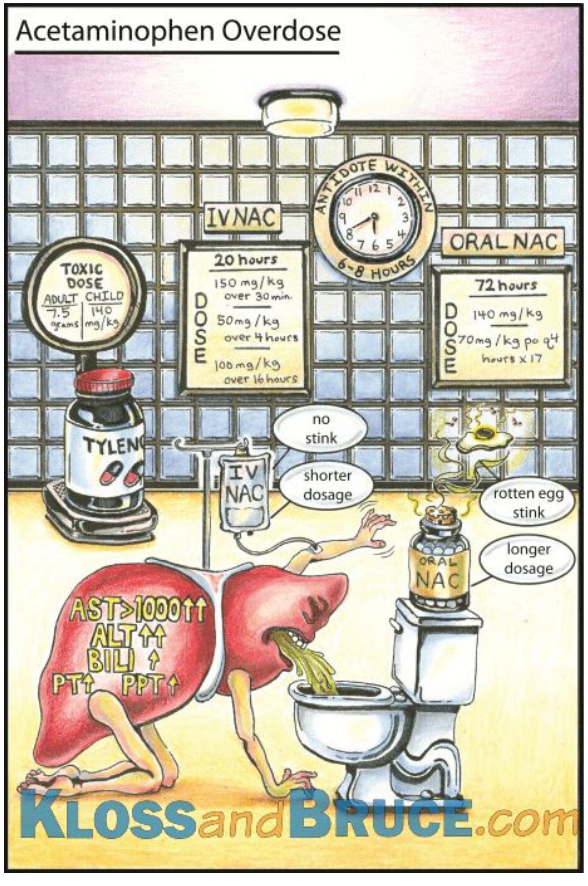
- The most common cause of acute liver failure in USA

- **The single acute toxic dose of acetaminophen is generally considered to be >200 mg/kg in children and >7.5-10 g in adolescents and adults.**

Classical signs and symptoms

STAGE	T after Ingestion	CHARACTERISTICS
I	0.5–24 hr	Anorexia, nausea, vomiting, malaise, pallor, diaphoresis
II	24–48 hr	Resolution of earlier symptoms; right upper quadrant abdominal pain and tenderness; elevated bilirubin, prothrombin time, hepatic enzymes; oliguria
III	72–96 hr	Peak liver fxn abnormalities; anorexia, nausea, vomiting, and malaise may reappear
IV	4 days–2 wk	Resolution of hepatic dysfunction or complete liver failure

Acetaminophen



Acetaminophen overdose Rx

- After ABCs
- Hx
  - Time
  - Quantity
  - Regular vs extended rlease
  - Intetion
- LFTs, Lytes, renal function
- Obtain a level 4 hours after ingestion
- Use Rumack-Matthew nomogram
  - Only for single ingestion