Poisoning: A Public Health Problem

LEARNING OBJECTIVES
Upon completion of this module, the subscriber will be able to:

1. Define poison and poisoning, and explain why it is a public health concern in the U.S.
2. Describe the functions of a Poison Control Center.
3. Describe the top five substances most frequently involved in poisonings.
4. Differentiate between household substances expected to cause minimal toxicity in an unintentional exposure, and household substances capable of causing major toxicity in an unintentional exposure.
5. Identify tips for poison prevention and safety.

ACCREDITATION
Pharmacy Tech Topics™ modules are accredited for Continuing Pharmacy Education (CPE) by the Illinois Council of Health-System Pharmacists. The Illinois Council of Health-System Pharmacists is accredited by the Accreditation Council for Pharmacy Education as a provider of continuing pharmacy education. The intended audience is pharmacy technicians.

This module will provide 2.5 contact hours of patient safety continuing pharmacy education credit for pharmacy technicians.

ACPE Universal Activity Number: 0121-0000-15-001-H05-T | Type of Activity: Knowledge-based
Release Date: 01/01/15 | Expiration Date: 01/31/17
MEET THE AUTHOR

Carol DesLauriers, PharmD, DABAT
Dr. Carol DesLauriers is a pharmacist and a Diplomate of the American Board of Applied Toxicology. She serves as the Operations Director of the Illinois Poison Center, and is responsible for the day to day operations, and for the achievement of its mission of public education, professional education, public health integration, surveillance and research. Dr. DesLauriers serves as a preceptor in Poison Information for several colleges of pharmacy. She serves on various committees such as the Illinois Attorney General Safe Home Coalition, the American Association of Poison Control Centers Accreditation Committee, and the Chicago Department of Public Health Pharmacy Committee.

FACULTY DISCLOSURE. It is the policy of the Illinois Council of Health-System Pharmacists (ICHP) to ensure balance and objectivity in all its individually or jointly presented continuing pharmacy education programs. All faculty participating in any ICHP continuing pharmacy education programs are expected to disclose any real or apparent conflict(s) of interest that may have any bearing on the subject matter of the continuing pharmacy education program. Disclosure pertains to relationships with any pharmaceutical companies, biomedical device manufacturers, or other corporations whose products or services are related to the subject matter of the topic.

The intent of disclosure is not to prevent the use of faculty with a potential conflict of interest from authoring a publication but to let the readers know about the relationship prior to participation in the continuing pharmacy education activity. It is intended to identify financial interests and affiliations so that, with full disclosure of the facts, the readers may form their own judgments about the content of the learning activity.

The author’s submission has been peer reviewed with consideration and knowledge of these potential conflicts and it has been found to be balanced and objective. The author has no real or apparent conflict(s) of interest that may have any bearing on the subject matter of this continuing pharmacy education program.

NOTICE: Medicine is an ever-changing science. As new research and clinical experience broaden our knowledge, changes in treatment and drug therapy are required. The author and the publisher of this work have checked with sources believed to be reliable in their efforts to provide information that is complete and generally in accord with the standards accepted at the time of publication. However, in view of the possibility of human error or changes in medical sciences, neither the authors nor the publisher nor any other party who has been involved in the preparation or publication of this work warrants that the information contained herein is in every respect accurate or complete, and they are not responsible for any errors or omissions or for the results obtained from use of such information.

Readers are encouraged to confirm the information contained herein with other sources. For example and in particular, readers are advised to check the product information sheet included in the package of each drug they plan to administer to be certain that the information contained in this module is accurate and that changes have not been made in the recommended dose or in the contraindications for administration. This recommendation is of particular importance in connection with new or infrequently used drugs. Always refer to changes in federal law and any applicable state laws.
Poisoning: A Public Health Problem

Poisoning: What Is It and Why Is It a Public Health Problem?

A poison is any substance that has the potential to cause harm. The degree of harm a poison is likely to cause is determined by its dose. In other words, practically every substance in existence is a potential poison. What is thought of as a “traditional” poison may include substances such as cyanide, arsenic and strychnine, which are considered to be dangerous in small amounts. However, life-saving drugs and medications are poisons if they are taken in an overdose. Even life-sustaining substances such as water and oxygen can harm the human body if they are taken in extreme excess.

Coming into contact with a potentially harmful substance is known as an exposure. Exposures can occur by any route—ingestion, inhalation, ocular, dermal, or parenteral. A poisoning means that the person has been physically harmed by the exposure in some way—the person’s symptoms could be minor or severe. Not all exposures will result in a poisoning. An exposure to a certain amount of substance may cause a poisoning in one patient but not in another.

- Example One: 1,000 mg of acetaminophen given every 6 hours is the therapeutic dose for an adult, however, if a 25 pound child was given 1,000 mg of acetaminophen every 6 hours, he or she could develop liver failure.
- Example Two: if a healthy adult inhales household bleach fumes for a few minutes while cleaning, he or she may not develop any symptoms; however, if an adult with a respiratory disease like asthma inhales bleach fumes, he or she may develop coughing and shortness of breath.

How sick or poisoned someone becomes after an exposure to a poison depends on the poison, the dose, and also on the patient. Toxicology is the science and study of toxic substances (poisons).

Poisoning was identified as a serious public health problem shortly after World War II. During this period, a plethora of new household chemicals, cleaning supplies, pesticides, and pharmaceuticals were being manufactured and made their way into American households. These products were often poorly packaged, their labels lacked ingredient information, and many were highly toxic. Unintentional poisonings resulted, often in the pediatric population. In the years 1949-1950, 834 children died from poisoning, and in 1953 the American Academy of Pediatrics reported that approximately 50% of childhood accidents were due to unintentional poisoning.

Over the next 60 years, a variety of developments and changes led to a significant decrease in childhood deaths due to poisoning: improved product packaging (including child-resistant containers), reformulation of household products to include safer ingredients, the establishment of a network of poison control centers, poison prevention education, and advances in emergency and critical care medicine. In 1981, childhood deaths due
to poisoning were only 25% of the 1961 levels. In 2011, there were less than 50 deaths reported in children age 4 years and younger due to poisoning.

While pediatric deaths ignited public concern over poisoning, poisoning is not only a pediatric problem. Today, approximately 50% of cases reported to US poison centers involve adolescents and adults, and the majority of illness and death due to poisoning occurs in adults. Exposures in children are usually different than those in adults. Pediatric exposures occur because naturally curious children learn about their environment by touch and taste; exposures are unintentional, and are usually small tastes or licks of substances in their homes. Many personal care products and household cleaners are minimally toxic in these small amounts. Ninety-nine percent (99%) of pediatric exposures reported to poison centers in 2012 resulted in either no symptoms or only a minor effect. Conversely, adult exposures are often ingestions of larger amounts of one or more substances, either for self-harm or for abuse, and this results in greater incidence of illness and death.

The substances involved in poisoning cases have also evolved since the mid-20th century. The majority of exposures were once household products and chemicals, whereas now they are pharmaceuticals. The increase in poisoning due to pharmaceuticals has correlated with an increase in prescriptions written. In 2011, more than four billion prescriptions were written in the United States (US). According to the American Association of Poison Control Centers (AAPCC), the 10 substance categories with the greatest rate of exposure increase between 2000 and 2012 are all pharmaceuticals.

**Data and Statistics**

Poisoning is the leading cause of injury-related death in the United States, with 42,844 deaths reported to the Centers for Disease Control and Prevention (CDC) in 2011. Deaths from poisoning exceed deaths from motor vehicle crashes and firearms. Drug overdose death rates have tripled since 1990. Over 90% of poisoning deaths reported to the CDC were due to drugs (including illegal/illicit drugs). Of these drug overdose deaths, 55% were caused by pharmaceuticals (prescription and over-the-counter [OTC] medications). Of those nearly 23,000 pharmaceutical-related deaths, 74% were caused by opioid analgesics (see Figure 1). This increase in opioid-related deaths is attributable to abuse and misuse of these medications. More than 75% of people who abuse opioids report getting them from a friend or family member, versus obtaining a legitimate prescription. About half of all opioid-related deaths involve at least one other drug (such as a benzodiazepine); many also involve alcohol. Another alarming trend in poisoning is the number of deaths that are unintentional. Unintentional (non-suicide) deaths accounted for 85% of all poisoning deaths in 2011.

**Poison Control Centers**

The first Poison Control Center was established in 1953 in Chicago in response to the increasing number of childhood deaths due to poisoning. Prior to the existence of poison centers, little information was available regarding expected symptoms and effective treatments for poisoning, and poison prevention education was nonexistent. Poison centers fulfilled such an important need that many hospitals throughout the country established a

![Figure 1. Poisoning Deaths in 2011](image)
Poisoning: A Public Health Problem

Poison center program as a community service. Many of these programs were nothing more than one telephone in a pharmacy or emergency room, manned by poorly trained personnel with limited resources available. At the peak, there were 661 poison centers in the country, with 100 in Illinois alone. The American Association of Poison Control Centers was established in 1958 to institute quality standards for poison centers.

Today there are 55 poison centers in the US poison center system; all states and territories of the United States are covered by poison center services. Members of the general public and health care professionals can reach a poison center on a toll free helpline (1-800-222-1222). Callers are routed to the nearest regional poison center which is staffed 24 hours a day, 7 days a week, 365 days a year. Poison centers field calls in more than 150 languages and do not impose a direct fee on the caller. Poison centers are staffed by health care professionals specially trained in toxicology. Each poison center is operated independently. Some are based in hospitals or universities and others are stand-alone non-profit organizations. Funding for poison centers also differs among the nation’s 55 centers. As a national average, approximately 62% of funding comes from state/local sources, 25% of funding comes from private sources (such as private grants, hospitals in the service region, or the host institution), and 13% comes from federal funds.

There are four main services provided by Poison Centers:

1. Provide immediate, expert consultation on potential poisonings to the general public. This service has two tiers.
   - The first tier is to triage which exposures can be safely managed at the site of exposure (usually the home), and which exposures require evaluation and management by a physician in an acute care setting (i.e. hospitals, emergency departments, urgent care centers). More than 90% of patients who contact a poison center are able to be managed at the site of exposure without the need for evaluation in a health care facility.
   - The second tier is to provide treatment advice and observation instructions for those majority of patients who are managed at the site of exposure.

2. Provide immediate, expert consultation on poisonings to health care providers.
   - More than 20% of exposure calls to nationwide poison centers originate from a health care provider, the majority of which are in acute care facilities.
   - The medical treatment of poisonings requires considerable specialized knowledge that not all clinicians can be expected to acquire and maintain; the overwhelming majority of health care facilities in the US do not employ a toxicologist. Health care facilities depend on the expertise of poison center specialists to assist in the management of their poisoned patients.

3. Surveillance and situational awareness
   - Details of all calls to the nation’s poison centers are uploaded into the AAPCC database, called the National Poison Data System (NPDS), approximately every 20 minutes (excluding patient identifying information such as names or phone numbers). This allows for real-time analysis of data, which is unique to this database.
   - Poison centers have been instrumental in toxicology-related events such as the Gulf Oil spill of 2010, the synthetic drug outbreak of 2011, and a large-scale water contamination incident in West Virginia in 2014.

4. Provide education in toxicology and poison prevention
   - Poison centers play an important role in training the next generation of physicians, pharmacists, and nurses in the subject of clinical toxicology.
   - Poison centers perform outreach and provide public education in the area of poison prevention and home safety, with the goal of poisoning prevention.

Poison centers field calls on exposures to all varieties of potentially toxic substances: household products; chemicals; medication overdoses; medication errors, snake and bug bites and stings; ingestion of plants and mushrooms; exposure to chemicals in the workplace; drugs of abuse and alcohol, etc.

Poison centers nationwide managed 2.275 million human exposures in 2012. The number of deaths reported to poison centers in 2012 was 1,190. This is significantly lower than the death total reported by the CDC. This is because poison centers are consulted to treat a living patient, and if the patient is deceased before they reach the hospital, there would be no reason to call a poison center.
Details On Calls To The Nation's Poison Centers

**WHO?** Approximately half of the exposures occur in children under age 6, and approximately half of the exposures occur in adolescents and adults.

**WHAT?** See Table 1 for the top 10 substance categories involved in poisonings nationwide (2012 data).

**WHERE?** 94% of exposures occur at the patient’s own home.

**WHEN?** A poison center’s busiest time is typically in the evening, and calls to poison centers increase in the warmer months of the year.

**WHY?** Exposures are unintentional (non-suicide) in approximately 90% of exposures.

**HOW?** Ingestion is the most common route of exposure, occurring in 83% of exposures.

Through their services to the general public and health care professionals, poison centers provide cost savings by preventing the use of unnecessary health care services. This is done in three ways:

1. **Preventing unnecessary emergency department visits.** As mentioned previously, more than 90% of exposures reported to poison centers can be managed safely at home with telephone follow-up. Several studies have shown that when poison center services are not available (due to previous poison center closures), people with potential poisoning exposures seek more costly healthcare resources—65 to 85% of would-be callers would seek emergency treatment instead.⁹

2. **Preventing unnecessary hospital admissions.** If a hospital does not consult a poison center to assist in patient management, patients are admitted to the hospital more frequently rather than being discharged from the emergency department. When poison center services are unavailable, hospital admissions for poisoning increase by 12-16%.⁹

3. **Reducing length of stay in the hospital.** When patients are admitted to the hospital for a poisoning, consultation with a poison center results in length of stay that is approximately 3 days shorter than when not consulted.⁹

In addition to cost savings, this reduced health care usage also saves time and stress on families, and allows emergency resources to be used where they are truly needed. In all,

<table>
<thead>
<tr>
<th>Substance category</th>
<th>Examples of products</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Analgesics</td>
<td>acetaminophen, ibuprofen, aspirin, hydrocodone, methadone, oxycodone</td>
</tr>
<tr>
<td>2. Cosmetics/Personal Care Products</td>
<td>lipstick/lip balm, soaps, hand/body lotion, toothpaste</td>
</tr>
<tr>
<td>3. Household Cleaners</td>
<td>all-purpose cleaner, oven cleaner, toilet bowl cleaner, laundry detergent, bleach</td>
</tr>
<tr>
<td>4. Sedative Hypnotic/Antipsychotics</td>
<td>alprazolam, lorazepam, zolpidem, olanzapine, quetiapine, phenobarbital</td>
</tr>
<tr>
<td>5. Foreign Bodies/Toys</td>
<td>coin, marble, battery, holiday decoration, piece of a toy, dirt</td>
</tr>
<tr>
<td>6. Antidepressants</td>
<td>fluoxetine, sertraline, amitriptyline, venlafaxine, bupropion</td>
</tr>
<tr>
<td>7. Cardiovascular Drugs</td>
<td>atenolol, verapamil, losartan, atorvastatin, clonidine, amiodarone</td>
</tr>
<tr>
<td>8. Antihistamines</td>
<td>diphenhydramine, chlorpheniramine, ranitidine, cimetidine</td>
</tr>
<tr>
<td>9. Topical Preparations</td>
<td>hydrocortisone cream, antibiotic ointment, diaper rash cream, acne cream</td>
</tr>
<tr>
<td>10. Pesticides</td>
<td>ant and roach sprays, rat poison, weed killer</td>
</tr>
</tbody>
</table>
the national poison center system saves over $1.8 billion in medical costs and productivity each year; for every dollar spent to operate poison centers, $13.39 is saved.\textsuperscript{9}

**Test Your Knowledge #2**

Name 3 functions of a Poison Control Center

1. ________________________________
2. ________________________________
3. ________________________________

*Answers on page 22.*

**THE FIVE TOXIC SUBSTANCES MOST FREQUENTLY INVOLVED IN POISONING EXPOSURES – AN OVERVIEW OF EACH**

These five substance categories—analgesics, cosmetics/personal care products, household cleaners, sedative hypnotics/antipsychotics, foreign bodies/toys—make up 37% of total poisonings reported to the nation’s poison centers.

**Analgesics**

Analgesics are responsible for more total exposures and deaths reported to poison centers than any other substance.\textsuperscript{5,8} Several different classes of medications fall into this category, and they all have different mechanisms of toxic action, expected symptoms, and treatments. The four most common will be discussed here: acetaminophen (APAP), aspirin (ASA), nonsteroidal anti-inflammatory drugs (NSAIDs), and opioids.

**Acetaminophen (APAP)**

Acetaminophen is found in more than 600 different over-the-counter (OTC) and prescription medications, and more than 50 million Americans use acetaminophen each week.\textsuperscript{10} It is used to treat pain and fever. Acetaminophen toxicity can occur after acute (a large dose taken all at once) or chronic (a small overdose repeated numerous times over days to weeks) ingestion. Acetaminophen is often abbreviated “APAP” for its chemical name, N-Acetyl-P-Aminophenol.

**Mechanism of Toxicity**

Excessive acetaminophen intake can cause liver damage. Acetaminophen is broken down by the liver into a toxic metabolite (by-product). The molecules of this metabolite combine directly with liver cells to damage and destroy them.\textsuperscript{11,12}

**Symptoms of Poisoning**

Even in a large overdose, symptoms of acute acetaminophen poisoning may be minimal for the first 24 hours. This is because it takes time for acetaminophen to be broken down into the toxic metabolite and for the metabolite to exhaust the body’s existing protective mechanism against it. Once liver injury begins, symptoms include nausea/vomiting, abdominal pain, bleeding, jaundice (yellowing of the skin and eyes), confusion, kidney damage, coma and death.\textsuperscript{11,12}

**Treatment**

N-acetylcysteine (NAC) is an effective antidote for both acute and chronic acetaminophen toxicity. NAC works to detoxify the acetaminophen metabolite before it can injure liver cells. NAC is always given in a hospital setting; it can be given orally or intravenously. It is most effective when given early on after an acute overdose, before liver injury begins (within 8-10 hours of the exposure). However, NAC is still beneficial when given after liver injury has begun. If an acetaminophen-poisoned patient comes to the hospital very late after the ingestion, the liver injury may be so severe that a liver transplant is required, or the patient will expire.\textsuperscript{11,12}

The outcome of an acetaminophen-poisoned patient is dependent on many factors such as the dose ingested, previous health conditions (e.g., pre-existing liver injury), and how soon the patient received medical care after the overdose. Approximately 450 people die each year in the US from APAP-induced liver failure.\textsuperscript{10}

**Case Example: Acute vs Chronic**

**ACUTE:** AC is a 2 year old male who ingested an entire 30-count bottle of fruit-flavored chewable pain reliever while his mother was in the shower.

**CHRONIC:** CH is a 20 year old female who recently had her wisdom teeth removed. She was prescribed hydrocodone 5mg/APAP 325mg tablets by her dentist, with directions to take 1-2 tablets every 4-6 hours. Despite
taking the prescription medication as directed, she was still experiencing pain so she also began taking an OTC pain reliever she had in her medicine cabinet at home, 2 tablets every 6 hours. She took the combination for several days before realizing that both the OTC medication and the prescription medication (which referred to acetaminophen as APAP) contained acetaminophen.

**Aspirin (ASA)**

Aspirin has been used as a pain-reliever and fever reducer for nearly 200 years.\(^1\)\(^3\) It is an OTC medication that is taken for pain, inflammation, and to prevent heart attack and ischemic stroke. Like acetaminophen, aspirin poisoning can occur after acute or chronic ingestion. Aspirin is a member of the salicylate family; it is often abbreviated ‘ASA’ for its chemical name, acetylsalicylic acid.

**Did you know?** There are other salicylates in commonly used OTC products: Methyl salicylate is a common ingredient in topical muscle rubs, and salicylic acid is found in topical acne treatments.

**Mechanism of Toxicity**

Aspirin and other salicylates have several different toxic effects, the mechanism of which is complex. The net result is that it disrupts cellular metabolism and limits energy production in cells.\(^1\)\(^1\)\(^2\)

**Symptoms of Poisoning**

Nausea/vomiting, rapid breathing, ringing in the ears, fever, acidosis (abnormal increase in the acidity of blood and extracellular fluids), sweating, confusion, seizures, coma, fluid in the lungs, swelling of the brain, death.\(^1\)\(^1\)\(^2\)\(^1\)\(^4\)

**Treatment**

There is no antidote for aspirin poisoning. Patients with ASA toxicity are often given intravenous sodium bicarbonate to help the kidneys excrete more aspirin in the urine faster. If patients have a large amount of aspirin in their body, the kidneys may not be able to excrete it fast enough, even with the help of sodium bicarbonate. In this case, the patient may be given dialysis (dialysis is a procedure in which the patient’s blood is passed through a machine to remove substances).\(^1\)\(^1\)\(^3\)

Opioids refer to the category of drugs that act on opioid receptors in the body. This category includes:

1. Substances naturally occurring in the poppy plant (*Papaver somniferum*), e.g., morphine, codeine.
2. Semi-synthetic drugs derived from the naturally occurring compounds, e.g., hydrocodone, oxycodone, hydromorphone, heroin.
3. Fully synthetic drugs that are chemically unrelated to the naturally occurring compounds, e.g., fentanyl, meperidine, methadone.\(^1\)\(^1\)\(^5\)

Opioids have been used therapeutically (for analgesic properties) and recreationally (for euphoric properties) for centuries.

**Mechanism of toxicity**

Opioids stimulate opioid receptors throughout the body, producing a variety of effects. However, the primary toxic effect due to opioid receptor activation is respiratory depression (slowing or ceasing of breathing).\(^1\)\(^1\)\(^5\)

**Symptoms of Poisoning**

Toxicity from opioids can cause drowsiness, analgesia, euphoria and other psychoactive effects, decreased respiratory rate (which can escalate to apnea, or cessation of breathing), slowed intestinal motility, and pinpoint pupils. Some of the synthetic opioids can produce additional symptoms in overdose. For example, meperidine can cause seizures and methadone can cause cardiac arrhythmias. However, the primary toxicity for all opioids is considered to be respiratory depression.\(^1\)\(^1\)\(^5\)

**Treatment**

The antidote for respiratory depression due to opioids is naloxone. Naloxone is a competitive antagonist at the opioid receptors. This means that naloxone will attach to the opioid receptor but not activate it, effectively blocking the receptor so that the opioid cannot reach it. Naloxone is an extremely effective and rapidly acting antidote. After the administration of naloxone, opioid toxicity is reversed within seconds to minutes. Since respiratory depression is the primary mode of toxicity, another effective treatment is intubation and mechanical ventilation of the patient until the opioid has been metabolized.\(^1\)\(^5\)

The outcome of an aspirin-poisoned patient depends on how much the patient ingested and how soon the patient received medical care after the overdose.
Nonsteroidal anti-inflammatory drugs (NSAIDs)

NSAIDs are used to treat fever, pain and inflammation. Prescription NSAIDS include ketorolac, nabumetone, diclofenac, and meloxicam, among others. OTC NSAIDs include naproxen and ibuprofen. While they have the potential to cause serious adverse effects, NSAIDs are considered to be much safer in overdose compared to APAP, ASA, and opioids.

Mechanism of toxicity

NSAIDs inhibit an enzyme called cyclooxygenase.\textsuperscript{11,12}

Symptoms of Poisoning

Most cases of acute NSAID poisoning result in mild to moderate toxicity with nausea/vomiting and occasionally drowsiness. In massive overdoses, seizures, coma, low blood pressure, kidney failure, bleeding and acidosis can result.\textsuperscript{11,12}

Treatment

There is no antidote for NSAID poisoning. Patients’ symptoms are managed with supportive care (therapies to manage specific symptoms as they appear).

Test Your Knowledge #3

Match the analgesic with its mechanism of toxicity.

_____ 1. Acetaminophen  A. Respiratory Depression
_____ 2. Aspirin  B. Metabolite combines directly with liver cells to damage and destroy them
_____ 3. Opioids  C. Inhibits an enzyme called cyclooxygenase
_____ 4. NSAIDs  D. Disrupts cellular metabolism and limits energy production in cells

Answers on page 22.

Cosmetics/Personal Care Products

While analgesics are involved in the most poison exposures reported to poison centers overall, the cosmetics/personal care products category is responsible for the most pediatric exposures.\textsuperscript{5} Many of the exposures to products in this category are small unintentional exposures. Some examples include: a 14 month old child ingests a lick of hand soap; a 2 year old swallows a gulp of toothpaste; a 5 year old gets shampoo in his eyes; a 2 year old licks his hand after hand lotion has been applied; an adult inadvertently sprays herself in the eyes with hair spray; an 18 month old takes a bite out of a stick of deodorant; and a 2 year old swallows a bite of her mother’s lipstick.

Cosmetics and personal care products are around both adults and children in almost every room in the home, and are used in almost everyone’s daily lives. These products are regularly applied to the skin (soap, lotion, deodorant) or even regularly put in the mouth (toothpaste, lipstick). Small unintentional exposures to these products usually do not result in anything more than minor effects. Below is a description of some of the specific substances in this category, and what symptoms might be seen.

Hand Or Body Soaps (e.g. liquid hand soap, bar soap, shampoo, body wash)

These products contain mild detergents which create foam or bubbles, which wash away dirt, oil and bacteria. If these substances are ingested, they can irritate the gastrointestinal (GI) tract which can cause spontaneous vomiting. One mouthful may cause no symptoms, or minor symptoms such as one episode of vomiting or a loose stool. Since poisoning is always a matter of dose, it is certainly possible to ingest a dangerous amount of soap—for example, a large amount of soap could cause such severe vomiting and diarrhea that dehydration could result. Treatment for a small unintentional ingestion consists of giving a small amount of oral fluid and observation for GI symptoms at the site of exposure.\textsuperscript{12}

Toothpaste And Fluoride-Containing Mouthwashes

Most toothpastes and some (enamel building) mouthwashes contain fluoride as the active ingredient. Fluoride is directly irritating to the stomach and can also be absorbed into the body. When fluoride enters the body it binds to calcium. This fluoride-calcium combination traps the calcium, keeping it away from the areas in the body it is needed. Calcium is critical to muscle move-
ment, including the heart muscle. An ingestion of one mouthful of toothpaste or fluoride containing mouthwash does not contain enough fluoride to trap a significant amount of calcium, but ingestion of any more than that requires evaluation by a poison specialist. Inactive ingredients in these products (such as sorbitol) are also known to cause GI tract irritation as well (vomiting and diarrhea). Treatment for a small unintentional ingestion consists of giving a small amount of oral fluid and observation for GI symptoms at the site of exposure.11,12

Alcohol-Containing Products (e.g. hairspray, hand sanitizer, mouthwash, perfume)

Some personal care products contain ethanol, which is the same type of alcohol that is in alcoholic beverages. Mouthwashes usually contain between 12% ethanol (about the strength of wine) and 20% ethanol (about half the strength of vodka). Hand sanitizers, hairspray and perfume often contain over 50% ethanol. Children are especially susceptible to the effects of ethanol. If a taste or mouthful of one of these products is ingested by a child, usually only mild stomach upset will result (a child-size mouthful is estimated to be 5 to 7.5 ml). However larger amounts can produce significantly toxic effects. If a 25 pound toddler drank 1 ounce of mouthwash containing 20% ethanol, he or she would be legally drunk, and drinking 3-4 ounces is enough to cause major toxicity like low blood sugar or coma. These products have also been used by adolescents and adults for abuse purposes as an alcohol substitute. Treatment for a small unintentional ingestion consists of giving a small amount of oral fluid and observation at the site of exposure. Larger or intentional ingestions require evaluation at a healthcare facility for symptoms of alcohol toxicity which include nausea/vomiting, drowsiness, confusion, low blood sugar, coma, and respiratory depression.12

Cosmetics (e.g. lipstick, lip balm, blush, eye shadow, mascara, foundation)

Cosmetics are considered to have low toxicity and usually only cause mild stomach upset or loose stools at most. Treatment for a small unintentional ingestion consists of giving a small amount of oral fluid and observation at the site of exposure. Household Cleaners

Household cleaners refer to ready-to-use products commercially available to clean household surfaces. Examples include all-purpose cleaner, oven cleaner, toilet bowl cleaner, laundry detergent, bleach, dishwashing detergent, drain opener, mildew remover and carpet cleaner. It is important to note that industrial strength cleaners and disinfectants often contain different or higher concentrations of active ingredients. Many household cleaners can be described as local irritants in a small unintentional ingestion—chemicals that will irritate the skin or mucous membranes directly on contact. There are some household cleaners with the potential to cause more serious effects; the most common of those are described below.12

Glass Cleaner and All-Purpose Cleaner

Household glass and multi-purpose cleaners are mostly water and contain low concentrations of some alcohols and other chemicals. They are expected to be minimally toxic in small unintentional ingestions. Treatment consists of giving a small amount of oral fluid and observation at the site of exposure. It is important to note that windshield washer fluid for automobiles is NOT included in this category; windshield washer fluids contain methanol which has high toxicity.

Household Bleach

Household bleach contains sodium hypochlorite at a concentration of 3 to 5.25%.12 Household bleach causes mild irritation to mucous membranes and the GI tract in small unintentional ingestions. Irritation of the mouth and throat, or vomiting can occur. Treatment consists of giving a small amount of oral fluid and observation at the site of exposure for GI symptoms. Large, intentional ingestions of household bleach, or ingestions of higher concentrations of bleach can cause more significant tissue damage.

Household Ammonia

Household ammonia contains ammonium hydroxide at a concentration of 3 to 10%, which like bleach, is expected to cause irritation to the mucous membranes and GI tract.12,16 Irritation of the mouth and throat, or vomiting can occur. Treatment consists of giving a small amount of oral fluid and observation at the site of exposure for GI symptoms. Higher concentrations of ammonia can cause more significant tissue damage.
Laundry Detergent—Liquid Or Granular

Liquid or granular laundry detergent contains non-caustic detergents but can also contain alkaline (basic) detergents, which can cause irritation or chemical burns to mucous membranes. Most unintentional ingestions by children involve a taste or lick of the product and result in minor symptoms. Treatment consists of giving a small amount of oral fluid and observation at the site of exposure for GI symptoms.11,12

Laundry Detergent—Laundry Pods

Laundry detergent pods are ‘unit dose packs’ of concentrated laundry detergent held within a thin, water-soluble membrane. The majority of laundry pod exposures (and poisonings) occur in children.5,17 Laundry pods are colorful, have a pleasant smell, and have a consistency pleasing to children; it is especially important that laundry detergent pods be locked away out of sight and reach of children. Laundry detergent pods have been on the market in the US for less than 5 years. It has been demonstrated that unintentional exposures to laundry detergent pods cause significantly greater illness than similar exposures to regular liquid or granular laundry detergent.17,18 Laundry detergent pods have the potential to cause significant effects, even in a small unintentional ingestion.

Mechanism of Toxicity

The exact mechanism for the toxic effects of laundry pods is unknown.

Symptoms of Poisoning

Laundry pod ingestions can cause excessive vomiting, coughing, drowsiness, coma, and severe respiratory distress. Additionally, they have been shown to cause eye injury (ocular exposures).17,18

Treatment

Children who have symptoms after ingesting a laundry pod should be evaluated in an emergency department. Patients’ symptoms are managed with supportive care. Children have required mechanical ventilation after ingesting the contents of less than one laundry detergent pod.17,18

Dishwashing Detergent

Hand dishwashing detergent contains non-caustic detergents similar to those found in hand and body soaps, and is expected to cause vomiting or diarrhea when ingested. Automatic dishwasher detergents are alkaline (basic) and can cause irritation or chemical burns to mucous membranes when ingested. Most unintentional ingestions by children involve a taste or lick of the product and result in minor symptoms. Treatment consists of giving a small amount of oral fluid and observation at the site of exposure.12

Oven Cleaner, Toilet Bowl Cleaner, and Drain Opener

Products in this category are very often caustic/ corrosive. Oven cleaners often contain strong bases such as sodium hydroxide. Drain openers and toilet bowl cleaners are either strong acids (hydrochloric, sulfuric or phosphoric acids) or strong bases (sodium hydroxide or ammonium hydroxide).12,16 These corrosive substances have the potential to cause significant effects, even in a small unintentional ingestion.

Mechanism of Toxicity

A caustic (or corrosive) substance is a chemical that will damage any human tissues it comes into contact with.16 Corrosives can cause tissue injury to intact skin and eyes; the lungs if inhaled; and the GI tract if swallowed. The two most common corrosive agents are strong acids and strong bases. Both have the potential to cause severe damage to local tissues, but they do so in different ways.

- Strong acid: When a strong acid comes into contact with human tissue, it damages or destroys the tissue; this dead tissue clumps or coagulates together (forming what is called an eschar). The eschar limits the acid from penetrating further into the tissue. Tissue damage due to a strong acid is known as coagulation necrosis. ‘Necrosis’ means tissue death, and ‘coagulation’ refers to the eschar that is produced on contact with the acid.12,16
- Strong base (alkali): Alkalis do not produce an eschar when they come into contact with tissues. Rather, the alkali will dissolve and emulsify proteins, fat, and cell membranes. This allows the base to penetrate deeply into the tissues. Tissue injury due to a strong base is referred to as liquefactive necrosis.12,16

Symptoms of Poisoning

If a strong acid or strong base is swallowed, symptoms can include redness and swelling of the affected areas, vomiting, drooling, stridor (a high pitched whistling
sound due to swelling or obstruction in the airway\textsuperscript{14}, pain, or burns and necrosis of the GI tract (esophagus, stomach, intestine) which can lead to ulceration or perforation. Inhalational exposure can cause respiratory tract injury and swelling in the lungs. Eye exposure can cause blistering, burns or even blindness. The severity of tissue injury from the acid or base depends on the exact agent, the concentration, and the amount of substance involved in the exposure.

**Treatment**

Any patient exhibiting symptoms after a caustic ingestion should be considered for endoscopy. Endoscopy (a fiberoptic tube is guided down the esophagus) is used to determine the extent of tissue injury to the GI tract. Damage to tissues cannot be reversed. Patients’ symptoms are managed with supportive care.\textsuperscript{12,16} Surgical intervention may be necessary. In the event of an ocular exposure, eyes should be irrigated for 30 minutes (refer to eye exposure section below).

**Mixing Household Cleaners**

Mixing two, otherwise minimally toxic household cleaners can cause a chemical reaction which produces a toxic gas.

**Mechanism of Toxicity**

Bleach plus an acid (such as a drain opener or toilet bowl cleaner) will produce chlorine gas, and bleach plus ammonia will produce chloramine gas. Depending on the concentration in the air and duration of exposure, chlorine and chloramine gas can cause minor to severe eye and respiratory tract irritation.\textsuperscript{12} Chlorine gas was used as a chemical warfare agent in World War I.\textsuperscript{19}

**Symptoms of Poisoning**

Exposure to chlorine or chloramine gas can cause red, itchy, watery eyes; runny nose; cough; chest burning and tightness, and difficulty breathing.\textsuperscript{12}

**Treatment**

Fresh air is the first line treatment for a chlorine or chloramine gas exposure. Some patients may require physician evaluation and intervention if their symptoms are severe. Treatment for both gases may consist of oxygen and bronchodilators.\textsuperscript{12}

---

**Test Your Knowledge #4**

Name a household cleaner that is expected to be minimally toxic in small unintentional ingestions. Name a household cleaner that has the potential to cause serious injury in a small unintentional ingestion.

---

**Ocular Exposure**

While ingestion is the most common route of exposure, cosmetics/personal care products and household cleaners present another opportunity for an exposure—an ocular exposure. The eyes tend to be more sensitive to an exposure to a substance than the skin and even the GI tract. An eye exposure can result in damage to the cornea (the transparent membrane covering the eye)\textsuperscript{14} and put vision at risk. Caustic and corrosive substances are especially damaging in an eye exposure. When an ocular exposure occurs in the home, the following procedure should be followed:

- Contact lenses should be removed immediately.
- The eye should be irrigated for 15 minutes with lukewarm/body-temperature tap water:
  - *For Older Children or Adults:* Irrigation is best done standing in the shower. The head should be tilted so that a steady stream of water runs over the bridge of the nose and into the eye(s).
  - *For Infants or Younger Children:* The infant/child should be placed on their back and water should be poured over the bridge of the nose into the eyes using a clean cup. For small children, wrapping one towel around the child to secure their arms and placing another towel under the child’s head will make them more comfortable and facilitate irrigation.
- For a caustic (acid or alkali) ocular exposure, irrigation should be continued for an additional 15 minutes for a total of 30 minutes.
- After irrigation, the eye(s) should be allowed to rest for 15-30 minutes. Tap water (which is hypotonic) irrigation removes the natural lubrication from the eye causing the eye to temporarily feel “dry” until the natural tears return.
- No form of eye drops should be used at this time (such as artificial tears or a decongestant), as these can mask key symptoms.
- If any pain or swelling persists, if there are any visual changes, or if there is a foreign body sensation, evaluation by a physician is necessary.
Sedative Hypnotics/Antipsychotics

The therapeutic classes in this category include benzodiazepines, hypnotics used for sleep such as zolpidem and eszopiclone, barbiturates, typical/first generation antipsychotics, and atypical/second generation antipsychotics. The two classes associated with most frequent exposures are benzodiazepines and atypical antipsychotics.\(^5,20\)

Benzodiazepines

Benzodiazepines are used therapeutically to treat anxiety, promote sleep, or treat seizures. Examples include alprazolam, diazepam, lorazepam, and clonazepam.

Mechanism of Toxicity

Benzodiazepines work by increasing the effect of an inhibitory neurotransmitter called GABA (gamma amino butyric acid) resulting in generalized depression of the central nervous system.\(^12\)

Symptoms of Poisoning

General central nervous system (CNS) depression is the primary effect—drowsiness, lack of coordination, slurred speech, and coma. Although respiratory arrest is possible, benzodiazepine overdoses are usually not life-threatening unless combined with another CNS depressant drug such as ethanol (alcohol) or an opioid.\(^11,12\)

Treatment

Flumazenil is the antidote for benzodiazepines. It is a competitive antagonist at the benzodiazepine receptor. This means that flumazenil will attach to the benzodiazepine receptor but not activate it, effectively blocking the receptor so that the benzodiazepine cannot reach it. Flumazenil can unmask seizures in patients habituated to benzodiazepines or patients who have taken a co-ingestion of seizure causing medications. Therefore, the risks of flumazenil usually outweigh its benefits in overdose, and it is rarely indicated. The recommended treatment for a benzodiazepine poisoning is conservative observation and supporting the respiratory function. This may require oxygen and mechanical ventilation.\(^11\)

Atypical Antipsychotics

Atypical antipsychotics or second-generation antipsychotics include drugs such as olanzapine, quetiapine, clozapine, risperidone, ziprasidone, and aripiprazole. This class of antipsychotics treats the spectrum of schizophrenic symptoms, and may also be used to treat other psychiatric disorders.\(^12,20\)

Mechanism of Toxicity

These drugs exert action at dopamine and serotonin receptors, and cause a variety of effects (mostly on the central nervous system and cardiovascular system).\(^20\)

Symptoms of Poisoning

Drowsiness, which can be severe enough to cause coma; increased heart rate, decreased blood pressure; and respiratory depression. Additionally these drugs can interfere with the heart rhythm, causing EKG abnormalities.\(^11,20\)

Treatment

There is no antidote for atypical antipsychotics. Patients’ symptoms are managed with supportive care, which may include mechanical ventilation and observation of the heart rhythm.

Toys/Foreign Bodies

Foreign body ingestion is most likely to occur among pediatric patients aged 3 months to 6 years.\(^21\) Foreign bodies are solid items which remain in that state during passage through the GI tract. The substances which fall into this category are practically limitless: piece of a toy, holiday decoration, a piece of plaster, a rock, a coin, a piece of plastic, a piece of balled up tinfoil, an earring, a pencil eraser, a paperclip or rubber band, a piece of foam or furniture stuffing, a silica gel packet, and so on. The primary concern with an ingestion of a solid item is obstruction. The first opportunity for obstruction is choking on the foreign body (airway obstruction). If the item is swallowed without obstructing the airway, the concern then is regarding potential GI obstruction. The larger the item is, the greater the potential for obstruction.

Initial symptoms of GI obstruction include vomiting, abdominal pain, and change in bowel habits. Foreign bodies that become lodged in the GI tract have the potential to cause a perforation (abnormal opening in a hollow organ caused by injury or rupture\(^14\)), however this is rare for most foreign bodies.\(^21,22\) Foreign bodies usually pass through the GI tract uneventfully, and without the need for intervention, though there are some important exceptions which are discussed below. Management of foreign body ingestion is usually conservative—watch and wait for the object to be passed in the stool. A child
who has ingested an object larger than a dime, or a child who has not passed the object in several days should be evaluated in a health care facility. Imaging studies (such as an X-ray) can be performed to determine the need for endoscopic or surgical removal.

**Batteries**

Button cell or disc batteries (see Illustration 1) are coin shaped batteries used in electronic items such as toys, remote controls, musical greeting cards, hearing aids, calculators, and other small devices. The size of button batteries ranges from 5-25 mm in diameter. Button batteries pose a unique risk to children if ingested, and they have caused several deaths in recent years.

**Mechanism of Toxicity**

Button batteries injure the GI tract (most often the esophagus) in several ways.

1. If the battery becomes lodged in the esophagus, it can generate an electric current. This creates hydroxide ions which directly damage the tissue. This is the primary mechanism of toxicity. See photo below.

2. By being exposed to the digestive liquids in the GI tract, the outside metal housing of the battery can become compromised causing the alkaline material inside the battery to leak out. The surrounding tissues would be subjected to alkaline injury as described in the caustic/corrosive section above (see Illustration 2).

3. The battery itself can physically put pressure on adjacent tissue—this would not have much effect alone, but can contribute to injury if the surrounding tissue is already damaged by the electric current or alkaline medium from inside the battery.

Larger button batteries have been implicated in the most serious injuries to children, specifically lithium cells that are ≥20 mm in size. These larger batteries are more likely to get lodged in the esophagus of a child and complete the circuit, allowing for the electrical current to be conducted. Additionally, the ≥20 mm lithium cells are 3 volt batteries (compared to 1.5 volts for smaller button cells), so they can generate more current. A 20 mm button battery’s size is between that of a US penny (which is 19 mm) and a US nickel (which is 21 mm). Studies have shown that exposures to and significant injuries from button cell batteries have been on the rise in recent years, correlating with the increased household use of 20mm lithium button cell batteries.

**Symptoms of Poisoning**

Early symptoms after button battery ingestion include coughing, gagging, difficulty swallowing, and vomiting. Tissue damage caused by a button battery can cause bleeding, perforation, fistulas (a passage from one body cavity to another created by injury, such as from the esophagus to the trachea or from the esophagus to an artery), and strictures (narrowing of the esophagus). This tissue damage can manifest weeks after the battery is removed.

**Treatment**

A child who is suspected of having ingested a button battery must be evaluated immediately in an emergency department. An X-ray can determine the location of the battery. A battery in the esophagus must be removed endoscopically. Batteries should be removed within 2 hours; severe burns have been reported after just 2-2.5 hours of ingestion, even when the child is asymptomatic initially. If the battery has passed beyond the esophagus and is in the stomach or intestine, removal is not necessary. The stools should be strained for the battery to ensure passage. If the battery has not passed in several days, a repeat X-ray is performed to ensure the battery is moving freely through the GI tract.

**Magnets**

Another foreign body ingestion associated with a recent increase in exposures and serious injury in children is small, high powered magnets. Small high powered magnets (3-6 mm in size) are used in toys (construction sets, desk toys) and faux piercings. While foreign body ingestions are most likely to occur among pediatric patients aged 3 months to 6 years, multiple magnet ingestions are also seen...
in older children and adolescents. Circumstances surrounding these ingestions in older children include swallowing a faux piercing used in the mouth area, or using the teeth to separate attracted magnets.

**Mechanism of Toxicity**

If one single magnet is ingested, the expected effects are those of a traditional foreign body—the magnet is expected to pass through the GI tract uneventfully and conservative expectant management is indicated. Multiple magnets, or one magnet swallowed with a piece of metal, however, pose a much higher risk of injury to the GI tract. Inside the GI tract, multiple magnets can attract each other through different loops of the intestine (bowel). The connected magnets, with bowel tissue caught in between, can halt bowel movement and the pressure can cause tissue necrosis.

**Symptoms of Poisoning**

If magnets become attracted to each other in the GI tract, symptoms can include intestinal perforation, fistulas, obstruction, infection, and death.

**Treatment**

Magnets should be visualized on X-ray. They usually require removal either by endoscopy or surgery. Consultation with a GI specialist is necessary. Damage to the intestine may be so severe that surgical removal of part of the bowel may be required. Several studies have shown that when multiple magnets are ingested, 31-56% of patients require some form of surgical intervention.

**Lead Objects** (e.g. lead paint chips, fishing weight, lead shot)

Lead is a soft metal that is used in a variety of industries. Children are especially susceptible to lead toxicity, and they can come into contact with lead by a variety of ways—lead paint, contaminated soil (from deteriorated lead paint, lead industry pollution, leaded gasoline emissions), water from plumbing made with lead materials, and imported items such as pottery, jewelry, or folk medicines. The most common source is by ingesting lead-based paint or dust from lead-based paint. Lead paint chips can be eaten, or dust from lead paint can be deposited on the hands, toys, or other items that the child places in their mouth. Lead is more commonly a chronic poisoning (e.g., a child ingests dust from lead paint in his home over a period of months) but can be acute (e.g., a child lives in a lead paint-free home but ingests a lead fishing weight foreign body). Homes built after 1978, as required by law, do not contain lead-based paint. However, it should be expected that homes built before 1978 will contain lead-based paint. The CDC estimates that there are 24 million housing units in the US that contain deteriorated lead paint and elevated levels of lead-contaminated house dust. Young children reside in 4 million of these homes.

**Mechanism Of Toxicity**

Lead exerts its effects through a variety of mechanisms, and it affects different proteins, receptors, and cellular processes. Lead poisoning has an impact on many organ systems. Lead is well absorbed from the GI tract of children, and is deposited in tissues all over the body, including the bone.
Symptoms of Poisoning\textsuperscript{11,12,26}

Lead has effects on many organ systems, but the CNS is of most concern in developing children.

- Lead poisoning can result in general non-specific symptoms such as irritability, fatigue, headache, nausea, loss of appetite and weight loss, and muscle aches and weakness.
- CNS symptoms include inability to concentrate, lack of coordination, and tremor. Chronic lead poisoning can cause stunted growth, hearing impairment, learning disabilities, diminished IQ, and impaired behavioral development. Severe lead poisoning can lead to encephalopathy (coma, seizures, agitated delirium, swelling of the brain, death).
- Symptoms affecting other organ systems include kidney damage, high blood pressure, and anemia.

Treatment

The initial step in the treatment of lead poisoning is to remove the child from the source of lead. This can be challenging if the source of lead is the child’s home. Children with elevated blood lead levels are given a medication to remove the lead from the child’s body. These drugs are called chelating agents, and they include calcium disodium edetate, dimercaprol, and succimer. Chelating agents bind to lead to form a complex which is then excreted in the urine. Calcium disodium edetate and dimercaprol are parenteral medications, and succimer is given orally. Because lead is stored in the bone, it can take a significant length of time to remove all of the lead in a child’s body even with chelation. Additionally, removing lead from a child’s body will not reverse neurological damage that has already been done. Because lead poisoning causes permanent neurologic damage to children, prevention is key. Lead poisoning prevention tips are described in the poison prevention section below.\textsuperscript{11,12,26}

Lead Poisoning Prevention Tips\textsuperscript{27}

- In homes with lead paint, be sure to mop floors and wipe windowills regularly (at least every 2-3 weeks) by using a damp mop or cloth and an all-purpose detergent.
- Window areas can contain high levels of lead dust because the repeated action of opening and closing windows can cause paint particles to flake off. Other high-traffic areas prone to chipping paint include stair railings and wall corners/edges.
- Wipe other flat surfaces where dust collects once per week.
- Be sure to keep children away from areas with peeling lead paint, and ensure that they do not have access to chewable surfaces with lead paint.
- Tight fitting contact paper or duct tape can be secured over areas with peeling lead paint to provide a temporary barrier.
- Renovations or paint-removal in homes with lead-based paint should be performed only by certified personnel.
- Children and pregnant women should not remain in a building being renovated if it was built before 1978.
- Regularly wash children’s toys and hands.
- Anyone who works with lead should shower and change clothes before coming into contact with children.
- A simple blood test is the only way to determine if someone has an elevated blood lead level or lead poisoning—ALL children should be screened and assessed for lead poisoning, especially in the age range of 12-24 months, even if they are not experiencing any symptoms.

General Poison Prevention

Children

Pediatric patients in the 18-36 month range are at an increased risk for poisoning. Children at this developmental stage are naturally curious and learn about their environment by touching and putting things in their mouths. They imitate others and often do not understand if they are doing something wrong. Children at this age cannot read and do not have a good grasp of cause and effect. They usually cannot distinguish between things that are similar in appearance, such as determining if a small, brightly colored object is candy or a pill (see Illustration 3).

Test Your Knowledge #5

Name 3 foreign bodies that can cause serious injury when ingested, especially by children:
1. ______________________________
2. ______________________________
3. ______________________________

Answers on page 22.
Poison Prevention Tips For Caregivers of Children:28,29

- Teach children never to eat or drink anything without asking first.
- Never call medicine “candy,” or make a game out of taking it.
- Do not take medication in front of children.
- Use child-resistant caps on medication bottles—but remember, child-resistant does NOT mean child-proof. Child-resistant caps will increase the length of time it takes for a child to open the bottle, but it usually will not stop them altogether.
- Keep children away from situations where they have access to potentially harmful substances (playing in bathrooms, kitchens, garages, etc.).
- Store all potentially poisonous products (cleaners, chemicals, medications) in cabinets with child-resistant safety locks or high up out of children's sight and reach.
- Tape up battery compartments of toys and remote controls to reduce access to button batteries; closely supervise children who are playing with devices that are powered by button batteries.
- Do not allow children to play with high-powered magnet toys.

**Test Your Knowledge #6**

Name 3 reasons why children are at an increased risk for unintentional poisoning.

1. ______________________________  
2. ______________________________  
3. ______________________________

Answers on page 22.

**Illustration 3. Photo of Candy/Pill Confusion**


Drugs and Medications

Nearly 70% of Americans take at least one prescription medication30 and more than $23 billion was spent on OTC medications in 2010.31 Medications are everywhere in American homes, and as mentioned previously, account for a large portion of poisonings. Poison centers nationwide are seeing more poisonings from pharmaceuticals than ever before, and in every age group. Poisoning from medication can occur by a variety of mechanisms:5

1. Unintentional exploratory ingestion by a child
2. Intentional self-harm
3. Intentional abuse or misuse
4. Therapeutic error (such as mixing up medications and taking too many, or taking medication too frequently)
5. Drug interaction (including taking two drugs with very similar actions)

There were over 280,000 therapeutic/medication errors reported to poison centers in 2012; which is 12.3% of all exposures. The two most common reasons for an error were taking a double dose and taking the wrong medication.5

The best weapon against poisoning from a medication error is education.

Poison Prevention Tips for Pharmaceuticals:28,29

- Know the names of your medications, why you take them, how much you should take (the dose) and how often you should take it. If you have questions, call your physician or pharmacist.
- Before giving medicine, read the medicine label, every time. Do not take or give medication in the dark or when distracted.
- Never take someone else's prescription medicine.
- Only take the prescribed dose; do not take a higher dose or more often than prescribed.
- Always use the measuring device that comes with liquid medicine—never use a kitchen spoon to dose medication.
- Using a pillbox can help adults manage their medications, increase compliance, and avoid therapeutic errors. However, pillboxes are NOT child-resistant and must always be stored out of sight and reach of children at all times.
- Properly dispose of unused or expired medications promptly.
**Liquid Medication Tips**

Liquid medications pose a unique risk for medication errors. A study published in Pediatrics in 2014 found that approximately 40% of parents made an error when giving liquid medication.33

- In the US, there are several different units of measure for liquid medications—teaspoon, tablespoon, milliliter, cubic centimeter—which can lead to confusion in the lay public.
- Tablespoon and teaspoon are especially problematic
  - The word ‘spoon’ in the name implies that a traditional spoon (i.e., a kitchen or household spoon) can or should be used to dose the medication
  - The abbreviations for these two measurements are very similar and can be confusing—TS, tsp, tbs, ts, T
- Kitchen teaspoons and tablespoons are not calibrated to be exactly 5 ml and 15 ml, respectively. Kitchen spoons are designed for aesthetics or for the ergonomics of eating.
- Patients and caregivers should always be instructed to dose medication using a syringe or calibrated dosing spoon—never a kitchen spoon.
- Standardizing liquid units of measure to the milliliter has been suggested by the CDC, the FDA, and the American Academy of Pediatrics.32

**Proper Disposal of Medications**

It is important to rid the home of unused and expired medications promptly. Unneeded medications that are kept in the home are then available to be taken mistakenly, or to be used for non-medical purposes (such as abuse of an opioid or benzodiazepine). Follow the FDA’s recommendations for medication disposal.32

- Ideally, medications should be disposed of using Medication Take-Back programs, which are usually provided by local government.
- If one of these programs is not available, follow the below instructions to dispose of the medications in the household trash:
  - Mix the medication with kitty litter or used coffee grounds to make it unpalatable to pets, children, or drug-seekers
  - Place this mixture in a sealed plastic bag and place this bag in the household trash
  - There are some extremely potent opioid medications that the FDA recommends flushing (instead of throwing away), because they pose such a great risk even if one tablet is ingested by someone not prescribed the medication. The full list can be found at www.FDA.gov.

**Household Substances**

Almost every home contains non-pharmaceutical items that are potential poisons: cleaning products, mouthwash, antifreeze, drain opener, paint, insect-killer, houseplants, gasoline, and many more.

In the event of any poisoning, a poison center should be consulted immediately at 1-800-222-1222.12,14,15 If the person is unconscious or not breathing, call 911 instead.29

**Poison Prevention Tips for Household Substances**28,29

- Close/recap all products immediately after use. Many exposures to household substances occur while the product is in use. Return household and chemical products to safe storage immediately after use.
- Keep all household products and medicines in their original, labelled, child-resistant containers.
- Do not store chemicals and cleaning products near food.
- Do not store cleaning, automotive or gardening products where they can be accessed by children. Store these products in cabinets with child-resistant locks.
- Always follow package label directions for use, including instructions for diluting concentrated products.
- Never mix cleaning products; this can create dangerous gases.
- Use household chemicals and cleaning products in a well-ventilated area.

**Poison Prevention Tips for Plants**

- Know both the common name and botanical/Latin name for each plant in and around your home.
- If you are unsure of the identity of a plant, bring a clipping into your local nursery/greenhouse for assistance with identification.
- Keep houseplants up high, out of reach of children and pets.
- Children should be watched closely while outdoors near wild plant life.

**Never Induce Vomiting**

For many years, inducing vomiting was considered to be a mainstay in the treatment of an ingested/swallowed poison. Syrup of ipecac (an emetic) has been the traditional way of doing so. Syrup of ipecac is a mixture of compounds found in the Carapichea ipecacuanha plant.
These compounds cause vomiting by direct irritation of the stomach and stimulation of the chemoreceptor trigger zone in the brain.\textsuperscript{11,34}

The rationale behind inducing vomiting is that doing so will remove the substance from the stomach and prevent absorption of the poison, and the patient will have a better outcome. However, research has shown that this is not the case; risks of giving ipecac nearly always outweigh the benefits.

- Vomiting does not remove the entire stomach contents. Studies have shown that when syrup of ipecac is administered, anywhere from 0 to 78\% of stomach contents are removed. The amount removed is extremely variable, and the longer after the ingestion (i.e., even as long as only 10-30 minutes) the less substance that is removed by vomiting.\textsuperscript{34}

- There are many drugs and toxins whose effects would be very dangerous when combined with vomiting. Some examples include:\textsuperscript{34}:
  - The patient is, or could become (by the effects/symptoms of the substance they ingested) drowsy, unconscious, or have seizures. A patient who is lethargic or having a seizure is not able to control their airway and they can aspirate (inhale) vomit into their lungs. This can cause asphyxia (lack of oxygen) or pneumonia.
  - The patient has ingested a caustic/corrosive substance. These substances can cause chemical burns in the GI tract on contact, and the physical strain of vomiting can cause further injury to the already damaged GI tract. Vomiting in this situation would also cause the caustic substance to pass over the esophagus more than once, worsening chemical burn injury. Additionally, it can cause the substance to be aspirated into the lungs, which could cause chemical burn injury to the lungs.
  - The patient has ingested a hydrocarbon (such as lamp oil, kerosene or gasoline). Aspiration of hydrocarbon causes injury to the lungs and can interfere with oxygen transfer to the blood. Vomiting increases the likelihood of aspiration.

- Complications and side effects can result in the following:\textsuperscript{34}
  - Diarrhea, drowsiness, aspiration and prolonged vomiting.
  - Rare, severe complications including death have been reported.
  - Use of syrup of ipecac can delay administration of effective antidotes or other treatments.

- Storing ipecac in the home can lead to inappropriate use such as:\textsuperscript{35}
  - Ipecac may be given by a well-meaning caregiver for a completely nontoxic ingestion, subjecting the patient to side effects and potential complications unnecessarily.
  - Ipecac has been misused by adolescents with eating disorders (bulimia).
  - Ipecac has been used by child caregivers involved with Munchausen syndrome by proxy (a syndrome in which caregivers purposely cause harm to the children they are caring for to garner attention and/or sympathy).

Ipecac is no longer manufactured in the United States, and while some bottles may remain in households, it is rarely available for purchase. The American Academy of Pediatrics and the American Academy of Clinical Toxicology advise against the use of syrup of ipecac and the induction of vomiting by any other means.\textsuperscript{34,35}

\begin{center}
\textbf{Test Your Knowledge #7}
\end{center}

Name 3 reasons why syrup of ipecac is not recommended for poison ingestions:
1. ______________________________________
2. ______________________________________
3. ______________________________________

\textit{Answers on page 22.}

\section*{Conclusion}
Poisoning is a significant public health problem in the United States for all age groups. Pharmaceuticals account for a significant portion of illness and death related to poisoning. Pharmacy professionals can be key players in the prevention of poisonings, as they are some of the most available and accessible health care professionals to the general public. Awareness of the potential for poisoning, and education on medication and household safety are crucial to limiting the impact of poisoning.
References


