Evaluation and Management of Common Childhood Poisonings

TAMARA McGREGOR, MD, *University of Texas Southwestern Family Medicine Residency Program, Dallas, Texas*
MEHJABIN PARKAR, MD, *Fort Bend Family Health Center, Richmond, Texas*
SHOBHA RAO, MD, *University of Texas Southwestern Family Medicine Residency Program, Dallas, Texas*

Family physicians often manage substance ingestions in children, most of which are nontoxic in nature. Physicians should know the phone number of the poison control center, understand the appropriate initial assessment of suspected toxin ingestion, and recognize important toxidromes. Rapid triage is crucial, including airway, respiration, and circulation stabilization. Appropriate supportive or toxin-specific treatment should be initiated. Gastric decontamination, such as activated charcoal and gastric lavage, are no longer routinely recommended. These methods should be reserved for the most severe cases, with poison control center support. The use of ipecac is no longer recommended. A child with few symptoms or a witnessed toxin exposure may be monitored at home. However, some long-acting medications have delayed toxin effects and require additional surveillance. (*Am Fam Physician.* **2009;79(5):397-403.** **Copyright © 2009 American Academy of Family Physicians.**)

▶ **Patient information:** A handout on accidental childhood poisonings, written by the authors of this article, is available at http://www.aafp.org/afp/20090301/397-s1.

Poison control centers in the United States received more than 2.4 million reports of toxin exposures in 2003. Most exposures involved oral ingestion (76 percent), occurred in the home (93 percent), and were unintentional (more than 80 percent).[1] Children younger than six years accounted for 51 percent of the exposures. Of these, 38 percent involved children three years or younger. Most ingestions involved nontoxic substances and were managed at home. There were 1,183 reported fatalities from poisoning in 2003, including 27 children younger than six years. Fourteen of these children died after ingesting prescription medications.[1]

Intentional toxin ingestions for suicide or substance abuse are more common in adolescents and adults. These ingestions usually involve more than one substance and are more often fatal than unintentional ingestion.[1] Intentional ingestion should prompt rapid consultation with a poison control center and ambulance transport to the emergency department. This article focuses on the evaluation and treatment of children younger than 12 years with unintentional toxin ingestions.

Evaluation of Children with Suspected Toxin Ingestion

INITIAL ASSESSMENT AND TRIAGE

The initial evaluation of childhood poisonings may be performed in the office or the emergency department. If the physician receives a phone call in the office about a suspected poisoning, the first step is to ascertain whether the patient is symptomatic (i.e., respiratory, circulatory, or neurologic symptoms). Symptomatic patients should receive ambulance transport to the emergency department.[2-5] If there is no hospital nearby, the patient should be transported to the physician's office. The caller should be kept on the line while poison control (800-222-1222) and ambulance transport are contacted.[6] If the ingestion was witnessed, a nontoxic substance was involved, and the patient appears asymptomatic, a prompt examination by the physician in the office or a period of observation at home

SORT: KEY RECOMMENDATIONS FOR PRACTICE

Clinical recommendation	Evidence rating	References
Any patient who may have ingested a toxin and who has respiratory, circulatory, or neurologic symptoms should be transported by ambulance to the nearest emergency department.	C	2-5
The history of patients with suspected toxin ingestions should include age and sex of the patient, time and type of probable exposure, and all medications present in the home.	C	2
An asymptomatic child with suspected toxin ingestion may have ingested a delayed-action medication and should be monitored for a longer period.	C	3
Gastric lavage is only recommended when performed by a physician with experience placing orogastric tubes and when administered within one hour of the ingestion.	C	3, 20
The routine use of activated charcoal is discouraged, except within one hour of ingestion.	C	3, 19
Syrup of ipecac is no longer recommended for treating suspected toxin ingestions.	C	22-24

A = consistent, good-quality patient-oriented evidence; B = inconsistent or limited-quality patient-oriented evidence; C = consensus, disease-oriented evidence, usual practice, expert opinion, or case series. For information about the SORT evidence rating system, go to http://www.aafp.org/afpsort.xml.

may be appropriate.[7] If there is any doubt, poison control should be consulted, and the patient should be evaluated in the physician's office or emergency department.

Patients presenting to the emergency department should be stabilized, if necessary. When the patient is stable, a history should be obtained, including patient age and sex, the time of probable or witnessed toxin exposure, the type of substance involved, and the method of exposure (i.e., skin contact, inhalation, or ingestion).[2] The possible method of exposure is vital to detecting substance abuse or suicidal intent, which is especially relevant in adolescents. The physician should ask for the original containers of the possibly ingested substances, and the names of any prescription or over-the-counter medications in the home to which the patient had access. Medications brought into the home by visitors should also be considered. The ingestion of medications brought into the home, such as in a visitor's purse or pillbox, accounts for a significant number of accidental childhood poisonings each year.[1]

EMERGENCY STABILIZATION

Emergency stabilization begins with checking the ABCs (airway, breathing, and circulation), followed by a thorough physical examination and laboratory testing. Because the patient's status can change rapidly, it is essential to reassess the patient often and monitor the need for ventilator support.

After the ABCs have been evaluated, dextrose or electrocardiography (ECG) may be needed.[2] A blood glucose reading should be obtained from any patient with altered mental status or lethargy, and from any patient who may have ingested oral hypoglycemic agents or alcohol. Symptoms of hypoglycemia (e.g., cool, clammy skin; altered mental status; diaphoresis), with or without a glucose reading of less than 80 mg per dL (4.4 mmol per L), may be rapidly reversed with intravenous dextrose. Thiamine should be given before dextrose administration to prevent Wernicke encephalopathy. If intravenous access is difficult, 1.0 mg of intramuscular glucagon (Glucagen) may be given as a temporizing measure.[3]

An ECG should be obtained in patients who have ingested cardiotoxic medications (e.g., antidepressants, digoxin, calcium channel blockers, beta blockers, antiarrhythmics) or other potent medications. Cardiac monitoring should be continued if any abnormalities are noted or suspected.[2] Pulse oximetry is helpful in assessing all patients, but especially those with impaired mental or respiratory status. Although altered mental status in a child may be presumed to be from poisoning, traumatic head injury should also be considered. Focal findings may point to an acute neurologic event. Because an opioid overdose may present as altered mental status, treatment with naloxone (Narcan; brand no longer available in the United States) may be appropriate, alone or as part of the "coma cocktail."[8] The patient may exhibit symptoms related to opioid withdrawal in cases of long-term or multiple-drug ingestions.[8]

Table 1 includes dosing information for medications used in the emergency stabilization of children who

Table 1. Emergency Medications for Childhood Poisonings

Indication	Medication	Infants	Children
Hypoglycemia, altered mental status	Dextrose*	5 mL per kg at 10 percent	4 mL per kg at 25 percent
Suspected opioid overdose; long-term or multiple-drug ingestion	Naloxone (Narcan; brand no longer available in the United States)	0.1 mg per kg (for children five years and younger)	0.1 to 0.8 mg per kg

**—Intravenous thiamine (10 mg for infants and 10 to 25 mg for children) should be given before dextrose is administered to prevent Wernicke encephalopathy.*

Information from references 2 and 8.

Table 2. Prevalence of Commonly Ingested Substances in Children Younger than Six Years

Substance	*Percentage of all exposures (%)*
Cosmetics and personal care products	13.4
Cleaning products	10.0
Analgesics	7.9
Topical agents	7.4
Foreign bodies	7.3
Cough and cold preparations	5.4
Plants	4.4
Pesticides	4.2
Vitamins	3.9
Antihistamines	2.8
Antimicrobials	2.7
Arts/crafts/office supplies	2.4
Gastrointestinal preparations	2.4
Electrolytes and minerals	2.0
Hormones and hormone antagonists	1.8

Adapted with permission from Watson WA, Litovitz TL, Rodgers GC Jr, et al. 2004 Annual report of the American Association of Poison Control Centers Toxic Exposure Surveillance System. Am J Emerg Med. *2005;23(5):598. http://www.sciencedirect.com/science/journal/07356757.*

have ingested toxins.[2,8] Patients with continued symptoms may require hospital admission for supportive care with monitoring, symptom relief, and hydration.

Commonly Ingested Substances

The age of the patient can help guide appropriate toxin triage.[3] Infants and nonambulatory toddlers are seldom able to access objects beyond their reach, such as cosmetics and soaps. Therefore, significant toxicity in these children should prompt consideration of parental or caregiver abuse.[3] Most toxin ingestions occur among toddlers and children younger than six years with access to unsecured substances *(Table 2*[1]*).*[1,6]

Although most childhood ingestion of toxins produce mild or no symptoms, ingesting even a small amount may have consequences. The most toxic substances to a child who is small in size include iron, antidepressants, hypoglycemics, cardiovascular drugs, salicylates, anticonvulsants, and illicit drugs.[2] *Table 3* includes substances with higher toxicity in children, as well as those that may be lethal to a child in very small doses.[4,6,9] An asymptomatic patient with suspected toxin ingestion may have taken a medication with a delayed absorption or mechanism of action *(Table 4)* and may require a longer period of observation.[3]

Iron poisoning is one of the most fatal in children younger than six years.[10] Children usually access iron through their mother's prenatal iron tablets or through children's iron supplements. Although ingesting as much as an entire bottle of children's iron-containing vitamins has a low potential for toxicity, ingesting as few as five to 10 adult ferrous fumarate tablets (55 mg of elemental iron per tablet) can kill or seriously harm a child.[11] Deaths from iron poisoning have decreased over the past decade, primarily because of education and child-safety packaging.[12]

Table 3. Selected Substances with Higher Toxicity in Children

Nonpharmacologic agents	
Alcohols	Beverage ethanol, ethylene glycol (antifreeze), methanol (windshield wiper fluid)
Caustic agents	Acids (antirust compounds, toilet cleaners), alkalis (Clinitest tablets, drain or oven cleaner, perm relaxers), cleaning agents
Food-flavoring additives	Methyl salicylate (wintergreen oil)*
Hydrocarbons	Kerosene, lamp oil, mineral seal oil (furniture polish), mineral spirits (paint thinner), naphtha (lighter fluid)
Industrial chemicals	Methylene chloride (paint thinner), selenious acid (gun bluing), zinc chloride (soldering fluid)
Nail products	Acetonitrile (sculptured nail remover), methacrylic acid (artificial nail primer), nitromethane (artificial nail remover)
Pesticides and insecticides	Lindane,* organophosphates, paraquat
Pharmacologic agents	
Antidepressants and antipsychotics	Phenothiazines,* tricyclic antidepressants*
Antimalaria medications	Chloroquine* (Aralen), quinidine,* quinine* (Qualaquin)
Cardiovascular agents	Beta blockers,* calcium channel blockers,* clonidine* (Catapres)
Opioids	Cough syrups, diphenoxylate/atropine* (Lomotil), methadone,* oxycodone* (Oxycontin)
Oral hypoglycemic agents	Metformin (Glucophage), sulfonylureas*
Topical agents	Benzocaine* (Americaine), lindane,* methyl salicylate (wintergreen oil),* podophyllum resin 25%* (Podocon), tea tree oil*
Other agents	Isoniazid (Nydrazid), phenylpropanolamine (no longer available in the United States),* theophylline*

**—Substances that can be fatal in a small dose (1 to 2 tablets or teaspoons) to children weighing 10 kg or less.*

Information from references 4, 6, and 9.

Toxidromes

During the physical and neurologic examinations, the physician should identify any toxidromes or symptoms that point to toxin exposure. Constricted pupils, for

Table 4. Selected Toxins with Delayed Symptoms

Delayed absorption	Delayed mechanism	Toxic metabolites
Carbamazepine (Tegretol)	Anticoagulants	Acetaminophen
Concretions (iron, meprobamate [Miltown; brand no longer available in the United States], aspirin, theophylline)	Monoamine oxidase inhibitors	Acetonitrile
Diphenoxylate/atropine (Lomotil)	Sulfonylureas	Dapsone
Enteric-coated preparations	Thyroid hormones	Toxic alcohols (methanol, ethylene glycol)
Sustained-release preparations	Toxic mushrooms	**Other**
		Lithium

Adapted with permission from Barry JD. Diagnosis and management of the poisoned child. Pediatr Ann. *2005;34(12):940.*

example, may suggest poisoning by cholinergic agents or opioids. The patient's mental status, vital signs, pupil reactivity, skin moisture and color, and bowel sounds should also be noted. Powder or vomit around the mouth and any unusual breath odors are also important indicators. *Table 5* lists toxic symptoms and toxidromes, as well as possible initial treatments.[5,6,13,14]

Laboratory Assessment

A thorough history and physical examination are usually sufficient to diagnose most poisonings in children. However, selective laboratory studies can provide vital information to guide monitoring and treatment. *Table 6* lists subsets of useful laboratory tests that may help avoid excessive testing.[3] The initial assessment subset includes testing for the most potentially dangerous toxins and should be obtained in all patients with a clinically significant toxin exposure. An ECG showing dysrhythmias or conduction delays is indicative of more serious toxicity. Serum acetaminophen levels are routinely ordered for most patients with toxin exposure. Acetaminophen is easily available and accessible in most homes and has serious toxic potential, especially in children.[3] Acetaminophen levels tested about four hours after ingestion may be most accurate, with serial levels following well-established nomograms that may guide the administration of *N*-acetylcysteine (Mucomyst; brand no longer available in the United States).[15]

The probing subset of laboratory tests focuses on specific findings according to clinical suspicion.[3] Most hospital laboratories can quantify theophylline, digoxin, anticonvulsant, and tricyclic antidepressant levels. Toxicologic screens of the urine and blood typically test for drug abuse (e.g., amphetamines, cocaine, marijuana, opioids, phencyclidine). Without clinical suspicion or suspected access to illicit drugs, toxicologic screens are not usually useful in guiding treatment. In one study, only 3 percent of screening test results in the pediatric emergency department were positive without suspicion of an exposure.[16] In a second prospective study, toxicologic screening influenced treatment decisions in children only when quantitative assays, such as acetaminophen, salicylates, phenytoin (Dilantin), and carbamazepine (Tegretol) levels, were performed.[17] Positive urine drug screens should be verified by another method of detection; conversely, a false-negative urine screen could misdirect treatment.

Treatment

For many years, all poisonings were treated with the same protocol of aggressive decontamination and standard antidote regimens. There is still controversy as to which patients are likely to benefit from decontamination. Gastric decontamination, such as activated charcoal and gastric lavage, are no longer routinely recommended and should be reserved for the most severe cases, with poison control center support. The physician should consider the type and amount of substance ingested, the potential toxicity, the time elapsed since ingestion, and the symptoms exhibited.[14] *Table 7* summarizes decontamination methods used in children.[8,14,18,19] Supportive care should be initiated with all childhood poisonings.

GASTRIC LAVAGE

Gastric lavage has been used for many years to empirically remove ingested toxins from the stomach. It involves the administration of normal saline via a large-bore orogastric tube. Orogastric tubes may recover significant amounts of gastric contents, but are limited by poor tolerability because of their size, placement difficulty, and gag stimulation.[3,20] The patient benefit diminishes as time elapses after ingestion.[3,20] Multiple complications are possible, including aspiration, respiratory compromise, mechanical injury or perforation, and electrolyte imbalance.[3] Relatively few studies have been conducted on the effectiveness and safety outcomes of gastric lavage in patients exposed to toxins. The American Academy of Clinical Toxicology (AACT) and European Association of Poison Centres and Clinical Toxicologists (EAPCCT) discourage the routine use of gastric lavage in the emergency department, unless performed by well-practiced physicians within one hour of the ingestion.[20]

ACTIVATED CHARCOAL

Activated charcoal can decrease the absorption of a wide variety of toxins in the stomach and intestinal tract. The use of activated charcoal is most likely to help children who may have ingested carbamazepine, dapsone, phenobarbital, quinine (Qualaquin), theophylline, salicylates, phenytoin,

Table 5. Toxidromes/Toxic Symptoms and Antidotes

Type of poisoning	*Agents*	*Toxidromes/toxic symptoms*	*Antidotes*
Acetaminophen	Acetaminophen	Abdominal pain, nausea/vomiting, elevated aspartate transaminase level (greater than 1,000 IU per L after 24 hours), jaundice, confusion, somnolence, coma, disorientation	*N*-acetylcysteine (Mucomyst; brand no longer available in the United States)
Anticholinergic	Antihistamines, atropine (Atreza), belladonna alkaloids, toxic mushrooms, psychoactive drugs	Tachycardia, hyperthermia, mydriasis, warm and dry skin, urinary retention, ileus, delirium	—
Anticoagulant	Warfarin (Coumadin), rodenticides	Ecchymoses, bleeding, prolonged prothrombin and bleeding times	Vitamin K
Cardiac medication	Calcium channel blockers, beta blockers, digoxin	Bradycardia, arrhythmias, hypotension, dizziness, heart block, nausea, vomiting	Calcium chloride, glucagon (Glucagen), digoxin immune fab (Digibind)
Cholinergic, muscarinic	Carbamates, some mushrooms, organophosphates, physostigmine, pilocarpine (Isopto Carpine), pyridostigmine	Salivation, lacrimation, urination, diarrhea, bronchorrhea, wheezing, bradycardia, vomiting	Atropine/pralidoxime (not available in the United States)
Cholinergic, nicotinic	Black widow spider bites, carbamates, insecticides, nicotine	Tachycardia, hypertension, fasciculations, gastrointestinal cramps, emesis, miosis	Atropine/pralidoxime (not available in the United States)
Cyanide	Cyanide	Syncope, cyanosis, hypotension, psychosis	Sodium nitrite 3%, sodium thiosulfate 25%
Ethylene glycol, methanol	Antifreeze, rubbing alcohol	Central nervous system depression, respiratory depression, seizures, hypotension, hypoglycemia	Ethanol 10% or fomepizole (Antizol)
Iron	Iron-containing products	Dyspepsia, nausea, vomiting, diarrhea, dark stools	Deferoxamine (Desferal)
Opioid	Opioids (e.g., morphine, hydrocodone [Hycodan], methadone)	Hypoventilation, hypotension, miosis, sedation, hypothermia, ileus	Short-acting naloxone (Narcan; brand no longer available in the United States), monitor closely for withdrawal symptoms and relapsing sedation
Salicylate	Aspirin products	Tinnitus, nausea, vomiting, fever, disorientation, lethargy, tachypnea	—
Sulfonylurea	Sulfonylurea	Hypoglycemia, tachycardia, diaphoresis, clammy skin, mental status changes, coma	Octreotide (Sandostatin)
Sympathomimetic	Amphetamines, caffeine, cocaine, ephedrine, 3,4-methylenedioxymethamphetamine (also called Ecstasy), phenylpropanolamine (no longer available in the United States), theophylline, diphenoxylate/atropine (Lomotil)	Tachycardia, hypertension, mydriasis, agitation, seizures, diaphoresis, psychosis, hyperthermia	—

Information from references 5, 6, 13, and 14.

Table 6. Suggested Laboratory Tests

Test	*Condition*
Initial assessment subset	
Bicarbonate	Renal failure
Blood glucose	Hypoglycemic ingestion
Electrocardiography	Cardiotoxicity
Electrolytes, blood urea nitrogen, serum creatinine	Renal failure, electrolyte imbalance
Prothrombin time	Coagulopathy
Pulse oximetry	Hypoxia
Serum acetaminophen	Acetaminophen toxicity
Urine human chorionic gonadotropin (if patient is a woman of childbearing age)	Pregnancy
Probing subset	
Arterial blood gas or pulse oximetry	Hypoxemia
Creatine kinase	Nephrotoxicity, rhabdomyolysis
Serum osmolality	—
Specific drug levels (e.g., salicylates, iron, digoxin, anticonvulsants, alcohol)	—
Urine drug screen	Opioid or street drug ingestion
Urinalysis	Nephrotoxicity/renal failure

Adapted with permission from Barry JD. Diagnosis and management of the poisoned child. Pediatr Ann. *2005;34(12):943.*

or valproic acid (Depakene).[3] Activated charcoal interrupts the enterohepatic and enteroenteric recirculation of drugs in the gut lumen. Its use may be limited because of its taste, appearance, and the tendency of children to vomit after its administration. Additionally, there are some agents that do not absorb well with activated charcoal.

The AACT discourages the routine use of activated charcoal except within one hour of ingestion.[3,19] There is insufficient evidence to show that later administration improves clinical outcomes. If activated charcoal is used, a charcoal-to-drug ratio of 10:1 is recommended. A dose of 1 to 2 g per kg is recommended for children with ingestions of an unknown quantity. The first dose is often given with a cathartic agent, such as sorbitol, to improve taste and transit through the intestinal tract. Multiple doses should not include sorbitol each time because it may cause electrolyte and fluid abnormalities.[3,21]

CATHARTICS AND WHOLE BOWEL IRRIGATION

High-dose cathartics may be an effective means of ridding the lower gastrointestinal tract of toxins; however, they carry a risk of electrolyte imbalances and dehydration, as well as pain and cramping. As mentioned previously, sorbitol is often used with the first dose of activated charcoal and is occasionally given again later. Polyethylene glycol is less likely to cause electrolyte imbalances and is being used with whole bowel irrigation for some poisonings. Although whole bowel irrigation may be helpful for those who have ingested heavy metals or long-acting or sustained-release medications, there are few clinical trials about the effectiveness of this procedure in children.[22]

HEMODIALYSIS AND URINE ALKALINIZATION

Hemodialysis may be appropriate for lithium, salicylate, theophylline, methanol, atenolol (Tenormin), phenobarbital, or valproic acid toxicity. Toxicology and nephrology consultation is also advised. Urinary alkalinization with sodium bicarbonate may be used for poisonings with salicylates, tricyclic antidepressants, phenobarbital, chlorpropamide (Diabinese; brand no longer available in the United States), chlorophenoxy herbicides, or methotrexate.[3]

SYRUP OF IPECAC

There is no clinical evidence that syrup of ipecac improves patient outcomes, even when given within minutes of toxin ingestion. In 1992, the AACT and the EAPCCT recommended that the routine use of ipecac be abandoned because of this lack of evidence.[22,23] Likewise, the American Academy of Pediatrics no longer recommends ipecac for home use in children.[24]

TOXIN-SPECIFIC TREATMENTS

If physical examination or laboratory findings suggest a specific toxidrome, the physician should consider toxin-specific treatments, such as an antidote *(Table 5*[5,6,13,14]*)*. Antidotes are usually given after the patient is stable, preferably within a few hours of ingestion, and may require multiple doses because of short durations of action. The physician should consult with the local poison control center before administering an antidote unless he or she has ample experience with specialized poison treatment.

Supportive Care and Disposition

Childhood poisonings require supportive treatment, including monitoring and continued observation. Low-risk patients with minimal symptoms, nontoxic ingestions, and no expected sequelae may be discharged to caregivers after a short observation period.[1] High-risk patients (e.g., intentional ingestions, patients who exhibit continued toxidromes or prolonged symptoms) should be admitted to the hospital for ongoing treatment and extended observation.[2,3] Psychiatric consultation is appropriate with intentional ingestion. Repeated instances of unintentional poisonings within one family should prompt a discussion about preventive measures, as well as a closer look at the caregiver situation and the possibility of child abuse or neglect.

Table 7. Agents Used for Gastrointestinal Decontamination in Children

Agent	*Dose*	*Risks*	*Contraindications*
Activated charcoal*†	1 to 2 g per kg (maximum of 50 to 60 g)	Aspiration, constipation, vomiting	Unlikely to benefit patients who ingested alcohols, strong acids or bases, minerals, iron, lithium, or hydrocarbon
Gastric lavage*†	10 to 15 mL per kg saline instilled via large-bore orogastric tube, repeated until aspirates clear	Esophageal/laryngeal trauma, aspiration, nausea/vomiting, impaired level of consciousness	Unprotected airway, ingestion of hydrocarbons or corrosives, risk of perforation or hemorrhage
Polyethylene glycol (used with whole bowel irrigation)	500 mL per hour for children nine months to five years of age 1,000 mL per hour for children six to 12 years of age	Vomiting, cramping	Unprotected airway, intractable vomiting, gastrointestinal hemorrhage, ileus, perforation, obstruction
Sorbitol (used with activated charcoal)	1 to 2 g per kg	Hypernatremia, dehydration	Obstruction, perforation, ileus

**—May not be beneficial if given more than one hour after ingestion.*
†—Not routinely recommended.

Information from references 8, 14, 18, and 19.

The Authors

TAMARA McGREGOR, MD, is an assistant professor of family medicine at the University of Texas Southwestern Family Medicine Residency Program in Dallas. Dr. McGregor received her medical degree from the University of Texas Southwestern Medical School and completed a family medicine residency at John Peter Smith Hospital in Fort Worth, Texas.

MEHJABIN PARKAR, MD, is a family physician at Fort Bend Family Health Center in Richmond, Texas. At the time this article was written, Dr. Parkar was a resident at the University of Texas Southwestern Family Medicine Residency Program. Dr. Parkar received her medical degree from D.Y. Patil Medical College in India.

SHOBHA RAO, MD, is an associate professor of family medicine at the University of Texas Southwestern Family Medicine Residency Program. Dr. Rao received her medical degree from Sri Venkateswara Medical College in India. She completed a family medicine residency at the University of Texas Health Science Center in San Antonio, and a geriatrics fellowship at the University of Pennsylvania School of Medicine in Philadelphia.

Address correspondence to Tamara McGregor, MD, University of Texas Southwestern Family Medicine Residency Program, 6263 Harry Hines Blvd., Suite 300, Dallas, TX 75390-9067 (e-mail: Tamara.McGregor@UTSouthwestern.edu). Reprints are not available from the authors.

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