

# Drugs for Pediatric Emergencies

Committee on Drugs

**ABSTRACT.** This statement provides current recommendations about the use of emergency drugs for acute pediatric problems that require pharmacologic intervention. At each clinical setting, physicians and other providers should evaluate drug, equipment, and training needs. The information provided here is not all-inclusive and is not intended to be appropriate to every health care setting. When possible, dosage recommendations are consistent with those in standard references, such as the *Advanced Pediatric Life Support* (APLS) and *Pediatric Advanced Life Support* (PALS) textbooks.<sup>1-3</sup> Additional guidance is available in the manual *Emergency Medical Services for Children: The Role of the Primary Care Provider*, published by the American Academy of Pediatrics, as well as in the PALS and APLS textbooks.

**ABBREVIATIONS.** APLS, *Advanced Pediatric Life Support* (textbook); PALS, *Pediatric Advanced Life Support* (textbook); IV, intravenous; IM, intramuscular; PO, oral.

**T**he drug information in this statement assists health care providers and facilities in preparing for a crisis. **This document is not designed for use during an actual emergency.** It is useful to precalculate and distribute volumetric doses (eg, mL/kg) using the specific drug concentrations that are available in a particular institution. Precalculated drug cards or length-based resuscitation tapes are useful in the preparation process. **This document does not provide comprehensive drug information.** Descriptions of drug indications and side effects have been purposely limited.

Drug dosages are generally presented as milligram per kilogram (mg/kg). An exception is made for high-potency drugs (vasoactive amines and nitroprusside). For these drugs, dosage is given in microgram per kilogram ( $\mu$ g/kg) in Table 1.

In general, drug doses (including "bolus" doses) should be administered over several minutes to avoid transiently excessive blood levels of the drug. Exceptions to this rule include: adenosine, epinephrine, atropine, and muscle relaxants. Infusion devices (intravenous [IV] infusion pumps) should be used for all vasoactive drugs administered as a continuous infusion, such as dopamine or nitroprusside.

Unless otherwise indicated, the IV route is preferred. In an emergency, intraosseous administration is an acceptable alternative when IV access cannot be

obtained within 90 seconds or after three attempts to establish IV access. For some drugs, such as epinephrine, atropine, naloxone, and lidocaine, endotracheal administration is appropriate. A recommended method of endotracheal delivery is to administer the drug with or dilute in 1 to 5 mL of isotonic saline through a catheter inserted to the tip of the endotracheal tube. This method may enhance absorption from the lung.

The dosages provided are recommendations based upon expert consensus. The Committee on Drugs recognizes that pediatric labeling and dosage information do not exist for many of these drugs. Dosage should be individualized, taking into account the patient's age, weight, underlying illness, concurrently administered drugs, and known hypersensitivity.

A physician who administers drugs that depress the respiratory or central nervous system must have the skills necessary to manage the potential complications. It is important to implement the guidelines for monitoring published by the American Academy of Pediatrics.<sup>4</sup> **A practitioner who uses a neuromuscular blocking agent ("muscle relaxant") must be qualified to maintain the patient's airway through bag and mask ventilation and endotracheal intubation. Once the patient has received the muscle relaxant, there is no longer any respiratory effort.**

## SOME CONSIDERATIONS FOR THE USE OF DRUGS FOR ENDOTRACHEAL INTUBATION

The choice of drugs for control of the airway should address two concerns: adequate sedation/analgesia for laryngoscopy and appropriate selection of a muscle relaxant, if indicated. A patient who is in full cardiac arrest does not require sedatives or muscle relaxants to safely gain control of the airway. When cardiac arrest has not occurred, endotracheal intubation of the patient who is ill or who has been injured—especially if there is associated head injury—may be facilitated by administration of a sedative (benzodiazepine), IV local anesthetic (lidocaine), opioid (fentanyl), and a neuromuscular blocking drug. The choice of drugs depends on the physiologic status of the patient. A patient who is hypovolemic would be placed at risk with the rapid IV administration of barbiturates (such as methohexital or thiopental) because of the cardiac depressant and vasodilator effects of barbiturates. Ketamine would be a better choice in this circumstance. Conversely, a patient with a closed head injury would benefit from the use of barbiturates and/or lidocaine and fentanyl because this would reduce cerebral blood flow and

The recommendations in this statement do not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

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cerebral oxygen consumption and therefore intracranial pressure. Following head injury, ketamine therapy increases cerebral blood flow and intracranial pressure.

Combining drugs with different modes of action may be advantageous. For example, adding a benzodiazepine or narcotic to the regimen may prolong the effect and/or enable a reduction in the dose of ketamine or barbiturate required to sedate.

Airway equipment appropriate for the patient's size and age must be immediately available before a neuromuscular blocking agent is administered. This equipment includes an appropriate-sized face mask, a bag-mask-valve device for positive pressure ventilation, endotracheal tubes, oral airways, functioning laryngoscope blades, functioning handles, suction catheters, and suction apparatus to clear the airway if the patient vomits. The patient should be fully monitored with a cardiac monitor, blood pressure readings, and pulse oximetry. Nasogastric (orogastric) suction catheters are helpful in evacuating and decompressing the patient's stomach if gastric distention occurs. A stethoscope should be available to check breath sounds.

The choice of muscle relaxant depends on the circumstances. Succinylcholine remains the muscle relaxant of choice for the emergency control of the airway and is generally the muscle relaxant of choice for patients with a "full stomach." It has the most rapid onset and shortest duration of the relaxants that are currently available and has the longest "track record" for overall safety.

Administration of succinylcholine should be preceded by atropine to prevent significant bradycardia. In children over 5 years of age, a defasciculating dose of a nondepolarizing relaxant (10% of an intubating dose) 2 to 3 minutes before succinylcholine may prevent muscle fasciculations. Cricoid pressure is applied (firm pressure on the cricoid cartilage) to prevent passive regurgitation during laryngoscopy and intubation.

If succinylcholine therapy is contraindicated (history of malignant hyperthermia, muscular dystrophy, neuromuscular disease, neurologic denervation injury or crush injury), a nondepolarizing muscle relaxant is indicated. With nondepolarizing agents, the onset of neuromuscular blockade may be somewhat delayed compared with succinylcholine. Also, the duration of paralysis is markedly prolonged compared with succinylcholine. The peak effect of pancuronium, for example, generally occurs 2 to 3 minutes after administration. The effects of the most recently approved relaxant (rocuronium) occur within 45 seconds to 1 minute. This time is dose-dependent and in higher doses (0.8 to 1.2 mg/kg) is similar to that of succinylcholine. Rocuronium may be a reasonable alternative to succinylcholine when succinylcholine is contraindicated.

Recent concerns about the elective use of succinylcholine in pediatric patients have focused on the occasional reports of hyperkalemic cardiac arrest, particularly in children with undiagnosed Duchenne muscular dystrophy. The incidence of Duchenne muscular dystrophy is only 1 in 3000 to 8000 male children. The revised labeling continues to permit the use of succinylcholine for emergency control of the airway and treatment of laryngospasm. *Succinylcholine is the only neuromuscular blocking agent currently available that has been demonstrated to be effective after intramuscular (IM) administration when emergency control of the airway is required and there is no IV access.* In this circumstance, the dosage must be increased to 4 to 5 mg/kg IM. Atropine is administered simultaneously. Following IM succinylcholine, onset of neuromuscular blockade takes approximately 2 to 5 minutes; the response in patients who are hypotensive or hypovolemic is unpredictable. Standard textbooks of advanced life support, eg, *Pediatric Advanced Life Support* or *Advanced Pediatric Life Support* (PALS, APLS), should be consulted for more detail.<sup>1-4</sup>

**TABLE 1.** Frequently Used Emergency Drugs

Adenosine	Diazoxide	Glucose	Meperidine	Phenylephrine
Albuterol	Digibind	Haloperidol	Methylprednisolone	Phenytoin
Atropine	Diphenhydramine	Insulin	Midazolam	Procinamide
Bicarbonate	Dopamine	Ipecac	Morphine sulfate	Propranolol
Calcium chloride	Dobutamine	Kayexalate	Naloxone	Prostaglandin E
Calcium gluconate	Epinephrine	Ketamine	Nitroprusside	Rocuronium
Charcoal	Fentanyl	Lidocaine	Oxygen	Succinylcholine
Dexamethasone	Fosphenytoin	Lorazepam	Pancuronium	Thiopental
Diazepam	Glucagon	Mannitol	Phenobarbital	Vecuronium

## Adenosine

Indication: Supraventricular tachycardia

Dosage: Initial dose: 0.05 mg/kg as rapidly as possible followed by flush of the IV catheter.

Subsequent doses: If atrioventricular (AV) block occurs or if there is no response within 30 seconds, increase by 0.05 mg/kg (eg, 0.1 mg/kg followed by flush of the IV catheter; if no response, increase to 0.15 mg/kg and flush IV catheter).

Maximum single dose, 12 mg.

**WARNING: Contraindicated in heart transplant patients.**

Note: Higher doses of adenosine may be needed when a patient is taking methylxanthine preparations.

Note: The antidote for profound bradycardia is aminophylline, 5 to 6 mg/kg over 5 minutes. *Atropine is contraindicated.* A defibrillator must be immediately available.

## Albuterol

Indication: Status asthmaticus, bronchospasm

Dosage: 0.1 to 0.15 mg/kg by nebulization. Repeat as needed.

Note: 0.02 to 0.03 mL/kg of 5 mg/mL solution with normal saline to make 3 mL total in nebulizer; maximum single dose, 2.5 mg.

Note: Administration can be repeated and dose adjusted until desired clinical effect or symptomatic tachycardia.

Note: Oxygen is the preferred gas source for nebulization. Supplemental oxygen should be considered when compressed air driven nebulizers are used or when oxygen flow rate dictated by nebulizer is inadequate. Blended oxygen may be required for premature newborns who are still at risk for retinopathy of prematurity.

## Atropine Sulfate

Indication: 1) Symptomatic bradycardia

Dosage: Intramuscular (IM): 0.02 to 0.04 mg/kg

Intratracheal: 0.02 to 0.04 mg/kg

IV: 0.02 mg/kg.

Minimum single dose, 0.1 mg

Maximum single dose, 0.5 mg for child, 1.0 mg for adolescent. This dose may be repeated once.

Note: Oxygenation and ventilation are essential first maneuvers in the treatment of symptomatic bradycardia. Epinephrine is the drug of choice if oxygen and adequate ventilation are not effective in the treatment of hypoxia-induced bradycardia.

Note: If administered through an endotracheal tube, follow the dose with or dilute in saline flush (1 to 5 mL) based on patient size.

Indication: 2) Anticholinesterase poisoning.

Dosage: IV: 0.05 mg/kg

Repeat as needed for clinical effect.

Note: Anticholinesterase poisonings may require large doses of atropine or the addition of pralidoxime.

Indication: 3) To prevent succinylcholine-induced bradycardia.

Dosage: 0.02 mg/kg IV or 0.02 to 0.04 mg/kg IM just before or simultaneously with succinylcholine

## Bicarbonate, Sodium

Indication: 1) Metabolic acidosis

2) Tricyclic antidepressant overdose.

Dosage: IV: 1 to 2 mEq/kg

**WARNING: Only 0.5 mEq/mL concentration should be used for newborns; dilution of available stock solutions may be necessary.** Administer slowly because bicarbonate solution is hyperosmotic.

Note: Routine initial use of sodium bicarbonate in cardiac arrest is not recommended. However, sodium bicarbonate may be used in cases with documented metabolic acidosis *after* effective ventilation has been established.

## Calcium Chloride

Indication: 1) Ionized hypocalcemia

2) Hyperkalemia

3) Hypermagnesemia

4) Calcium channel blocker toxicity

Dosage: IV: 20 mg/kg (if using 10%  $\text{CaCl}_2$ , dose is 0.2 mL/kg). Inject slowly. Repeat dose as necessary for desired clinical effect.

**WARNING: Stop injection if symptomatic bradycardia occurs. Extravascular administration can result in severe skin injuries.**

Note: Calcium is recommended for cardiac resuscitation only in cases of documented hyperkalemia, hypocalcemia, or calcium channel blocker toxicity.

## Calcium Gluconate

Indication: 1) Ionized hypocalcemia

2) Hyperkalemia

3) Hypermagnesemia

4) Calcium channel blocker toxicity

Ionizes as rapidly as calcium chloride and may be substituted using three times the dose of calcium chloride (mg/kg).

Dosage: IV: 60 mg/kg (if using 10% gluconate, dose is 0.6 mL/kg). Inject slowly. Repeat dose as necessary for desired clinical effect.

**WARNING: Stop injection if symptomatic bradycardia occurs. Extravascular administration can result in severe skin injuries.**

Note: Calcium is recommended for cardiac resuscitation only in cases of documented hyperkalemia, hypocalcemia, or calcium channel blocker toxicity.

### Charcoal, Activated

Indication: Acute ingestion of selected toxic substances

Dosage: 1 to 2 g/kg

Note: Administer as a slurry or down a nasogastric tube. Note that iron, lithium, alcohols, ethylene glycol, alkalies, fluoride, mineral acids, and potassium do not bond to activated charcoal.

**WARNING: Commercially available preparations of activated charcoal often contain a cathartic, such as sorbitol. Fatal hypernatremic dehydration has been reported after repeated doses of charcoal with sorbitol. Nonsorbitol-containing products should be used if repeated doses are necessary.**

### Dexamethasone

Indication: 1) Emergency treatment of elevated intracranial pressure due to brain tumor

Dosage: IV: 1 to 2 mg/kg as a loading dose

Maintenance dose, 1 mg/kg/24 h

Indication: 2) Croup

Dosage: IV, IM, or PO: 0.6 mg/kg dexamethasone, 1 dose/d, or 2 mg/kg/24 h of prednisone. Further dosing and route of administration determined by clinical course.

### Diazepam

Indication: Status epilepticus

Dosage: IV: 0.1 mg/kg every 2 minutes. Maximum dose, 0.3 mg/kg (maximum 10 mg/dose).

Dosage: Rectal: 0.5 mg/kg up to 20 mg

Note: Do not give as IM injection.

**WARNING: There is an increased incidence of apnea when combined with other sedative agents or when given rapidly. One must be prepared to provide respiratory support. Monitor oxygen saturation.**

### Diazoxide

Indication: Hypertensive crisis

Dosage: IV: 1 to 3 mg/kg rapid IV push.

Note: Alternative regimen: 3 to 5 mg/kg IV over 30 minutes. This is reported to result in fewer problems with hypotension or hyperglycemia.

### Digoxin Immune FAB (Digibind)

Indication: Digoxin or digitoxin toxicity

Dosage: 1) Administer digoxin immune FAB intravenously in an amount equimolar to the total body load of digoxin or digitoxin.

2) 38 mg digoxin immune FAB binds 0.5 mg digoxin or digitoxin

Dosing methods:

A: Based on amount ingested:

1) For digoxin tablets, oral solution, IM injection

$$\text{Dose in mg} = \frac{\text{dose ingested (mg)} \times 0.8}{0.5} \times 38;$$

2) For digitoxin tablets, digoxin capsules, IV digoxin or IV digitoxin

$$\text{Dose in mg} = \frac{\text{dose ingested (mg)}}{0.5} \times 38;$$

B: Based on serum digoxin or digitoxin concentration (SDC)

1) Digoxin

$$\text{Dose in mg} = \frac{\text{SDC (ng/mL)} \times \text{weight (kg)}}{100} \times 38$$

2) Digitoxin

$$\text{Dose in mg} = \frac{\text{SDC (ng/mL)} \times \text{weight (kg)}}{1000} \times 38$$

C: If neither amount ingested nor serum concentration is known, 760 mg of digoxin immune FAB should be administered.

### Diphenhydramine

Indication: 1) Acute hypersensitivity reactions

2) Dystonic reactions

Dosage: V or IM: 1 to 2 mg/kg.

Maximum dosage, 50 mg.

Note: May cause sedation, especially if other sedative agents are being used.

May cause hypotension.



## Dopamine

Indication: Continued shock after volume resuscitation

Dosage: IV infusion: 2 to 20  $\mu\text{g/kg/min}$ .

A widely recommended starting dosage is 10  $\mu\text{g/kg/min}$ . Titrate to desired clinical effect.

Note: Preparation of infusion solution: 6 mg  $\times$  body weight (kg) diluted to 100 mL. Infuse at 10 mL/h = 10  $\mu\text{g/kg/min}$  using a constant infusion pump.

**WARNING: Extravascular administration can result in severe skin injuries.**

## Dobutamine

Indication: Impaired cardiac contractility

Dosage: IV infusion: 5 to 25  $\mu\text{g/kg/min}$ .

A widely recommended starting dosage is 10  $\mu\text{g/kg/min}$ . Titrate for desired clinical effect.

Note: Preparation of infusion solution: 6 mg  $\times$  body weight (kg) diluted to 100 mL. Infuse at 10 mL/h = 10  $\mu\text{g/kg/min}$  using a constant infusion pump.

## Epinephrine

Indication: 1) Cardiac arrest or profound bradycardia, asystole, ventricular fibrillation, or pulseless electrical activity

Initial Dose: IV: 10  $\mu\text{g/kg}$  (0.01 mg/kg)

Intraosseous: 10  $\mu\text{g/kg}$  (0.01 mg/kg)

Endotracheal: 100  $\mu\text{g/kg}$  (0.10 mg/kg)

Note: 10  $\mu\text{g/kg}$  = 0.1 mL/kg of 1:10 000 dilution

100  $\mu\text{g/kg}$  = 0.1 mL/kg of 1:1000 dilution

Note: If administered through an endotracheal tube, follow the dose with saline flush or dilute in isotonic saline flush (1 to 5 mL) based on patient size.

Subsequent doses: given every 3 to 5 minutes

IV: 100  $\mu\text{g/kg}$  (0.1 mg/kg)

Intraosseous: 100  $\mu\text{g/kg}$  (0.1 mg/kg)

Endotracheal: 100  $\mu\text{g/kg}$  (0.1 mg/kg)

Note: For subsequent doses of epinephrine, a dosage up to 200  $\mu\text{g/kg}$  (0.2 mg/kg) may be given.

Indication: 2) Anaphylaxis

Dosage: Subcutaneous (SC): 10  $\mu\text{g/kg}$  per dose (maximum 3 doses)

IV: 10  $\mu\text{g/kg}$  per dose:

10  $\mu\text{g/kg}$  = 0.01 mL/kg of 1:1000 dilution or 0.1 mL/kg of a 1:10 000 dilution

Note: Repeat the SC dose every 20 minutes while attempting IV access. Some anaphylactic reactions, eg, latex allergy, require large doses of epinephrine. A continuous infusion of epinephrine may be necessary.

Indication: 3) Continued shock after volume resuscitation

Dosage: IV infusion: 0.1 to 3.0  $\mu\text{g/kg/min}$ .

Start at lowest dose and titrate for desired clinical effect.

Note: Preparation of infusion solution: 0.6 mg  $\times$  body weight (kg) diluted to 100 mL. Infuse at 1 mL/h = 0.1  $\mu\text{g/kg/min}$  using a constant infusion pump.

Note: Extravasation can result in tissue necrosis injuries.

Indication: 4) Status asthmaticus, bronchospasm

Dosage: SC: 10  $\mu\text{g/kg}$  per dose

10  $\mu\text{g/kg}$  = 0.01 mL/kg of 1:1000 dilution

Maximum single dose, 300  $\mu\text{g}$  (0.3 mL of 1:1000 dilution).

Note: Albuterol administered by inhalation is now considered the agent of choice for treatment of acute exacerbations of asthma.

Note: Repeat SC dose every 20 minutes if needed for clinical effect. Total of 3 doses.

Indication: 5) Laryngotracheobronchitis:

Dosage: Racemic epinephrine, 2.25% inhalation solution

0–20 kg: 0.25 mL in 2 mL with normal saline administered by nebulizer

20–40 kg: 0.50 mL in 2 mL with normal saline administered by nebulizer

>40 kg: 0.75 mL in 2 mL with normal saline administered by nebulizer

Note: L-Epinephrine: An equal volume of 1% L-epinephrine (1:100) is approximately equivalent in biologic activity to 2.25% racemic epinephrine; one can be substituted for the other in equal volumes for inhalation.

Alternatively, 5 mL of 1:1,000 L-epinephrine is equivalent to 0.5 mL of 1:100.

## Fentanyl

Indication: Pain

Dosage: IV: 0.5  $\mu\text{g}$  to 2.0  $\mu\text{g/kg}$ . Repeat dose as necessary for clinical effect.

Note: Higher doses may be necessary if the patient is tolerant.

Note: Rapid administration of fentanyl has been associated with both glottic and chest wall rigidity even with dosages as low as 1  $\mu\text{g/kg}$ . Therefore, fentanyl should be titrated in slowly over several minutes.

**WARNING:** There is an increased incidence of apnea when combined with other sedative agents, particularly benzodiazepines. Be prepared to administer naloxone. Monitor the patient's vital signs and oxygen saturation. Be prepared to provide respiratory support.

### Flumazenil

Indication: Benzodiazepine intoxication

Dosage: IV: 5 to 10  $\mu\text{g/kg}$  (up to 100  $\mu\text{g/kg}$  has been used)

Maximum dose, 1 mg

Note: Useful only for benzodiazepine intoxication.

**WARNING:** Duration of action is shorter than most clinically important benzodiazepines. Resedation may occur. May precipitate acute withdrawal in dependent patients; use drug with caution as its use may be associated with seizures. Patients who receive flumazenil should be continuously observed for resedation for at least 2 hours after the last dose of flumazenil.

### Fosphenytoin

Indication: Status epilepticus (same as phenytoin)

Dosage: ALWAYS IN PHENYTOIN EQUIVALENTS (PE)

10 to 20 mg PE/kg (same as phenytoin)

Route of administration: IM or IV: 1 to 3 mg PE/kg/min; maximum rate 150 mg PE/min

Note: Data are currently being collected on children less than 6 years of age.

Itching is a common and controllable by reducing flow rate.

**WARNING:** Rate of infusion should not exceed 3 mg PE/kg/min. Heart rate should be monitored and the rate of infusion reduced if the heart rate decreases by 10 beats/minute (same as phenytoin).

### Furosemide

Indication: 1) Fluid overload

2) Congestive heart failure

Dosage: IV, IM: 1 mg/kg

### Glucagon

Indication: 1) Hypoglycemia due to insulin excess

Dosage: Adult and adolescent: 0.5 to 1.0 mg SC, IM, IV; repeat every 20 minutes

Pediatric: 0.025 mg/kg up to 1.0 mg SC, IM, IV; repeat the dose every 20 minutes if needed for clinical effect. Total of 3 doses.

Note: An attempt should be made to provide a simultaneous IV glucose infusion.

Indication: 2) Beta-blocker or calcium channel blocker overdose

Dosage: Adolescent

IV: 2 to 3 mg followed by a 5 mg/h infusion.

Pediatric

IV: 0.025 to 0.05 mg/kg followed by 0.07 mg/kg/h infusion.

### Glucose

Indication: Hypoglycemia

Initial Dose: IV: 250 to 500 mg/kg

Maintenance

Dose: Constant infusion of 10% dextrose in water at a rate of 100 mL/kg/24 h (7 mg/kg/min). Older children may require a substantially lower dose. The rate should be titrated to appropriate glucose values.

Note: 250 to 500 mg/kg = 2.5 to 5.0 mL/kg of D10%

250 to 500 mg/kg = 1.0 to 2.0 mL/kg of D25%

250 to 500 mg/kg = 0.5 to 1.0 mL/kg of D50%

Note: Neonates should receive 10% to 12.5% glucose administered slowly.

Note: Glucose levels should be determined before and during administration. If large volumes of dextrose are administered, include electrolytes to prevent hyponatremia and hypokalemia.

### Haloperidol

Indication: Psychosis with agitation

Dosage: IM, IV: 0.1 mg/kg, may repeat hourly as necessary. Maximum single dose, 5 mg.

Note: Hypotension and dystonic reactions may occur.

### Insulin, Regular

Indication: 1) Diabetic ketoacidosis

Dosage: SC: 0.25 to 0.5 unit/kg per dose

IV infusion dose: 0.05 to 0.1 unit/kg/h

Neonatal dose: 0.05 unit/kg/h

Note: Blood glucose levels should be closely monitored. Appropriate fluid and electrolyte therapy are also required in treating diabetic ketoacidosis.

Indication: 2) Hyperkalemia

Dosage: IV: 0.1 unit/kg with 400 mg/kg glucose. Ratio of 1 unit of insulin for every 4 g of glucose.

Note: Potassium levels in blood or serum should be monitored.

### **Ipecac Syrup**

Indication: Acute ingestion of selected toxic substances

Dosage: Oral (PO): 6-month-old to 1-year-old = 10 mL

>1 year old = 15 mL

Adolescent/young adult = 30 mL

**WARNING: Do not use when patient is suffering from central nervous system depression or if having seizures. Contraindicated in caustic and hydrocarbon ingestion. Patients who ingest pesticides or other chemicals that may have a hydrocarbon base may need to have emesis induced. Consult your regional poison control center.**

Note: Administer with 120 to 180 mL of fluid; 90% effective in inducing vomiting within 25 minutes of first dose. May repeat once.

Note: Activated charcoal is now considered the first line therapy for most oral ingestions treated in the hospital setting.

### **Kayexalate (Sodium Polystyrene Sulfonate)**

Indication: Treatment of hyperkalemia

Dosage: Adults and adolescents

PO: 15 g (60 mL) 1 to 4 times/day

Rectal: 30 to 50 g every 6 hours

Children

PO: 1.0 g/kg every 6 hours

Rectal: 1.0 g/kg/dose every 2 to 6 hours (for small children and infants use lower doses by using the practical exchange ratio of 1 mEq K<sup>+</sup>/g of resin).

**WARNING: Avoid using the commercially available liquid preparation in neonates due to the hyperosmolar preservative (Sorbitol) content. Extremely premature newborns may develop intestinal hemorrhage (hematochezia) from rectal Kayexalate.**

### **Ketamine**

Indication: 1) Sedation/analgesia

Dosage: IM: 1 to 2 mg/kg

IV: 0.5 to 1 mg/kg

Indication: 2) Adjunct to intubation

Dosage: IV: 1 to 2 mg/kg

Note: Laryngospasm associated with ketamine is usually reversed with oxygen administration and positive pressure ventilation.

Note: Atropine or other antisialogogue should be used to prevent increased salivation.

**WARNING: Be prepared to provide respiratory support. Monitor oxygen saturation. Avoid use in patients with increased intracranial pressure or increased intraocular pressure.**

### **Lidocaine**

Indication: 1) Ventricular arrhythmia

Dosage: IV: 1 mg/kg as a single dose slowly, repeat every 5 to 10 minutes to desired effect or until maximum dose of 3 mg/kg is given

IV infusion: 20 to 50 µg/kg/min

Endotracheal: 1 mg/kg

Note: If administered through an endotracheal tube, follow the dose with saline flush or dilute in isotonic saline flush (1 to 5 mL) based on patient size.

Note: Preparation of infusion solution: add 120 mg (6 mL of a 2.0% concentration) to 100 mL of 5% glucose in water. Infusion of 1.0 to 2.5 mL/kg/h will deliver 20 to 50 µg/kg/min.

Note: A reduced infusion rate should be used in patients with a low cardiac output.

**WARNING: Contraindicated in complete heart block and wide complex tachycardia due to accessory conduction pathways.**

Note: Excessive dosage may result in myocardial depression, hypotension, central excitation, and seizures.

Indication: 2) To attenuate airway reflexes before endotracheal intubation or airway manipulation in patients with elevated intracranial pressure

Dosage: 1 mg/kg IV as a single dose 30 seconds before airway instrumentation.

### **Lorazepam**

Indication: 1) Status epilepticus

2) Adjunct for intubation

Dosage: IM or IV: 0.05 to 0.1 mg/kg

Repeat doses every 10 to 15 minutes for clinical effect.

**WARNING: There is an increased incidence of apnea when combined with other sedative agents. Be prepared to provide respiratory support. Monitor oxygen saturation.**

### Mannitol

Indication: Increased intracranial pressure

Dosage: IV: 0.25 g/kg given over a 15-minute infusion.

Note: A larger dose (0.5 g/kg given over 15 minutes) may be appropriate in an acute intracranial hypertensive crisis. In conjunction with mannitol, other measures to control intracranial pressure such as hyperventilation, barbiturates, and muscle relaxation (using a neuromuscular blocking agent) should be considered.

**WARNING: Rapid administration may cause hypotension, hyperosmolality, and elevated intracranial pressure.**

### Meperidine

Indication: Pain

Dosage: IV or IM: 1 to 2 mg/kg

Repeat dose is necessary for clinical effect.

Note: Higher doses may be necessary if patient is tolerant.

**WARNING: There is an increased incidence of apnea when combined with other sedative agents, particularly benzodiazepines. Be prepared to administer naloxone. Monitor the patient's vital signs and oxygen saturation. Be prepared to provide respiratory support.**

### Methylprednisolone

Indication: 1) Asthma/allergic reaction

Dosage: IV: 1 to 2 mg/kg every 6 hours

Indication: 2) Spinal cord injury

Dosage: IV: 30 mg/kg over 15 minutes. In 45 minutes begin a continuous infusion of 5 to 6 mg/kg/h for 23 hours.

Indication: 3) Croup

Dosage: IV: 1 to 2 mg/kg of methylprednisolone, then 0.5 mg/kg every 6 to 8 hours.

### Midazolam

Indication: Adjunct for endotracheal intubation or for sedation/anxiolysis

Dosage: IV: 0.05 to 0.2 mg/kg given over several minutes.

**WARNING: There is an increased incidence of apnea when combined with other sedative agents. Be prepared to provide respiratory support. Monitor oxygen saturation.**

### Morphine Sulfate

Indication: Pain, infundibular spasm ("Tet Spell")

Dosage: IV (slowly) or IM: 0.05 to 0.1 mg/kg.

Repeat dose as necessary for clinical effect.

Note: Higher doses may be necessary if patient is tolerant.

**WARNING: There is an increased incidence of apnea when combined with other sedative agents, particularly benzodiazepines. Be prepared to administer naloxone. Monitor the patient's vital signs and oxygen saturation. Be prepared to provide respiratory support.**

### Naloxone

Indication: Respiratory depression induced by opioid

Dosage: IV, IM: 0.1 mg/kg from birth (including premature infants) until age 5 years or 20 kg of weight. Thereafter, the minimum dose is 2.0 mg. Doses may be repeated as needed to maintain opiate reversal. IM absorption may be erratic.

Note: This dosage is indicated for acute opiate intoxication. Titration to effect with lower initial doses (0.01 mg/kg or 10 µg/kg) should be considered for other clinical situations, eg, respiratory depression during pain management.

**WARNING: May induce acute withdrawal in opioid dependency. Patients who receive naloxone should be continuously observed for renarcotization for at least 2 hours after the last dose of naloxone.**

### Nitroprusside

Indication: Hypertensive crisis

Dosage: IV: 0.5 to 10 µg/kg/min.

Start at the lowest dosage and titrate for the desired clinical effect. Administer through low dead space system or as close to IV catheter as possible to prevent accidental bolus injection.

Note: Preparation of infusion solution: 6 mg × body weight (kg) diluted to 100 mL D5W. Infuse at 1 mL/h = 1 µg/kg/min using a constant infusion pump.

Note: Bottle, burette, or syringe pump but not the IV tubing should be covered with protective foil to avoid breakdown by light.

**WARNING: Administration may result in profound hypotension. Patients should be closely monitored. Blood pressure should be continuously monitored with an arterial line.**

**WARNING: Cyanide toxicity can result from large doses and/or prolonged infusions. Patients should be closely monitored for the development of metabolic acidosis. Patients with decreased renal function may be at increased risk.**



## Oxygen

- Indication: 1) Hypoxemia and/or respiratory distress  
2) Carbon monoxide poisoning  
3) Shock

Dosage: 100% by nonrebreather mask initially or endotracheal tube; wean as tolerated.

Note: The administration of supplemental oxygen should be considered during **EVERY** pediatric emergency.

## Pancuronium

- Indication: 1) Neuromuscular blockade to facilitate mechanical ventilation  
2) Emergency intubation

Dosage: IV: 0.1 mg/kg

Note: This drug does not alter the level of consciousness or provide analgesia or amnesia.

Note: This agent can be used when succinylcholine is contraindicated. Pancuronium is a long-acting neuromuscular blocker that requires ventilatory assistance for at least 1 hour. Satisfactory conditions for endotracheal intubation will generally occur 2 to 3 minutes after administration.

**WARNING: Ventilatory support will be necessary. Personnel with skills in advanced airway management must be present and prepared to respond when this agent is administered. Age-appropriate equipment for suctioning, oxygenation, intubation, and ventilation should be immediately available.**

## Phenobarbital

Indication: Status epilepticus

Dosage: IV: 20 mg/kg. Maximum dose, 1000 mg.

Repeat dose once if necessary for clinical effect after 15 minutes.

**WARNING: There is an increased incidence of apnea when combined with other sedative agents. Be prepared to provide respiratory support. Monitor oxygen saturation.**

## Phenylephrine

Indication: Infundibular spasm ("Tet Spell")

Dosage: 5 to 20  $\mu$ g/kg push then followed by infusion at 0.1 to 5.0  $\mu$ g/kg/min.

**WARNING: Blood pressure must be carefully followed and dose titrated to effect.**

## Phenytoin

Indication: Status epilepticus

Dosage: IV: 10 to 20 mg/kg initial dose.

Maximum initial dose, 1000 mg.

Maximum rate of administration, 50 mg/min or 1 mg/kg/min, whichever is less.

Note: The lower dose is indicated in neonates because of increased risk of toxicity due to decreased protein binding. Should be diluted in normal saline to avoid precipitation.

**WARNING: Rate of infusion should not exceed 0.1 mL of undiluted preparation per kg/min. Heart rate should be monitored and the rate of infusion reduced if the heart rate decreases by 10 beats/minute.**

## Procainamide

Indication: Wide complex tachycardia

Dosage: IV: Start at 3 to 6 mg/kg/dose over 5 minutes not to exceed 100 mg to a titrated maximum of 15 mg/kg/loading dose.

Maintenance dose, 20 to 80  $\mu$ g/kg/min (0.02 to 0.08 mg/kg/min); maximum, 2 g/24 h.

**WARNING: If 50% QRS widening or hypotension occurs during loading dose, the remainder of the loading dose is held, and the maintenance dose is delayed until these signs have resolved.**

## Propranolol

Indication: Infundibular spasm ("Tet Spell")

Dosage: IV: 0.01 to 0.02 mg/kg per dose infused over 10 min in 5% dextrose in water.

Maximum initial dose, 1.0 mg

Note: Oxygen should be administered first. Morphine is also an effective treatment for infundibular spasms. Phenylephrine is another adjunct for reversal of infundibular spasm. Use is contraindicated in congestive heart failure. Avoid in patients with a history of bronchospasm.

## Prostaglandin E<sub>1</sub>

Indication: Possible ductal-dependent cardiac malformation in the neonatal period

Dosage: 0.05 to 0.10  $\mu$ g/kg/min as an infusion in 5% dextrose in water.

Note: Preparation of infusion solution: 250  $\mu$ g in 80 mL of D5W infuse at 1 mL/kg/h = 0.05  $\mu$ g/kg/min.

**WARNING: Apnea, hyperthermia, and seizures may occur. Be prepared to provide respiratory support. Monitor oxygen saturation.**

### Rocuronium

Indication: 1) Neuromuscular blockade to facilitate mechanical ventilation  
2) Emergency intubation

Dosage: IV: 0.8 to 1.2 mg/kg

Note: This drug does not alter the level of consciousness or provide analgesia or amnesia.

Note: Alternative to succinylcholine for rapid intubation when succinylcholine is contraindicated. Duration of block is generally 30 to 45 minutes and is dose-dependent. Satisfactory conditions for endotracheal intubation will generally occur 45 to 60 seconds after administration.

**WARNING: Ventilatory support is necessary. Personnel with skills in airway management must be present and prepared to respond when this agent is administered. Age-appropriate equipment for suctioning, oxygenation, intubation, and ventilation should be immediately available.**

### Succinylcholine

Indication: Neuromuscular blockade for emergency intubation or treatment of laryngospasm

Dosage: 1 to 2 mg/kg IV

4 to 5 mg/kg IM

**WARNING: Contraindicated with previous history of malignant hyperthermia, severe burns, spinal cord injury, neuromuscular disease, or myopathies. When these contraindications exist use a non-depolarizing muscle relaxant such as rocuronium. Despite reports of acute rhabdomyolysis, hyperkalemia, and cardiac arrest with succinylcholine, this agent remains the drug of choice when immediate securing of an airway is indicated.**

**WARNING: Ventilatory support is necessary. Personnel with skills in airway management must be present and prepared to respond when this agent is administered. Age-appropriate equipment for suctioning, oxygenation, intubation, and ventilation should be immediately available.**

Note: Atropine, 0.02 mg/kg (minimum dose, 0.1 mg), should be combined with or precede succinylcholine to prevent bradycardia or asystole. Satisfactory conditions for endotracheal intubation generally occur 30 to 45 seconds after IV administration and 3 to 5 minutes after IM administration.

Note: If cardiac arrest occurs immediately after administration of succinylcholine, hyperkalemia must be suspected and treatment for this condition initiated. Hyperkalemia is especially likely to be responsible for cardiac arrest occurring in male children 8 years of age or younger.

### Thiopental

Indication: 1) Adjunct to intubation

Dosage: IV: 4 to 6 mg/kg

Note: A lower dose may be used if other sedatives/narcotics have been administered.

**WARNING: IM administration leads to tissue necrosis.**

**WARNING: Be prepared to provide respiratory support. Monitor oxygen saturation. High doses are associated with hypotension and apnea. Use with caution in patients with cardiac compromise or hypovolemia.**

Indication: 2) Control of intracranial hypertension

Dosage: 1 to 2 mg/kg, repeated as necessary

### Vecuronium

Indication: 1) Neuromuscular blockade to facilitate mechanical ventilation  
2) Emergency intubation

Dosage: IV: 0.1 mg/kg

Note: This drug does not alter the level of consciousness or provide analgesia or amnesia.

Note: This agent may be used for emergency intubation when succinylcholine is contraindicated. Satisfactory conditions for endotracheal intubation generally occur 1.5 to 2.0 minutes after administration.

**WARNING: Ventilatory support is necessary. Personnel with skills in airway management must be present and prepared to respond when this agent is administered. Age-appropriate equipment for suctioning, oxygenation, intubation, and ventilation should be immediately available.**

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# PEDIATRICS

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**e1 ABSTRACT.** Control of Hyperbilirubinemia in Glucose-6-Phosphate Dehydrogenase-deficient Newborns Using an Inhibitor of Bilirubin Production, Sn-Mesoporphyrin. Timos Valaes, MD; George S. Drummond, PhD; and Attallah Kappas, MD. *Background.* Hyperbilirubinemia in new-borns with glucose-6-phosphate dehydrogenase (G6PD) deficiency is a serious clinical problem because of the severity and unpredictability of its course. An innovative approach to this problem is suggested by previous experience with Sn-mesoporphyrin (SnMP), a potent inhibitor of bilirubin production, in moderating neonatal hyperbilirubinemia caused by ABO incompatibility, immaturity, and unspecified mechanisms.

*Objective.* To compare the effectiveness of the preventive and therapeutic uses of SnMP in ameliorating the course of bilirubinemia of G6PD-deficient neonates.

*Methods.* Neonates born at the Metera Maternity Hospital, Athens, Greece, and found to be G6PD-deficient by cord blood testing were stratified by sex and gestational age (210–265 days and >265 days) and randomized in pairs to receive SnMP (6  $\mu$ mol/kg birth weight, intramuscularly) either on the first day of life (preventive use) or if and when the plasma bilirubin concentration (PBC) level reached an age-specific threshold level for intervention (therapeutic use). In the case of failure of SnMP to control the rise of PBC levels, the protocol defined precisely the threshold PBC levels for switchover to phototherapy (PT) and, if necessary, exchange transfusion. PBC was measured daily until a declining value was obtained and the case was closed.

*Results.* A total of 86 G6PD-deficient neonates were randomized: 42 in the preventive arm and 44 in the therapeutic arm. Of the latter, 20 (45%) reached PBC levels requiring therapeutic intervention and thus received SnMP. Regardless of the trial arm, none of the 86 neonates required PT, whereas in a previous study in the same population, 33% of G6PD-deficient neonates required PT. In the intrapair sequential analysis, the favored arm was decided on the criterion of the age at closure of the case being shorter by at least 1 day. After plotting 30 untied pairs in the sequential analysis graph, the preventive use of SnMP proved to be the favored arm, and the trial was stopped. At this point, there were 2 unpaired neonates, 12 tied pairs, 22 pairs in which the preventive use of SnMP was favored and 8 pairs in which the therapeutic use of SnMP was favored. In the group analysis, infants in the preventive group, compared with those in the therapeutic group, had a lower maximum PBC level ( $8.2 \pm 3.1$  and  $10.9 \pm 2.8$  mg/dL, respectively), which was reached at an earlier age ( $63.5 \pm 34.8$  and  $82.2 \pm 24.7$  hours, respectively) as well as a lower closing PBC level ( $7.2 \pm 2.9$  and  $9.6 \pm 2.5$  mg/dL, respectively) and an earlier age at closing ( $89.1 \pm 35.6$  and  $110.8 \pm 23.6$  hours, respectively). Moreover, a PBC level of  $\geq 8.0$  mg/dL, a level at which jaundice is clearly visible, was not reached by 52% of the neonates in the preventive arm and 16% of the neonates in the therapeutic arm.

*Conclusions.* In G6PD-deficient neonates, a single dose of SnMP administered preventively or therapeutically entirely supplanted the need for PT to control hyperbilirubinemia. The preventive use of SnMP offers practical advantages in populations with a high enough prevalence of G6PD deficiency to justify cord blood screening. *Pediatrics* 1998;101(5). URL: <http://www.pediatrics.org/cgi/content/full/101/5/e1>; G6PD-deficiency, hyperbilirubinemia, heme oxygenase, Sn-mesoporphyrin, neonatal jaundice.

**e2 ABSTRACT.** Effects of Exposure to Alcohol in Mother's Milk on Infant Sleep. Julie A. Mennella, PhD, and Carolyn J. Gerrish, PhD. *Objective.* To test the hypothesis that exposure to alcohol in breast milk affects infants' sleep and activity levels in the short term.

*Methods.* Thirteen lactating women and their infants were tested on 2 days, separated by an interval of 1 week. On each testing day, the mother expressed 100 mL of milk, while a small, computerized movement detector called an actigraph was placed on the infant's left leg to monitor sleep and activity patterning. After the actigraph had been in place for  $\sim 15$  minutes, the infants ingested their mother's breast milk flavored with alcohol (32 mg) on one testing day and breast milk alone on the other. The infants' behaviors were monitored for the next 3.5 hours.

*Results.* The infants spent significantly less time sleeping during the 3.5 hours after consuming the alcohol-flavored milk (78.2 minutes compared with 56.8 minutes after feeding alcohol in breast milk). This reduction was apparently attributable to a shortening in the longest sleeping bout (34.5 compared with 56.7 minutes for sleeping after breast milk alone) and the amount of time spent in active sleep (25.8 minutes compared with 44.2 minutes after breast milk alone); the decrease in active sleep was observed in all but 2 of the 13 infants tested.

*Conclusions.* Although the mechanisms underlying the reduction in sleep remain to be elucidated, this study shows that short-term exposure to small amounts of alcohol in breast milk produces distinctive changes in the infant's sleep-wake patterning. *Pediatrics* 1998;101(5). URL: <http://www.pediatrics.org/cgi/content/full/101/5/e2>; alcohol, lactation, sleep, activity, development, infant behavior.

**e3 ABSTRACT.** Adverse Effects of High-dose Vitamin A Supplements in Children Hospitalized With Pneumonia. Charles B. Stephensen, PhD; Luis Miguel Franchi, MD; Herminio Hernandez, MD; Miguel Campos, MD, PhD; Robert H. Gilman, MD, DTMH; and Jose O. Alvarez, PhD. *Objective.* To test the hypothesis that high-dose vitamin A supplements will enhance recovery of children hospitalized for the treatment of community-acquired pneumonia.

*Design.* We conducted a randomized, double-blind, placebo-controlled clinical trial of high-dose vitamin A supplements among children 3 months to 10 years of age ( $N = 95$ ) admitted to hospital with community-acquired pneumonia in Lima, Peru. Children  $\leq 1$  year of age received 100 000 IU of water-miscible vitamin A on admission to the hospital and an additional 50 000 IU the next day. Children  $>1$  year of age received 200 000 IU on admission and 100 000 IU the next day.

*Results.* Children receiving vitamin A ( $n = 48$ ) had lower blood oxygen saturation (the mean difference on day 3 in hospital was 1.1%), higher prevalence rates of retractions (37% in the vitamin A group vs 15% in the placebo group on day 3), auscultatory evidence of consolidation (28% in the vitamin A group vs 17% in the placebo group on day 3), and were more likely to require supplemental oxygen (21% in the vitamin A group vs 8% in the placebo group on day 3) than children in the placebo group ( $n = 47$ ). Adjustment for baseline severity of disease and nutritional status did not alter the association of vitamin A with increased clinical severity, although the difference in blood oxygen saturation was no longer statistically significant. No differences were seen in duration of hospitaliza-

tion or in chest x-ray changes 14 days after admission. No deaths occurred, and toxicity of vitamin A was not seen.

**Conclusions.** This study indicates that high-dose vitamin A supplements cause modest adverse effects in children recovering from pneumonia and should not be used therapeutically in such patients unless there is clinical evidence of vitamin A deficiency or concurrent measles infection. *Pediatrics* 1998;101(5). URL: <http://www.pediatrics.org/cgi/content/full/101/5/e3>; *vitamin A, pneumonia, children, Peru, respiratory, lung, retinol*.

**e4 ABSTRACT.** Attitudes of the Physician Membership of the Society for Adolescent Medicine Toward Medical Abortions for Adolescents. Nancy H. Miller, MD; David J. Miller, PhD; and Laura M. Pinkston Koenigs, MD. **Objective.** To document the practices and attitudes of the US physician members of the Society for Adolescent Medicine (SAM) regarding adolescent abortion and contraception, as well as physician willingness to prescribe medical abortion if approved by the Food and Drug Administration (FDA).

**Design.** Cross-sectional questionnaire survey.

**Participants.** The entire physician membership of SAM ( $N = 1001$ ) was surveyed. A total of 713 physicians responded, with 668 usable surveys yielding an adjusted response rate of 70%.

**Results.** Of the respondents, 81% were trained as pediatricians; 58% had additional adolescent medicine training. Ninety-six percent prescribed contraception for their patients. Sixty-one percent of respondents identified abortion as an option for pregnant adolescents in all circumstances, whereas 4% believed abortion should never be an option. Eighty-nine percent referred their patients for abortions; 90% were aware of medications to induce abortions medically. If these medications (methotrexate and misoprostol, RU-486) were FDA-approved, 42% would prescribe them for their patients; 34% were unsure. Fifty-four percent believed if medical abortions were routinely available, they should be available from primary care physicians.

Physicians were significantly more likely to consider prescribing medical abortions if the physician were female, offered postcoital contraception, performed Norplant insertions, referred adolescents for abortions, or performed postabortion medical checkups. Physicians were no more likely to consider prescribing medical abortions according to physician age, specialty training, or date of residency training. Religious affiliation per se was not associated with likelihood of prescribing medical abortions, but Catholic physicians were significantly less likely to consider prescribing medical abortions.

**Conclusions.** Virtually all SAM physician respondents (96%) reported that abortion for pregnant adolescents should be available under some circumstances. Forty-two percent would prescribe medical abortion if the medications were FDA-approved, suggesting that medical abortion would potentially be available to adolescents from a larger group of physicians than is currently available. *Pediatrics* 1998;101(5). URL: <http://www.pediatrics.org/cgi/content/full/101/5/e4>; *adolescence, abortion, Society for Adolescent Medicine*.

**e5 ABSTRACT.** Do Missed Opportunities Stay Missed? A 6-Month Follow-up of Missed Vaccine Opportunities in Inner City Milwaukee Children. Swapna S. Sabnis, MD; Albert J. Pomeranz, MD; Patricia S. Lye, MD, MS; and Margaret M. Amateau, MD. **Objectives.** To determine 1) the frequency of missed vaccine opportunities (VOs) in inner city children  $\leq 3$  years of age; 2) whether the recommended vaccine(s) were given within 6 months of the missed opportunity (MO); 3) whether these vaccinations were age-appropriate according to the guidelines of the Advisory Committee on Immunization Practices; and 4) variables associated with MOs.

**Design.** Retrospective chart review with a nested retrospective cohort of children with MOs.

**Setting.** Two inner city practice settings in Milwaukee: a community health center and an academic continuity care practice.

**Patients/Selection Procedure.** A consecutive sample of 710 visits of inner city children  $\leq 3$  years of age with VOs, seen between January 1 and March 31, 1995. A VO was defined as any encounter when the child was vaccine-eligible according to Advisory Committee on Immunization Practices guidelines.

**Results.** MOs occurred in 47% (330/710) of the VOs. Only 40% of the children with MOs received age-appropriate immunizations within 6 months; 30% received the vaccinations beyond the age-appropriate time. The remaining 30% either did not return or were not vaccinated on return. The variables significantly associated with MOs were 1) age: children with MOs were older than those without, with a mean age of 15.5 months vs 10.9 months; 2) minor febrile illness; 3) moderate/severe illness; 4) acute illness encounters; and 5) patient's being seen at the community health center. Only 15.5% of all MOs were justified by the presence of moderate/severe illness.

**Conclusions.** VOs are frequently missed in inner city children. Most of the MOs were not justified by the valid contraindication of moderate/severe illness. Sixty percent of the children with MOs did not receive age-appropriate immunizations within 6 months. These children are vulnerable to vaccine-preventable diseases such as measles and pertussis. *Pediatrics* 1998;101(5). URL: <http://www.pediatrics.org/cgi/content/full/101/5/e5>; *immunization, vaccination, missed opportunities, children, pre-school*.

**e6 ABSTRACT.** Anabolic Steroid Use by Male and Female Middle School Students. Avery D. Faigenbaum, EdD; Leonard D. Zaichkowsky, PhD; Douglas E. Gardner, MA; and Lyle J. Micheli, MD. **Background.** The prevalence of anabolic steroid use by high school and college students has been reported in the literature. However, rumors persist regarding the use of steroids by younger populations.

**Objective.** To assess the extent of steroid use by male and female middle school students and to explore their attitudes and perceptions about these drugs.

**Methods.** A confidential self-report questionnaire was administered to 466 male and 499 female students between 9 and 13 years of age (mean  $\pm$  SD,  $11.4 \pm 0.9$  years) in 5th, 6th, and 7th grades from four public middle schools in Massachusetts. The number of students reporting steroid use and differences between users' and nonusers' underlying attitudes and perceptions about these drugs were evaluated.

**Results.** The response rate was 82% (965/1175 eligible). Results indicated that 2.7% of all middle school students reported using steroids; 2.6% were males and 2.8% were females. When steroid users were compared with nonusers, 47% versus 43% thought that steroids make muscles bigger; 58% versus 31% thought that steroids make muscles stronger; 31% versus 11% thought that steroids improve athletic performance; 23% versus 13% thought that steroids make one look better; 23% versus 9% knew someone their own age who currently took steroids; 38% versus 4% were asked by someone to take steroids; 54% versus 91% thought that steroids were bad for them; and 35% versus 2% indicated that they would take steroids in the future. Additional analyses determined steroid user involvement in sports and activities.

**Conclusion.** The results of this study suggest that the problem of illicit steroid use extends to children and young adolescents and that a segment of this population is mindful of the potential physiologic effects of steroids. This information will be useful to pediatricians, sport authorities, and school teachers whose guidance will become increasingly more important as steroid educational interventions for male and female middle school students are developed. *Pediatrics* 1998;101(5). URL: <http://www.pediatrics.org/cgi/content/full/101/5/e6>; *anabolic androgenic steroid, drug abuse, risky behavior, children, adolescents*.

**e7 ABSTRACT.** Early Dexamethasone Therapy in Preterm Infants: A Follow-up Study. Tsu F. Yeh, MD; Yuh J. Lin, MD; Chao C. Huang, MD; Yung J. Chen, MD; Chyi H. Lin, MD; Hong C. Lin, MD; Wu S. Hsieh, MD; and Yu J. Lien, MA. **Objectives.** To study the outcome at 2-year corrected age of infants who participated in a double-blind controlled trial of early (<12 hours) dexamethasone therapy for the prevention of chronic lung disease (CLD).

**Methods and Materials.** A total of 133 children (70 in the control group, 63 in the dexamethasone-treated group) who survived the initial study period and lived to 2 years of age were studied. All infants had birth weights of 500 to 1999 g and had severe respiratory distress syndrome requiring mechanical ventilation within 6 hours after birth. For infants in the treatment group, dexamethasone was started at a mean age of 8.1 hours and given 0.25 mg/kg every 12 hours for 1 week and then tapered off gradually over a 3-week period. The following variables were evaluated: interim medical history, socioeconomic background, physical growth, neurologic examinations, mental and psychomotor development index score (MDI and PDI), pulmonary function, electroencephalogram, and auditory and visual evoked potential.

**Results.** Infants in the control group tended to have a higher incidence of upper respiratory infection and rehospitalization than did the dexamethasone-treated group because of respiratory problems. Although there was no difference between the groups in somatic growth in girls, the dexamethasone-treated boys had significantly lower body weight and shorter height than the control boys ( $10.7 \pm 3.0$  vs  $11.9 \pm 2.0$  kg;  $84.9 \pm 5.7$  vs  $87.5 \pm 4.8$  cm). The dexamethasone-treated group had a significantly higher incidence of neuromotor dysfunction (25/63 vs 12/70) than did the control group. The dexamethasone-treated infants also had a lower PDI score ( $79 \pm 26$ ) than did the control group ( $87 \pm 23$ ), but the difference was not statistically sig-

nificant. Both groups were comparable in MDI, incidence of vision impairment, and auditory and visual evoked potential. Significant handicap, defined as severe neurologic defect and/or intellectual defect (MDI and/or PDI  $\leq 69$ ), was seen in 22 children (31.4%) in the control group and 26 (41.2%) in the dexamethasone-treated group.

**Conclusions.** Although early postnatal dexamethasone therapy for 4 weeks significantly reduces the incidence of CLD, this therapeutic regimen cannot be recommended at present because of its adverse effects on neuromotor function and somatic growth in male infants, detected at 2 years of age. A longer follow-up is needed. If early dexamethasone therapy is to be used for the prevention of CLD, the therapeutic regimen should be modified. The proper route of administration, the critical time to initiate the therapy, and the dosage and duration of therapy remain to be defined further. *Pediatrics* 1998; 101(5). URL: <http://www.pediatrics.org/cgi/content/full/101/5/e7>; *preterm infant, early dexamethasone therapy, follow-up study*.

**e8 ABSTRACT.** Self-reported Adherence, Management Behavior, and Barriers to Care After an Emergency Department Visit by Inner City Children With Asthma. Frederick E. Leickly, MD; Shari L. Wade, PhD; Ellen Crain, MD, PhD; Deanna Kruszon-Moran, MS; Elizabeth C. Wright, PhD; and Richard Evans III, MD, MPH. **Objective.** The inability to adhere to a prescribed therapeutic program for the treatment of a chronic disease may be responsible in part for continued disease activity. This problem may be more of an issue in the treatment of asthma, a common, potentially lethal chronic condition in which the lack of symptoms may be interpreted as remission. Adherence was one of the key areas of interest for the National Cooperative Inner-City Asthma Study. The focus of this study was to identify those issues reported by families that could adversely affect their adherence to an asthma care program. The identification of barriers to adherence could then form the basis of a successful intervention program. This study describes barriers to adherence, asthma management behavior, and self-reported adherence.

**Methods.** Patients presenting during an acute attack of asthma at an emergency department (ED) were recruited for this study. The medical record of the ED encounter was abstracted and compared with information that was obtained during a baseline interview 3 to 5 weeks later. During the baseline interview, parents were asked about health care behaviors related to adherence.

**Results.** There were 344 children 4 to 9 years of age living in inner city census tracts in the study. Four areas of adherence (medicine use, appointment-keeping, emergency actions, and asthma attack prevention) were investigated. The parental report of medications prescribed at the ED and the information on the abstracted ED report agreed 94.9% of the time for the  $\beta$ -agonists, 86.8% for steroids, and 69.4% for cromolyn. Among respondents, 85.4% of parents reported that they are able to follow the ED recommendations almost all of the time; side effects of medicines were a concern for 81.1% of caretakers who were adherent and for 89.5% of caretakers who were nonadherent. Doubts regarding the usefulness of medications occurred in 34.4% of those considered adherent and 54.2% who admitted nonadherence. Medications



were forgotten some of the time by 45.2% of the children, and 52.8% tried to get out of taking medicine. Appointments for follow-up care were kept by 69% of those given an appointment in the ED, by an estimated 60.0% of those who were told specifically to call for an appointment, and by an estimated 25.2% of those who were neither given an appointment nor told specifically to make one. Only one third of parents report that they were able to keep the child away from known asthma triggers nearly all of the time. Approximately half avoided allergens; however, only 37.5% reported avoidance of cigarette smoke. The use of preventive medicines occurred in 23.5%. Using a medicine and taking the child to a physician were reported as the first or second action during an acute attack of asthma by 72.1% of respondents.

**Conclusions.** Adherence to an asthma-management program involves a number of areas: medication, appointment-keeping, prevention, and applying an emergency plan of action. Barriers to adherence may exist in one or all four of these areas, leading to ineffective control of asthma. Recommendations are made for improving the patient-physician partnership to improve adherence. *Pediatrics* 1998;101(5). URL: <http://www.pediatrics.org/cgi/content/full/101/5/e8>; *asthma, adherence, inner city children*.

**e9 ABSTRACT.** Valproate Therapy Does Not Deplete Carnitine Levels in Otherwise Healthy Children. Shinichi Hirose, MD; Akihisa Mitsudome, MD; Sawa Yasumoto, MD; Atsushi Ogawa, MD; Yukiko Muta, BS; and Yasuko Tomoda, MD. **Objective.** To determine whether children with epilepsy undergoing valproate (VPA) antiepileptic therapy and who are otherwise healthy have a lower serum level of carnitine (CAR) and a higher plasma level of plasma ammonia than do normal children.

**Methodology.** A total of 45 children with epilepsy, 6.3 to 21.7 years of age, who were treated solely with VPA and were free of abnormal neurologic findings or nutritional problems were randomly selected (VPA-treated group). An age-matched control group ( $n = 45$ ) was selected from subjects without epilepsy (control group). Total (T) and free (F) serum CAR, serum VPA concentration, and the plasma ammonia level were measured and analyzed.

**Results.** Serum VPA concentration exhibited a weak negative correlation with both T- ( $r = -0.34$ ) and F-CAR ( $r = -0.41$ ). The T-CAR levels were  $55.7 \pm 12.4$  and  $57.6 \pm 12.1$  mM, and the F-CAR levels  $42.7 \pm 9.9$  and  $44.4 \pm 9.9$  mM in the VPA-treated and control groups, respectively. Thus, there was no significant difference in T- or F-CAR levels between the VPA-treated and control groups. Plasma ammonia levels were the same in the two groups:  $26 \pm 9.2$  and  $29.4 \pm 11.8$  mM in the VPA-treated and control groups, respectively. There was no significant correlation between blood ammonia and either T- ( $r = +0.024$ ) or F-CAR ( $r = -0.026$ ).

**Conclusion.** Children on a regular diet ingest a sufficient amount of CAR that more than meets their daily CAR requirement. The level of neither T- nor F-CAR in patients with epilepsy and without severe neurologic or nutritional problems being treated with VPA appeared to be affected by VPA therapy. Because the blood CAR level depends on nutritional condition rather than on blood VPA concentration, CAR deficiency caused by VPA is not likely to occur in this population. The usefulness of supplementation of CAR for this type of patient with epilepsy, therefore, must be reevaluated

carefully. *Pediatrics* 1998;101(5). URL: <http://www.pediatrics.org/cgi/content/full/101/5/e9>; *carnitine, valproate, valproic acid, epilepsy, liver dysfunction, hyperammonemia, lipid metabolism, Reye's syndrome, handicap, malnutrition*.

**e10 ABSTRACT.** Symptomatic Splenic Hamartoma: Case Report and Literature Review. Teresa C. Hayes, MD; Howard A. Britton, MD; E. Bruce Mewborne, MD; Dean A. Troyer, MD; Victor A. Saldivar, MD; and Irving A. Ratner, MD. An 11-year-old girl with low-grade fever, night sweats, thrombocytopenia, and an 8-year history of progressive splenomegaly underwent an elective splenectomy. Pathologic diagnosis was multiple splenic hamartoma. The patient's symptoms resolved after the splenectomy. Since first described by Rokitansky in 1861, ~140 cases of splenic hamartoma have been described in the literature. Most of the splenic hamartomas were discovered incidentally. A minority of these lesions were associated with hematologic symptoms such as pancytopenia, anemia, and thrombocytopenia. Only 20 of the reported cases of splenic hamartoma occurred in pediatric patients. However, compared with the adult patients, nearly half of these cases in pediatric patients was associated with symptoms. Splenectomy and partial splenectomy have relieved these symptoms. With advances in imaging, splenic hamartomas are being discovered with increasing frequency. A multimodal radiologic work-up has enabled some cases of splenic hamartoma to be diagnosed preoperatively. Inclusion of this benign entity in the differential diagnoses of symptomatic splenomegaly in a pediatric patient is important in the preoperative management and counseling of the patient and family. In patients who have discrete lesions, consideration of this entity preoperatively may avoid total splenectomy. *Pediatrics* 1998;101(5). URL: <http://www.pediatrics.org/cgi/content/full/101/5/e10>; *splenic hamartoma, pancytopenia, hypersplenism, splenomegaly, hemangiomas*.

**e11 ABSTRACT.** School-age Follow-up of Prophylactic Versus Rescue Surfactant Trial: Pulmonary, Neurodevelopmental, and Educational Outcomes. Robert A. Sinkin, MD; Bonnie M. Kramer, PhD; Joan L. Merzbach, MSW; Gary J. Myers, MD; John G. Brooks, MD; Donna R. Palumbo, PhD; Christopher Cox, PhD; James W. Kendig, MD; Charles E. Mercier, MD; and Dale L. Phelps, MD. **Background.** Exogenous surfactant replacement has improved survival and reduced pulmonary complications of prematurity. Improved early outcomes for infants of <30 weeks' gestation treated with a strategy of prophylactic versus rescue surfactant, if needed, were demonstrated in a multicenter, randomized trial conducted between 1985 and 1988. We reevaluated a subset of survivors from this trial to determine the pulmonary and neurodevelopmental outcomes at school age.

**Methods.** At 4.5 to 8 years of age, all survivors from one of the three centers were located, and 96% were evaluated. The original randomization included stratification by center and followed an intention-to-treat methodology in assessing the efficacy of prophylactic versus rescue treatment with surfactant. The follow-up test battery included a health-assessment questionnaire, spirometry, 88% saturation test, neurologic examination, and the McCarthy Scales of Children's Abilities (MSCA) and the



Conners' Parent Rating Scale-48. Educational achievement was determined by school class placement and teachers' reports of achievement.

**Results.** Of the 192 children originally enrolled, 154 survived. Evaluations were performed on 148 of these infants. An abnormal pulmonary history was found in 45 (30%) of the children: 16 (22%) in the prophylactic group and 29 (39%) in the rescue group. Formal pulmonary function was evaluated in 81 children; 29 (78%) in the prophylactic group and 33 (75%) in the rescue group were considered abnormal. No significant differences were found between the two groups on either cognitive or motor subscales of the MSCA, the Conners' Parent Rating Scale-48, the neurologic examination, the education services received in school, or the teacher ratings of below-average academic performance. Intelligence scores measured on the MSCA were low-normal for both groups. Some level of educational assistance was being provided to 72 (49%) of the cohort studied, and both groups had below average educational performance and increased needs for educational assistance.

**Conclusions.** Prophylactic surfactant administration to infants of <30 weeks' gestation was associated with fewer long-term clinical pulmonary complications than assignment to rescue administration. Formal pulmonary testing at school age did not reveal significant differences between treatment groups in those infants who could be tested. There also were no group differences found on neurologic, cognitive, behavioral, or educational assessments at school age. *Pediatrics* 1998; 101(5). URL: <http://www.pediatrics.org/cgi/content/full/101/5/e11; follow-up, newborn, premature, surfactant>.

**e12 ABSTRACT.** Predictors of Mortality From Fires in Young Children. Seth J. Scholer, MD, MPH; Gerald B. Hickson, MD; Edward F. Mitchel, Jr, MS; and Wayne A. Ray, PhD. **Background.** In the United States in 1994, fires claimed 3.75 lives per 100 000 child years and accounted for 17.3% of all injury deaths in children <5 years of age.

**Objectives.** To conduct a historical cohort study that uses maternal demographic characteristics to identify young children at high risk of fire-related deaths, thus defining appropriate targets for prevention programs.

**Methods.** The cohort consisted of children born to mothers who resided in the state of Tennessee between 1980 and 1995. Information was obtained by linking birth certificates, 1990 census data, and death certificates. Children were eligible for the study if they were <5 years of age at any time within the study period and if key study variables were present (99.2% of births).

Birth certificates provided information on maternal characteristics including age, race, education, previous live births, use of prenatal care, and residence (in standard metropolitan statistical area). Child characteristics included gender, gestational age, and birth type (singleton/multiple gestation). Neighborhood income was estimated by linking the mother's address at the time of birth to the 1990 census (block group mean per capita income).

The study outcome was a fire resulting in at least one fatality (fatal fire event) during the study period, identified from death certificates (coded E880 through E889 in the *International Classification of Diseases*, 9th rev). We calculated the fatal fire event rate corresponding to each stratum of maternal/child characteristics. We assessed the

independent association between each characteristic and the risk of a fatal fire event from a Poisson regression multivariate analysis.

**Results.** During the study period, 1 428 694 children contributed 5 415 213 child years to the cohort: there were 270 deaths from fire (4.99 deaths per 100 000 child years) and 231 fatal fire events. In the multivariate analysis, factors associated with greater than a threefold increase in fatal fire events included maternal education, age, and number of other children. Compared with children whose mothers had a college education, children whose mothers had less than a high school education had 19.4 times (95% confidence interval [CI], 2.6-142.4) an increased risk of a fatal fire event. Children whose mothers had more than two other children had 6.1 times (95% CI, 3.8-9.8) an increased risk of a fatal fire event compared with children whose mothers had no other children. Children of mothers <20 years of age had 3.9 times (95% CI, 2.2-7.1) increased risk of a fatal fire event compared with children whose mothers were ≥30 years old. Although both maternal neighborhood income and race were associated strongly with increased rates of fatal fire events in the univariate analysis, this association did not persist in the multivariate analysis. Other factors that were associated with increased risk of fatal fire events in the multivariate analysis were male gender and having a mother who was unmarried or who had delayed prenatal care.

The three factors associated most strongly with fire mortality were combined to create a risk score based on maternal education (≥16 years, 0 points; 13 to 15 years, 1 point; 12 years, 2 points; <12 years, 3 points); age (≥30 years, 0 points; 25 to 29 years, 1 point; 20 to 24 years, 2 points; <20 years, 3 points); and number of other children (none, 0 points; one, 1 point; two, 2 points; three or more, 3 points). The lowest-risk group (score <3) included 19% of the population and had 0.19 fatal fire events per 100 000 child years. In contrast, highest-risk children (score >7) comprised 1.5% of the population and had 28.6 fatal fire events per 100 000 child years, 150 times higher than low-risk children. Children with risk scores >5 contributed 26% of child years but experienced 68% of all fatal fire events. If the fatal fire event rate for all children had been equal to that of the low-risk group (risk score <3), then 95% of deaths from fires would not have occurred.

**Discussion.** Maternal education, age, and number of other children had strong and independent associations with fire-related deaths among young children. Taken together, these factors defined a steep risk gradient, where children in the highest-risk group had a fire-related mortality rate that was 150 times that of the lowest-risk group. From a public health perspective, maternal factors clearly define children who would be good candidates for prevention programs. There is an urgent need to develop prevention programs that can be shown to reduce fire-related injury in high-risk children. *Pediatrics* 1998;101(5). URL: <http://www.pediatrics.org/cgi/content/full/101/5/e12; wounds and injuries, fires, socioeconomic factors, risk factors>.

**e13 ABSTRACT.** Cat Scratch Disease Presenting With Peripheral Facial Nerve Paralysis. Robert S. Walter, MD, and Stephen C. Eppes, MD. Acquired peripheral facial nerve paralysis is a relatively common disorder that af-

fects both children and adults. The most frequent non-trauma-related etiologies in otherwise neurologically intact patients are idiopathic (Bell's palsy) and infectious, which includes otitis media, herpes zoster, Lyme disease, herpes simplex virus, Epstein-Barr virus, and *Mycoplasma pneumoniae*.<sup>1-5</sup>

Cat scratch disease (CSD) is typically a subacute, regional lymphadenitis caused by *Bartonella henselae* that

is seen in children and young adults. CSD most often has a benign, self-limited course. However, 11% of CSD patients may present atypically, most commonly with Perinaud's oculoglandular syndrome or acute encephalopathy.<sup>6-11</sup>

We present a child with the first reported case of acute facial nerve paralysis in serologically proven CSD with typical lymphadenitis.

#### ADDITION

A sentence has been added to the American Academy of Pediatrics statement from the Committee on Drugs, "Drugs for Pediatric Emergencies," published in the January 1998 edition of *Pediatrics electronic pages*, as article **e13**. The following should be added under the heading, "Propranolol," after the dosage but before the note that was initially published:

*Note: Some practitioners have used up to 0.15 to 0.25 mg/kg for the treatment of refractory infundibular spasm.*

The electronic version of this article will include links indicating this addition.

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*Pediatrics* 1998;101:e13

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