INTRODUCTION

The good news about pediatric emergencies is that we do not see them very often. The bad news is that we do not see them often. Familiarity with anything improves our ability to handle the cases and also improves our comfort level with those cases. Outside of a pediatric hospital, critical emergencies in the pediatric population are infrequent. For this reason, EMS personnel, and in most cases, emergency department personnel are always left anxiety ridden when dealing with these cases. To further complicate our angst, we also have to deal with different possible issues with different age groups. There is also the issue of dosage, voltage and tube adjustments for different ages and sizes. The goal of this paper is to familiarize our understanding of these cases so that we don't have to breathe in a bag and change our underwear after caring for this population.

THE NEW BORN

The new born infant presents several unique challenges. The younger the child, the less they are going to tell you. Their life revolves around sleeping, eating and defecating; throw in an occasional 12 pack and they are living every man's dream. Life begins at 37 weeks and when determining the age, one has to account for prematurity because this can affect the types of emergencies that could occur. As well, the type of delivery (vaginal vs. cesarean), along with complication during the pregnancy and delivery may contribute to the cause of the emergency. Breast feeding vs. bottle feeding also impacts the potential health of the infant. Breast milk continues to provide the mother's immunoglobulins to the infant which helps ward off infections.

The medical emergency may be primarily respiratory, cardiac, infectious or neurologic. Most complaints with infants, however, involve respiratory issues. Since the mother and infant now have short stays in the hospital, congenital issues may not manifest themselves until after the infant is home. As well, nosocomial infections or something brought home from the sibling or visitors can hit the infant early on.

BRUE OR BRIEF UNEXPLAINED EVENTS IN INFANTS replaces ALTE or APPARENT LIFE-THREATENING EVENT. BRUE encompasses acute changes in the infants (up to one year) breathing. Usually one or several of the symptoms may occur. Breathing irregularities and not just Apnea are now considered part of BRUE. The symptom usually is transient and by definition less than one minute. It can be associated with cyanosis or pallor, as well as the infant going limp or losing its muscle tone. The new term does not include choking or gaging associated with spiting up. Persistent respiratory symptoms and fevers also would exclude BRUE. Finally, it is a diagnosis of exclusion and only used when no other cause can be found.

Typically, the infant is back to normal by the time EMS arrives. This should not belie the possibility of a significant issue. You need to be vigilant with these cases. Recurrent episodes should be documented, and worsening episodes may require intervention.

Gastrointestinal causes such as reflux are the most common causes for BRUE. Neurologic such as seizures or unrecognized traumatic cerebral bleed from birth may be the cause. Infections, cardiac and respiratory issues all may play a role. Lastly, don't forget CHILD ABUSE.

AMERICAN ACADEMY OF PEDIATRICS DEFINITION OF BRUE:

BRUE is defined as an event occurring in an infant younger than 1 year when the observer reports a sudden, brief, and now resolved episode of ≥1 of the following: (1) cyanosis or pallor; (2) absent, decreased, or irregular breathing; (3) marked change in tone (hyper- or hypotonia); and (4) altered level of responsiveness. A BRUE is diagnosed only when there is no explanation for a qualifying event after conducting an appropriate history and physical examination

0-2 YEARS

THE VETERINARIAN YEARS

Up to the age of two, kids progressively become more communicative. This however is an evolving process, and for a good part of this period, information has to be obtained from the caregivers, nuances in behavior and the physical exam. Anatomically, this age group has smaller parts which mechanically can result in more significant issues especially when the problem is respiratory. Even in this age group, some emergencies are age dependent.

SIDS or SUDDEN INFANT DEATH SYNDROME occurs from one month to one year. It is the leading cause of death in this age group. It can occur up to 16 months and the peak incidence is between 2 and 4 months. The cause is unknown, and it is diagnosed when the history and autopsy offer no other alternative diagnosis. Since recommending that infants sleep on their back, the incidence of SIDS has dropped 50%. See appendix

While no definitive cause of SIDS has been found, it is associated with several modifiable risk factors, maternal smoking, prone sleeping, bed sharing with another child or adult.

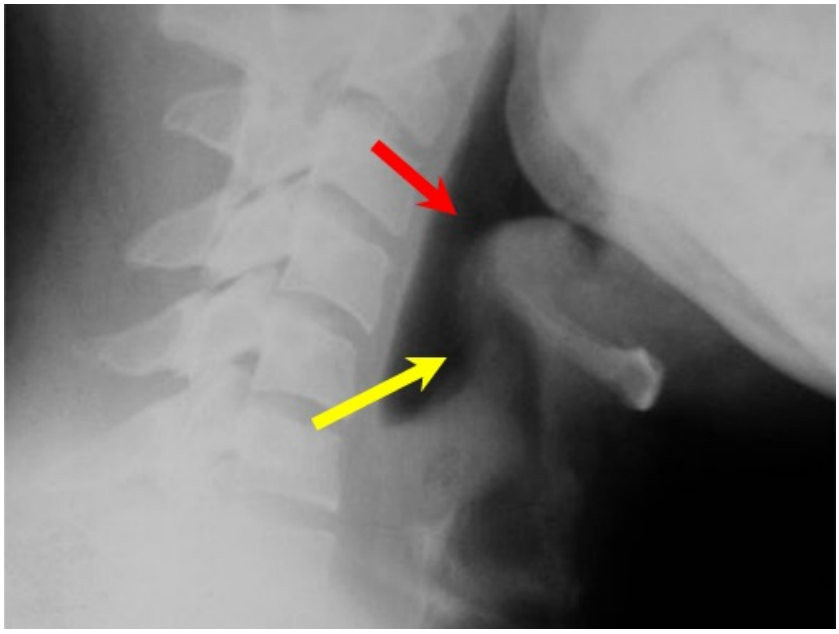
SIDS should not be confused with BRUE. BRUE is an event that typically occurs early in the first month of life while SIDS occurs between one month and one year. Epidemiologically, SIDS typically occurs in the evening and early morning while BRUE occurs during the day and early evening. SIDS has seen a dramatic decrease with interventions, especially having the baby sleep on their back. There has been no change in BRUE.

RESPIRATORY EMERGENCIES occur due to primarily infections and mechanical airway obstruction resulting from the edema and secretions. Anatomic size plays a large role in the severity of respiratory infections in this age group. Due to their small size, the obstruction caused by inflammation on the airway can result in life threatening emergencies.

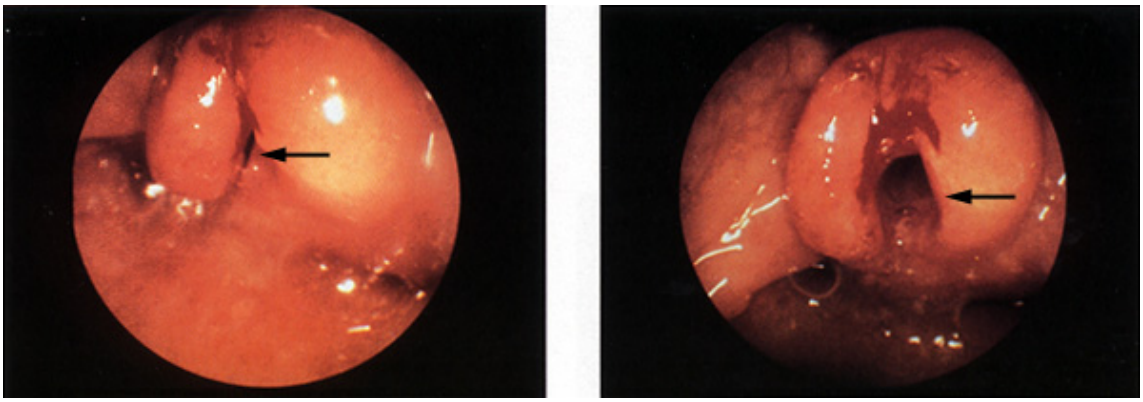
EPIGLOTTITIS is an inflammation of the epiglottis. The epiglottis sits above the vocal cords and normally closes like a trap door to block food from traveling into the airway when we swallow. With epiglottitis, the airway gets obstructed by the enlarged epiglottis that blocks off the trachea and vocal cords, preventing the passage of air. Onset is relatively sudden because in

part, it is not appreciated until the swelling has compromised the airway and caused a level of respiratory distress. There has fortunately been a significant decline in this disease with the advent of the Haemophilus Influenza type B vaccine.

EPIGLOTTITIS

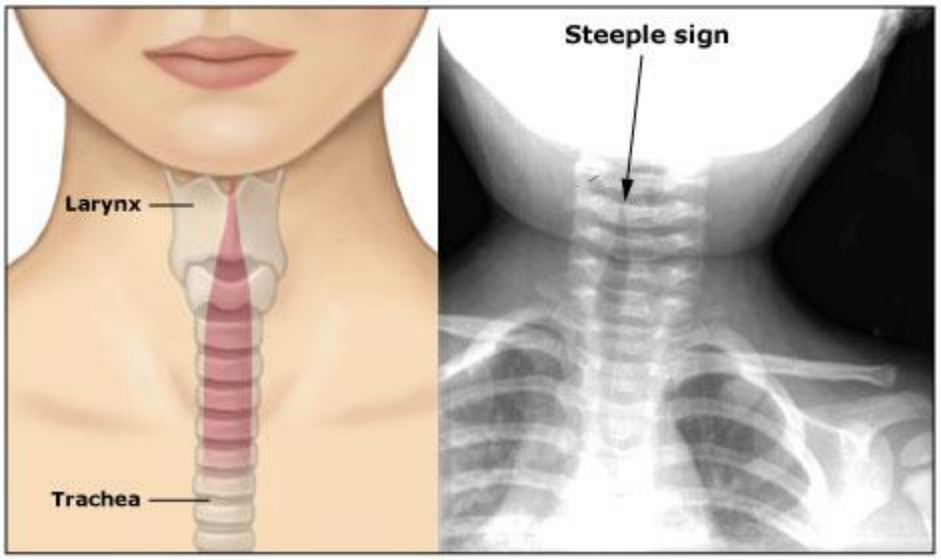


Lateral radiograph of the neck demonstrates and enlarged epiglottis (red/top arrow) and thickening of the aryepiglottic folds (yellow/bottom arrow).



On the left, an endoscopic view of the throat shows almost complete blockage of the airway (arrow). This finding is typical of epiglottitis. On the right, the airway has been opened (arrow) after insertion and removal of an endotracheal tube, although some redness and blood remain.

CROUP OR LARYNGOTRACHEOBRONCHITIS, results in swelling below the vocal cords along the walls of the trachea. It typically is seen between the ages or 6 to 36 months. The infection has a characteristic cough that sounds like a barking dog or seal. The typical story is that the child had a slight URI but was fine when he or she went to bed. After lying down, the breathing got severe and the parents heard the child making a barking sound. This is caused by a virus and the severity of the disease depends on the amount of edema which in turn creates the airway obstruction.



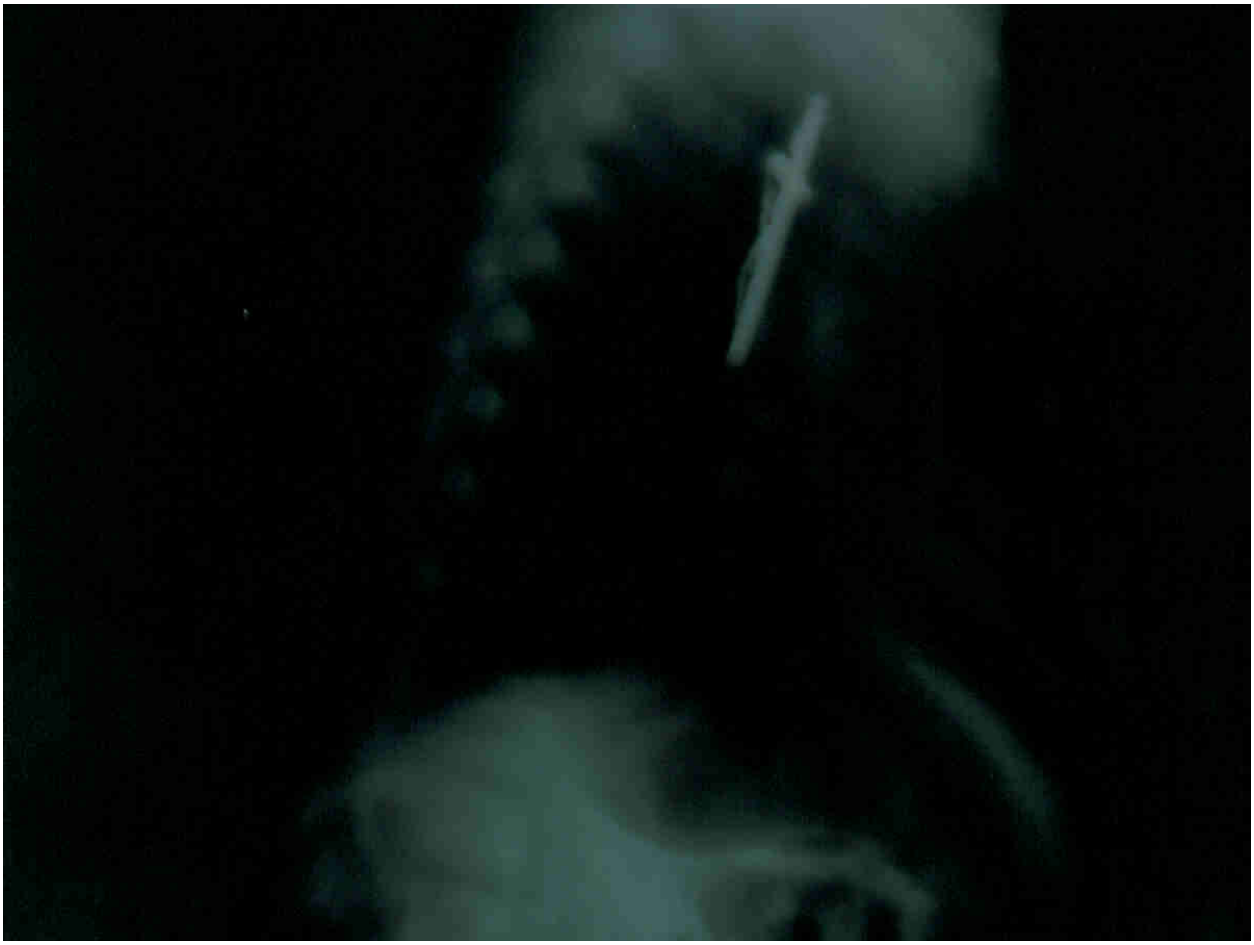
A chest X-ray would demonstrate a pitched narrowing of the upper airway that looks like a steeple on a church. The black is air that still can pass through while the darker area around it is the edema.

EPIGLOTTIS	**CROUP**
Most commonly H. Flu type B.	Most commonly viral
Peak incidence now closer to 6-7 years	Typically occurs from 6 months to 2 years
Obstruction above "EPI" the glottis	Obstruction below the glottis.

Other infections of the airway can result in obstruction and respiratory distress.
RESPIRATORY SYNCYTIAL VIRUS or RSV is a virulent upper respiratory virus. It is extremely common, easily transmitted and can result in significant respiratory compromise in the very young. The typical concern is for the infant who may have gotten exposed from an older sibling. For the older sibling, the virus caused a runny nose and a slight cough. But because of the small anatomy, the infant ended up with blocked bronchial airways and severe respiratory

distress. **BACTERIAL TRACHEITIS** inflames the trachea resulting in swelling and respiratory compromise. Typically, it is associated with high fevers and difficulty breathing. It may manifest itself as croup, but usually occurs in children older than the usual "crouper". In the ER world the return visit for croup has to be considered Bacterial Tracheitis until proven otherwise. **RETROPHARYNGEAL ABSCESS** can result on compression of the airway. It typically is associated with a complaint of a sore throat, neck pain and fever. As the abscess enlarges, it compresses on the airway causing a collapse and respiratory compromise. **MONONUCLEOSIS** is a rare but potential cause of obstruction due to the tonsillar enlargement and mucosal edema.

FOREIGN BODIES become a potential cause of obstruction especially when the child becomes mobile. When crawling and early in the walking phase, kids are curious about their surroundings and will oftentimes pick things up. These things can end up in the mouth whereby they get swallowed. Most things are small and usually end up in the digestive tract. However, some objects can end up in the bronchus. These ultimately will cause respiratory difficulties and if not removed can cause infections and trauma to the respiratory structures. Larger objects obviouslcould result in emergent life-threatening obstructions.



Mother's response to seeing the X-ray....."I've been looking for that cross"

BURNS, both thermal and chemical may result in airway obstruction. Inhalation of hot air can result in swelling to the airway. Direct communication with a hot fluid or caustic chemical will also result in burns, swelling and airway obstruction. This may occur from swelling above the trachea, or from the insult reaching the trachea and bronchi. Always be vigilant of potential airway compromises in these cases. Dark sputum, burning to the hair, mucosal burns or respiratory symptoms such as wheezing are all clues that a respiratory disaster is around the corner.

ALTERED MENTAL STATUS crosses many areas and can result from infections, ingestions and trauma; both accidental and deliberate. Metabolic causes such as new onset diabetes as well as first time presentations of congenital metabolic and structural anomolies may manifest themselves as an altered mental status.

During a child's first few months, the change in mental status has a broad range of possibilities and may be extremely subtle. These children are susceptible to infections due to their immature immune system. Manifestations of congenital abnormalities, and trauma may also result in altered mental status. At this stage sleeping more than usual, a weak cry and poor effort in eating may signal a significant health issue. To the family and the healthcare providers, the child "may just not look right". Findings in this group may be faint pulses, respiratory changes and periods of apnea, bradycardia, pallor or cyanosis, and low muscle tone.

As the child grows and becomes more active, the causes of altered mental status can change. Kids become inquisitive. They like to stick things in their mouth which may cause airway issues, but alternatively can result in a potential lethal ingestion. Lost pills, or ones left out on a night stand, chemicals under the sink are just a few of the possible ingestions that are in almost anyone's home. Older children begin to mimic their parents. They actually may grab the medicine because they see adults taking it. It is not all that uncommon for parents to wake up after having a party and finding their 3 or 4 year old drunk, passed out or hypoglycemic from sipping on the stale drinks left out overnight. Trauma both accidental and purposeful also increases as the child grows older. The "terrible twos" can be emotionally too much on the young baby sitter or even the parents. One to many hits or shakes of a child can result in head bleeds or bleeding to vital organs.

The infectious scourge of this age group has been MENINGITIS. Fortunately, with the advent of the Haemophilus Influenza and Streptococcal Pneumoniae vaccinations, we have seen a dramatic decrease of this often-lethal infection. In fact, the incidence of meningitis has shifted to adults and unvaccinated children. IT DOES HOWEVER STILL EXIST! Newborns, infants and children in the first few months are all susceptible since they have not yet been vaccinated or are only starting to receive the vaccinations.

Symptoms of meningitis early on can mimic other infections. A history of a URI and even a visit to the pediatrician earlier in the day are not uncommon. Its course reaches a very virulent rapid phase when it begins to affect the brain. In the first few months, the child may present

floppy, listless, and cool to touch. An older child may be ill appearing, lethargic and vomiting. Obviously, none of these symptoms cry out that the child has meningitis.

There is a focus in the literature on nuchal rigidity and its association with meningitis. The cause of the rigidity is due to inflammation of the meninges which cover the brain and spinal cord. Whenever the meninges along the spinal cord are stretched such as flexing the neck, the child should either complain of pain and/or try to compensate for it in order to reduce the discomfort. The problem with all the maneuvers is that they don't always occur or are misinterpreted. In the end, early diagnosis of meningitis is oftentimes a diagnosis that comes from a "clinical hunch" when the symptoms are nonspecific.

PEDIATRIC SEIZURES are also another source of altered mental status. They can either be intrinsic, a part of a congenital process, a manifestation of an acute underlying illness, metabolic abnormality or trauma. NEWBORN AND INFANT seizures are uncommon but do occur. They could represent a traumatic delivery with a cerebral bleed, or a presentation of a congenital process or brain tumor. Infections such as meningitis may also present with seizures in this age group. Never under estimate the possibility of child abuse. **FEBRILE SEIZURES** are typically seen between nine months and five years. These seizures are associated with some underlying illness such as a URI or ear infection. The seizure is not well understood and is thought to occur because the effect the sudden change in body temperature has on the developing brain. The seizures are usually grand mal and in most cases short lived. By the time EMS arrives, the child is usually well on his/her way to recovery. Focal or multiple seizures along with a fever,are considered complex febrile seizures and are treated differently. These typically need a more through work up.

PEDIATRIC RESUSCITATION is often delayed due to inexperience of recognizing the severity of the case and our innate reluctance to want to "torture" a child with iv's, monitors, cannulas etc. Part of this is due to our lack of experience with these cases, and the other part is due to the nature of pediatric illnesses. Unlike adults who may gradually get ill, children especially the very young have a tendency to compensate to the end and then fall off the edge of the cliff. We need to approach these emergencies like any emergency and aggressively but appropriately intervene. BE A PESIMISTIC OPTIMIST: expect the worse but hope for the best. You cannot possibly remember all the dosages and sizes of tubes for each age group. Have a cheat sheet or Broselow tape available. Airway and oxygenating the brain is still paramount in the patient's management. You need to assure appropriate oxygenation and also ventilation. Acidosis is a major killer in both kids and adults. Intravenous access is another area which oftentimes causes great difficulty and consternation. Little one's are usually chubby and veins are difficult to find. We tend to take extended periods of time looking for one. When these kids decompensate, they need and respond to fluids. Make every effort to find a vein, but if not readily available and it appears futile, move on to the intraosseous. Monitors need to be used so that heart rates can be monitored. Decelerations may be an early clue that the child is decompensating. Bear in mind that you still have to use your common sense and clinical acumen. A child who is septic and has had a febrile seizure may both present with an altered

mental status. I would not expect to see an intraosseous in the child who had the febrile seizure and is improving. Alternatively, if the child were to have recurrent seizures, an intraosseous may be necessary.

PEDIATRIC APPENDIX

NEWBORN RESUSCITATION

APGAR SCORE

Developed by Dr Virginia Apgar

SIGN	0 POINTS	1 POINT	2 POINTS
HEART RATE	ABSENT	< 100	> 100
RESPIRATORY EFFORT	ABSENT STRONG CRY	STRONG CRY	STRONG CRY
MUSCLE TONE	FLACCID	SOME FLEXION	ACTIVE MOTION
REFLEX IRRITABILITY	NO RESPONSE	GRIMACE	COUGH, SNEEZE OR CRY
COLOR	BLUE, PALE	BODY: PINK EXTREMITIES: BLUE	FULLY PINK

DEVELOPMENT SCALE

4 mos	raises head
5-6 mos	rolls over
8-9 mos	sits alone
15 mos	walks alone
18 mos	climbs stairs
22 mos	throws ball overhand
2-3 years	pedals tricycle
3 years	alternates feet up stairs
5 years	catches ball bounced

CARDIAC MEDICATIONS

EPINEPHRINE 1:10,000, 0.01 mg/kg IV or IO (maximum single dose 0.5 mg), or,

EPINEPHRINE 1:1,000, 0.1 mg/kg ET, followed by 2.0 mL sterile Normal Saline Solution. Subsequent ET dosages 0.1 to 0.2 mg/kg 1:1,000 every 3 - 5 minutes.

ATROPINE 0.02 mg/kg IV or ET (minimum single dose 0.1 mg, maximum single dose 1.0 mg). If administered via ET, follow with 2.0 mL of sterile Normal Saline Solution.

AMIODARONE 5 mg./kg. IV/IO OR Lidocaine 1 mg/kg IV / IO.

LIDOCAINE 1 mg/kg IV / IO.

CALCIUM CHLORIDE 0.2 mL/kg IV, IO slowly over 5 minutes for suspected calcium channel blocker toxicity.

SODIUM BICARBONATE 1 mEq/kg: IV/IO.

ADENOSINE 0.1 mg/kg IV Rapid IV push. If no effect, repeat Adenosine 0.2 mg/kg Rapid IV push. MAXIMUM single dose of Adenosine must not exceed 12 mg.

RESPIRATORY

ALBUTEROL 0.5% (via nebulizer):

If age less than 2 years, 1.25 mg by nebulizer

If age 2 years or greater, 2.5-3.0 mg by nebulizer

ALBUTEROL SULFATE 1.25 MG with IPRATROPIUM BROMIDE (ATROVENT), 250 mcg via nebulizer if less than 2 years of age.

ALBUTEROL SULFATE 1.25 MG with IPRATROPIUM BROMIDE (ATROVENT), 500 mcg via nebulizer if age 2 years or greater.

MAGNESIUM SULFATE 25 mg/kg. IV over 5 minutes.

ANTIDOTES

NALOXONE HCL 0.1 mg/kg of a 1-mg/mL solution: IV, ET, or IO, or nasal via atomizer.

If age less than 5 years: 0.1 mg/kg.

If age 5 years or greater: 2.0 mg. (NOTE: May repeat every two (2) to three (3) minutes as needed. If perfusion is adequate may give Subcutaneously (SC) or intramuscularly (IM). If given via ET, follow with 2.0 mL sterile Normal Saline solution.)

GLUCAGON 0.1 mg/kg IV, IO, IM, SC to max. 1.0 mg for suspected beta blocker or calcium channel blocker toxicity.

DIPHENHYDRAMINE (BENADRYL) 1.0 mg/kg up to maximum single dose of 50 mg IM or IV push.

DEXTROSE:

i. Dextrose 10% 0.5 gm/kg IV Bolus (for neonates).

ii. Dextrose 25% 0.5 gm/kg IV Bolus (if estimated body weight is less than 50 kg).

iii. Dextrose 50% 0.5 gm/kg IV Bolus (if estimated body weight is greater than 50 kg).

SEIZURES

DIAZEPAM 0.25 mg/kg, IV, IO to maximum single dose of 5-10 mg. or a RECTAL DOSE: 0.5 mg/kg unless contraindicated

OR

LORAZEPAM 0.05-0.1 mg/kg IV, IO slowly (dilute 1:1 in normal saline), or IM to maximum single dose of 2 mg*.

CARDIOVERSION

SVT: Synchronized cardioversion 0.5 joules/kg for symptomatic patients.

VTACH/VFIB: Defibrillate once at 2J/kg. Defibrillate 4J/kg every 2 minutes. Defibrillate 4J/kg 30-60 seconds after each medication.

PAIN MANAGEMENT

MORPHINE SULFATE 0.1 mg/kg IV/ (maximum individual dose 5.0 mg) or Fentanyl 1 mcg/kg. to max. 150 mcg. slow IV push.

IF NO IV ACCESS, MORPHINE SULFATE 0.1 mg/kg IM/SC/IO (maximum individual dose 5.0 mg) or FENTANYL 1 mcg/kg. to max 150 mcg nasally.

ONDANSETRON, for child under or up to 30 kg. 1 mg. IV; for a child over 30 kg., 2 mg. IV.

Changes in SIDS Incidence by Geographic Region

Site	Year	Rate	Year	Rate	+/- % Δ
Scotland	1990	2.40	1994	0.70	- 71 %
Ireland	1990	2.00	1994	0.90	- 55 %
Norway	1992	2.70	1995	0.50	- 81 %
Denmark	1992	1.80	1995	0.30	- 83 %
Sweden	1992	1.10	1995	0.40	- 64 %
France	1991	1.90	1994	1.20	- 37 %
Netherlands	1982	0.99	1994	0.30	- 70 %
Victoria, Australia	1990	2.30	1995	0.6	- 74 %
Perth, W Australia	1980-91	1.60	1993	0.70	- 56 %
N Adelaide, South Australia	1978-87	2.20	1991-95	0.90	- 59 %
New Zealand	1980's	4.00	1993	1.99	- 50 %
S. Alberta, Canada	1980's	2.02	1990's	1.17	- 42 %
United States	1990	1.48	1994	1.12	- 24 %
Minnesota	1986	2.30	1994	1.20	- 48 %
New York-Upstate	1974	1.43	1984	1.00	- 30 %

Source: Fourth SIDS International Conference Abstracts, Washington DC June 1996

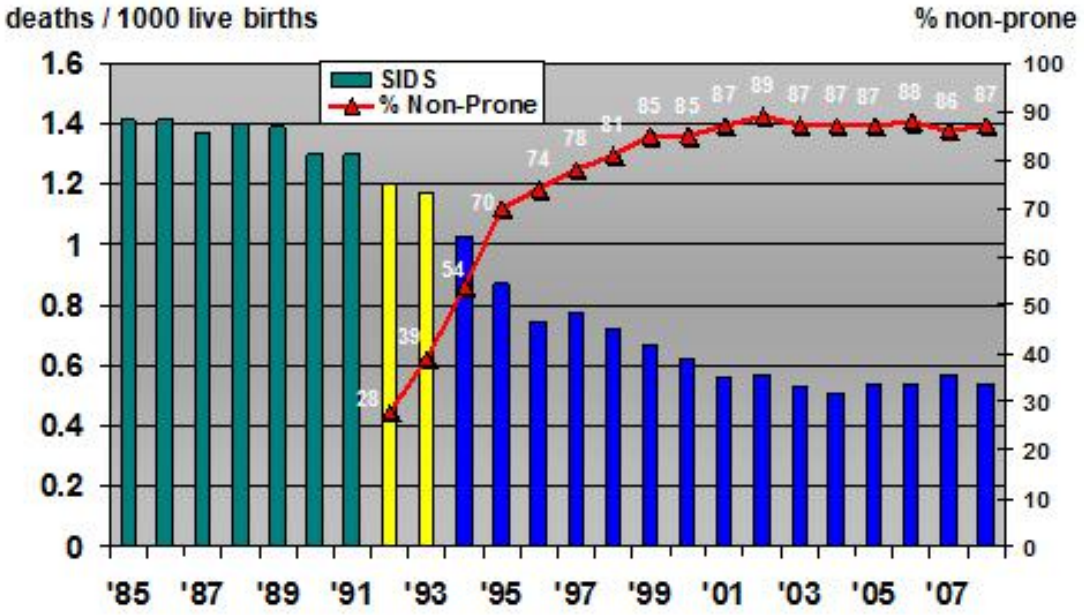
	American Academy of Pediatrics "Back to Sleep" Recommendations Pediatr 2005; 116: 1245-1255
1.	Infants should be placed exclusively on their back (supine) for every sleep. The side sleep position is not as safe as supine and is not recommended.
2.	Use a firm safety-approved crib mattress with a tight fitting sheet. Pillows, quilts, comforters or sheepskins should not be placed under the infant.
3.	Keep soft objects and loose bedding out of the crib. If blankets are used, they should be tucked in under the mattress so that the infant's head is less likely to become covered by bedding.
4.	Do not smoke during pregnancy. Avoid second-hand smoke exposure for the infant.
5.	A room-sharing sleep arrangement is recommended. Bed-sharing is associated with a higher risk for SIDS.
6.	Offer a pacifier when placing the infant down for sleep. Delay use of a pacifier until after one month of age for breast-fed infants.
7.	Avoid overheating and overbundling.
8.	Avoid commercial devices marketed to reduce the risk for SIDS.
9.	Do not use home monitors as a strategy to reduce the risk for SIDS.
10	Avoid development of positional plagiocephaly. Positional flattening of the head can be reduced by alternating head position during placement for sleep and use of "tummy-time" when awake.
11.	Continue "Back to Sleep" public awareness campaigns.

Current Recommendations on Sleep Position and the Infant Sleep Environment

- **place the infant on its back for sleep on a firm, tight-fitting mattress in a crib that meets current federal safety standards**
- **remove pillows, quilts, comforters, sheepskins, stuffed toys and other soft items from the crib**
- **do not place the infant on a waterbed, sofa, soft mattress, pillow or other soft surface to sleep**
- **consider using a sleeper or sleepsack as an alternative to blankets or other covers**
- **make sure that the infant's head remains uncovered during sleep**
- **place the infant so that its' feet are positioned at the foot of the crib**
- **if a thin blanket is used, tuck it around the crib mattress positioned up only as far as the infant's chest**

sources: American Academy of Pediatrics, National Institutes of Child Health and Human Development, Association of SIDS and Infant Mortality Programs, Consumer Product Safety Commission

SIDS Rate and Sleep Position
U.S. Infants 1985 - 2008



Sleep Position Source: NICHD NISP Household Survey
SIDS Rate Source: National Center for Health Statistics, CDC
Updated 05/08/2011

• AAP SIDS Statement 1992

• Back to Sleep Campaign 1994