Kids Are NOT Just Small Adults

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Kids = Adult?

- There are many similarities in the evaluation and treatment of children and adults in a disaster situation
- But there are many differences
- Knowing the differences will allow you to use the similarities to best advantage
- The purpose of this talk it to highlight the differences, and to note when they would most likely come into play

The Differences: Talk Overview

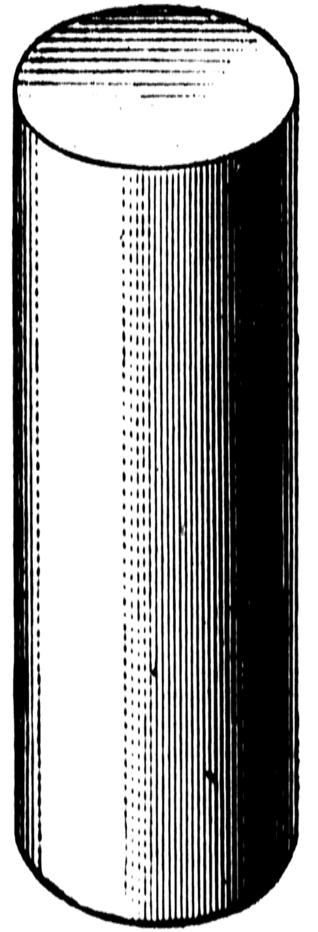
- Physiological and anatomical
- Psychological and developmental
- Situations that highlight differences:
  - Biological disasters
  - Chemical disasters
  - Radiological disasters
  - Blast disasters
  - Preparation
- Conclusions

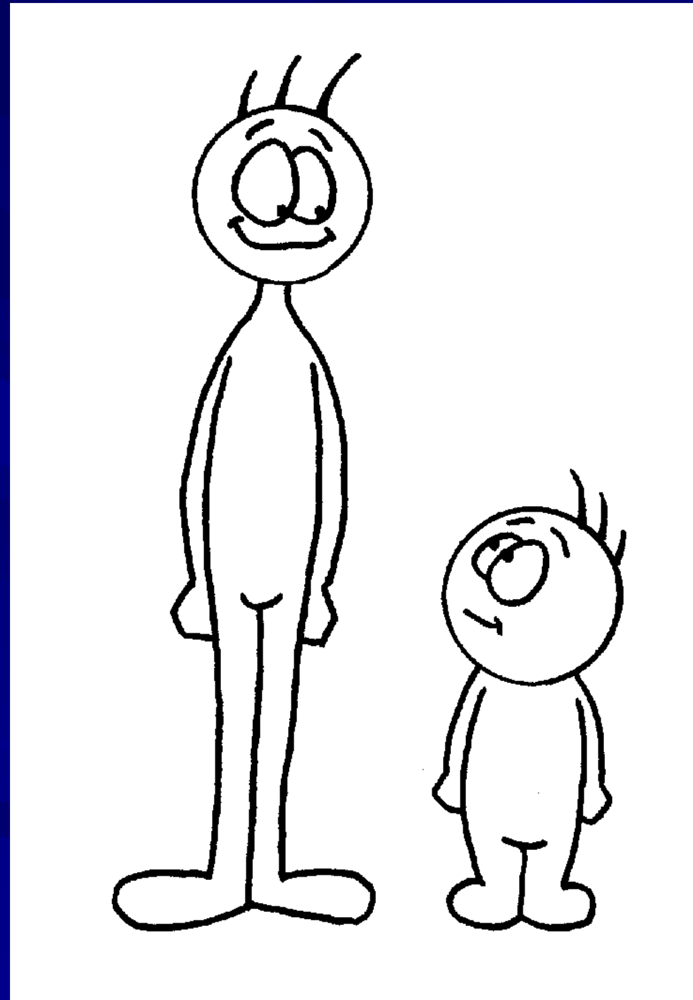
Dressed like, but still not adults...

Differences in Anatomy and Physiology:

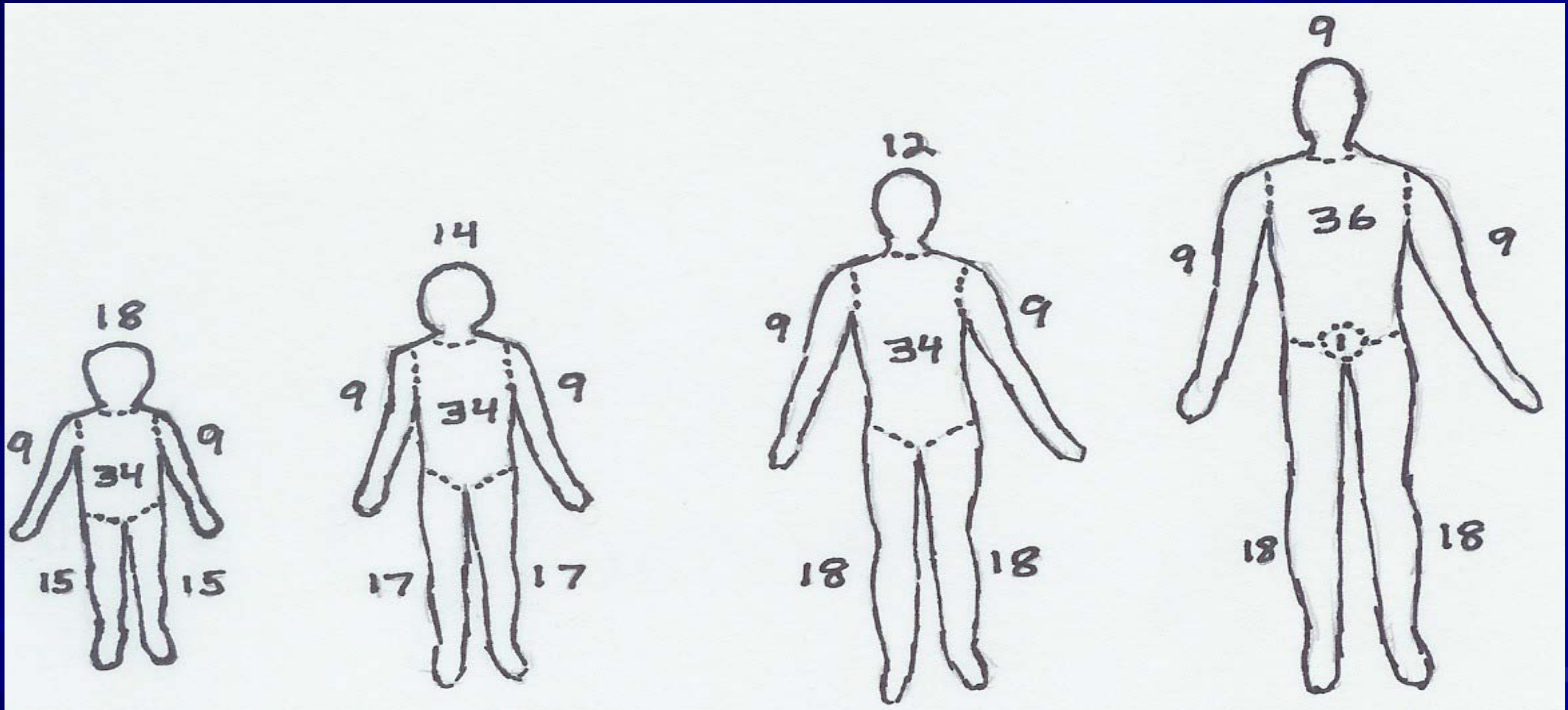
- Children are smaller than adults
  - Closer to the ground, hence get higher concentrations of agents that fall to the ground
- Children's body surface area is larger in proportion to their weight than adults
  - Absorb higher relative proportions of agents through the skin
  - Blast energies will be higher as a percentage of body mass (higher surface area per mass)
  - Increased loss of fluids per kg, most pronounced in infancy and gradually becoming that of an adult as they reach their late teens
  - Different BSA is especially relevant to estimation of burns

Kids are round balls, adults cylinders





Percentage of Total Body Surface Area



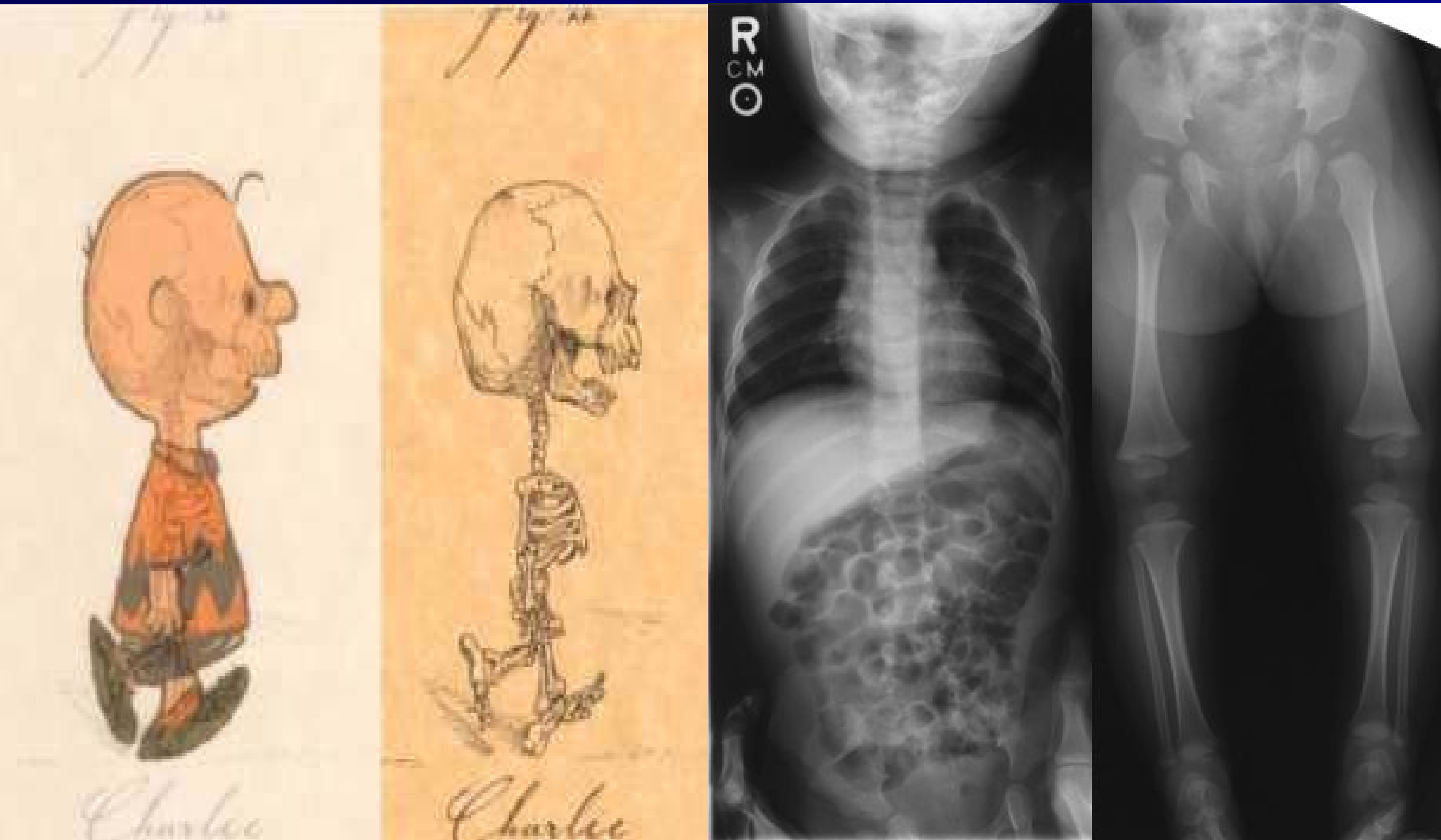
age <4 years old 5-8 years old 9-14 years old >14 y/o (adult)

(Numbers are percentages of body surface area, including both front and back)

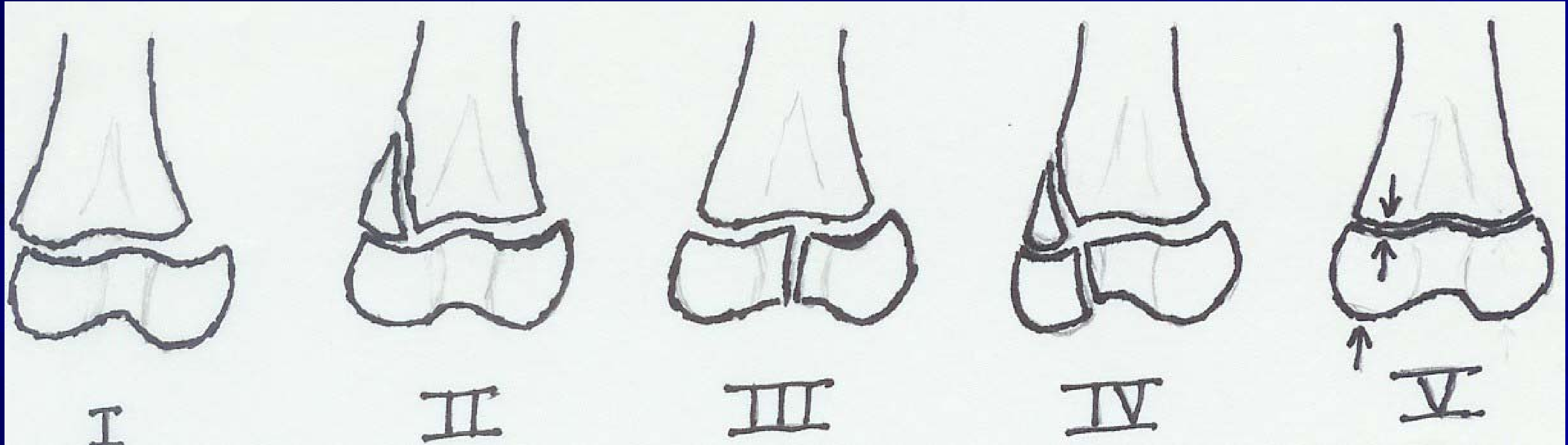
Differences in Anatomy and Physiology

- Skeletal differences
  - More pliable (can bend and not break)
  - Cervical spine is more subject to ligamental damage (spinal cord injury without radiographic abnormality or SCIWORA)
  - Incompletely calcified growth plates are more susceptible to fractures (so can break)
- Larger head
  - More heat loss
  - Higher probability of head injury

Kid’s Skeletons



Salter Fractures



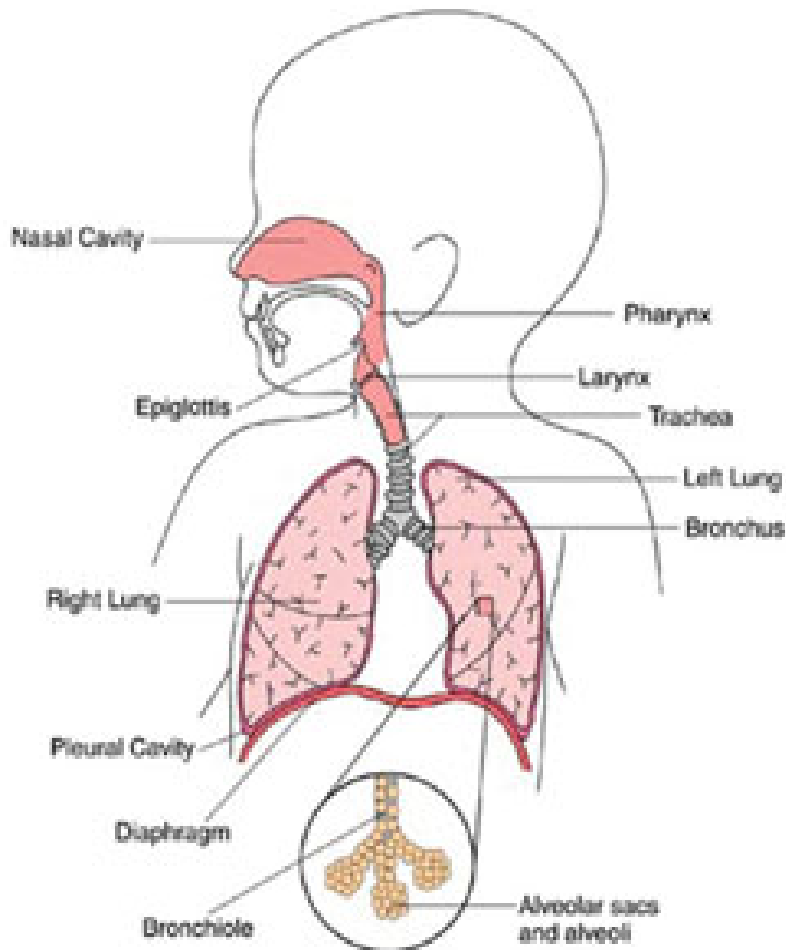
Slip	Above	Lower	Thru	ERase growth
S	A	L	T	ER!

(Draw the exclamation point like a long bone over a growth plate to remember ‘above’ and ‘low’)

Differences in Anatomy and Physiology

- Mobile mediastinum and weaker thoracic cage
  - Pneumothorax can more easily impair blood return to the right heart
  - Rib cage not as much protection to thoracic cavity contents
    - Pulmonary contusions can occur without rib fractures
- Airway differences
  - Higher and more anterior larynx can make intubation more difficult
  - Tongue is relatively larger for the mouth than in adults
    - Will obstruct airway more easily
  - Short trachea and decreased angle to mainstem bronchi makes migration of the ET tube more likely

Kid's Airways



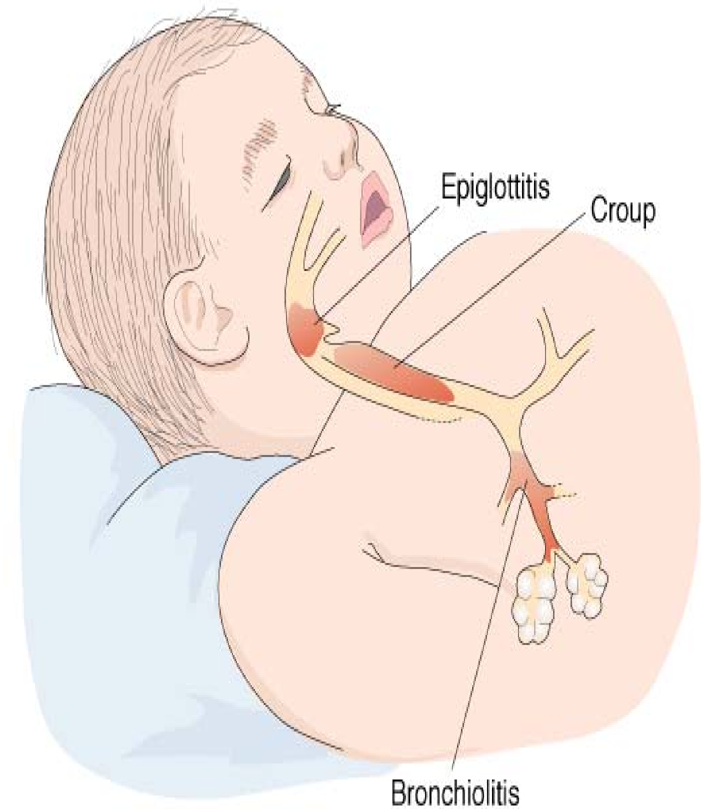


Figure 30-10 Location of airway obstruction in epiglottitis, acute laryngotracheobronchitis (croup), and bronchiolitis. (Courtesy of Carole Russell Hilmer, C.M.I.)

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Differences in Anatomy and Physiology

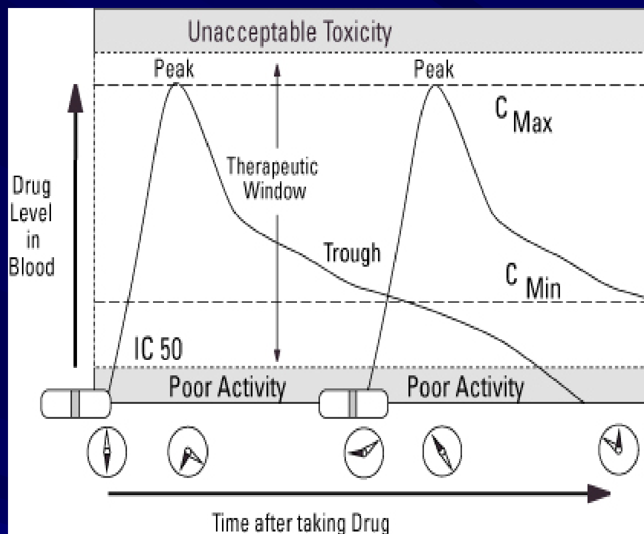
- ‘Normal’ vital signs are different in children than in adults
  - Must interpret in an age dependent manner
- Children lose fluids easier
  - Higher relative BSA
  - Skin is thinner and body fat not as developed
  - Differences in CNS control of thermoregulation
  - Children kidney’s have less concentrating ability and a lower GFR
- Children can compensate to initial volume loss with minimal changes in vital signs
  - Shock can sneak up on kids

VITAL SIGNS (ROUGH ESTIMATES)

Age	Weight Kg	HR (awake) beats/ min	SBP mm Hg	RR breaths/ min	Urine output L/ Kg/hr
0-6 months	3-8 Kg	120-180	60-100	30-60	2
6-12 months	8- 10 Kg	120-160	80-110	25-50	1.5
12-24 months	10-12 Kg	80-140	80-110	18-35	1.5
2-10 years	12-35 Kg	70-120	90-110	16-30	1
>10 years	>35 Kg	50-100	90-120	10-18	0.5

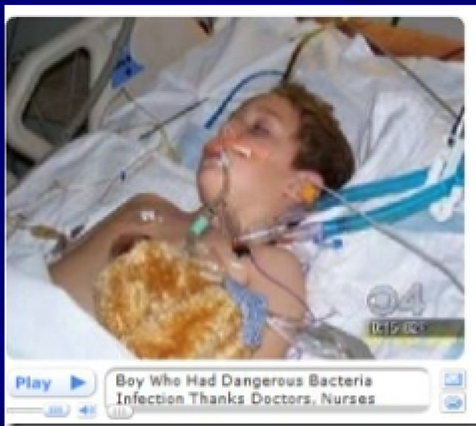
Differences in Anatomy and Physiology

- Children metabolize medications differently (renal and even liver)
- Children have less air reserve and higher minute ventilation requirements
- Children have decreased glycogen stores
- Children's immune systems are not as developed
  - Increased risk of infection



Metabolism affects medication dosing

Airway differences influence ventilation
And oxygenation requirements



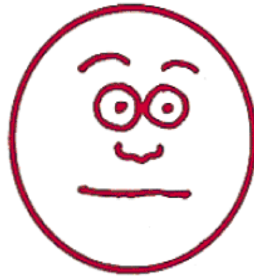
Immune system differences affects
risk and presentation of infections

Nutrition
Issues must
Be considered

Psychological and Developmental Differences

- Limited motor skills
- Inability to localize/describe pain
- Reaction to stress is different for kids
- Parents reactions to a disaster (depression, anxiety, fear, etc.) strongly influence the child’s reaction

Pain Scale for Kids

					
0	1	2	3	4	5
No Hurt	Hurts Little Bit	Hurts Little More	Hurts Even More	Hurts Whole Lot	Hurts Worst

STRESS REACTIONS IN CHILDREN

Age	Possible reactions
Pre-school	Regressive behavior, temper tantrums, clinginess, irritability (including increased crying), separation anxiety, sleep disturbances
School-age	Depression, anger, despair, anxiety, somatic complaints (headaches, stomach aches, others)
Adolescents	Depression, risk-taking behavior (including drug abuse, sexual promiscuity), increased risk of suicide. Note adolescents may deny and/or hide their feelings and behaviors for fear of not fitting in, increasing the difficulty diagnosing and treating these problems

How the differences come into play

- Biological disasters
- Chemical disasters
- Radiological disasters
- Blast disasters
- Preparation

BIOLOGICAL AGENTS

- Limited data in children
- Presentations of diseases are different
  - Inability to localize/describe pain, other symptoms
  - Interpret vital signs for age
  - Less air reserve
  - Shock different (volume loss, compensation, renal function, immune system) and can be sneaky
- Transmission mitigating steps, eg. wearing a mask, are hard in kids
  - Stress reactions are different in kids
  - Mitigating transmission between parents and children is very challenging. Breastfeeding must be a consideration

BIOLOGICAL AGENTS

- Antibiotics
  - In a disaster the type chosen will mirror the adult choice
    - Dose change due to size as well as clearance differences
    - Benefit greater than risk even for ‘non-kid’ choices like cipro and doxycycline
      - This is true for treatment and prophylaxis
- Laboratory investigations must be interpreted carefully when trying to generalize the results from adults to children
  - Anthrax- a widened mediastinum will often not be interpretable in infants due to the large thymic shadow that many will have

IV Fluids in Kids

PEDIATRIC FLUID MANAGEMENT

- Total maintenance fluid volumes for normo-volemic children:
  - 100 ml/Kg-day (4 ml/Kg-hour) for each of the first 10 Kg
  - 50 ml/Kg-day (2 ml/Kg-hour) for each of the next 10 Kg (between 10-20 Kg)
  - 20 ml/Kg-day (1 ml/Kg-hour) for each Kg over 20 Kg

- Glucose and electrolyte considerations for children with normal electrolytes:
  - Sodium: 2-4 meq/Kg-day
  - Potassium: 1.5-3 meq/Kg-day
  - Glucose: 5 gm/100 ml
  - Rough examples: (must adjust for abnormal electrolytes or for abnormal hydration status):
    - < 30 Kg: D5 ¼ NS plus 10 meq KCl/L
    - >30 Kg: D5 ½ NS plus 20 meq KCl/L

Treating Infections in Kids

PEDIATRIC ANTIBIOTIC DOSAGES*

Drug	Dosage (treatment, prophylaxis may be less)
Chloramphenicol	15-25 mg/kg IV q6
Ciprofloxin	15 mg/kg IV q12
Doxycycline	2.2 mg/kg IV q12
Gentamicin	2.5 mg/kg IV/IM q8 (or 5 mg/kg IV/IM qd)
Streptomycin	15 mg/kg IM q8
Ribavirin	30 mg/kg IV load then 16 mg/kg q6 x 4 days, then 8 mg/kg IV x 6 days

*Dosages should never exceed adult dosages

CHEMICAL AGENTS

- Higher exposure
  - Closer to ground
  - Thinner skin
  - Larger BSA for weight
- Decontamination of children may be challenging
  - Limited ability to cooperate
  - Difficulty of tending to small children while the care-giver is in a bulky personal protection suit
- Children may react differently
  - Exposure to anti-cholinesterase pesticides in kids have shown a higher degree of changes in levels of consciousness as well as more pronounced muscle weakness
  - Shock can be sneaky

Not So Easy in Practice

PEDIATRIC DRUG DOSAGES FOR CHEMICAL AGENT EXPOSURE*

Drug	Dosage
Atropine	0.05-0.1 mg/kg IV/IO
2-PAM	25-50 mg/kg IV/IM

*Dosages should never exceed adult dosages

RADIOLOGICAL AGENTS

- Children are still growing and organ systems still developing
  - More susceptible to the adverse effects of radioactive agents
  - Thyroid cancer and leukemia are more frequent complications in children than in adults; even more pronounced for children less than 4
- Thinner skin, greater BSA and greater metabolic demands predispose to increased complications
- There is limited literature on biological dosimetry in children

PEDIATRIC DRUG DOSAGES FOR RADIATION EXPOSURE*

Drug	Dosage
Prussian Blue	1 gm PO TID (2-12 y/o)
	3 gm PO TID (>12)
KI	16 mg (neonates)
	32 mg (1-36 months)
	65 mg (3-12 y/o)
	130 mg (>12 y/o)

*Dosages should never exceed adult dosages

BLAST ISSUES

- Physiology and anatomy predispose children to increased risks of certain injuries
  - Skeletal differences
    - Mobile mediastinum
    - Pliant bones, underlying injury can occur without fracture
    - Different fractures possible (SALTER)
  - High BSA to weight ratio increases injury potential
  - Large head
    - More head injuries
  - Mobile mediastinum, pliant rib cage
    - PTX will decrease right heart return more
    - Lung injury without fractures

BLAST ISSUES

- Physiology and anatomy predispose children to increased risks of certain injuries
  - Reactions different due to psych and developmental differences
  - Shock can be sneaky
    - Higher BSA
    - Thinner skin
    - Renal differences
    - Different vital signs
  - Airway differences
    - Obstruction (tongue)
    - ET tube loss
    - Mainstem intubations

Trauma in Kids can be Tricky

GLASCOW COMA SCALE:
Some the same for kids and adults

Eye Opening	Best Motor Response	Score
	Obeys	6
	Localizes	5
Spontaneous	Withdraws (flexion)	4
To loud voice	Abnormal flexion posturing	3
To pain	Extension posturing	2
None	None	1

GLASCOW COMA SCALE:
Best verbal response changes for kids less than 5

Adult	Child 0-2	Child 2-5	Score
Oriented	Social smile, fixes and follows, coos	Appropriate words or phrases	5
Confused	Cries but consolable	Inappropriate words	4
Inappropriate words	Persistently irritable	Persistent cries or screams	3
Incomprehensible sounds	Restless, agitated, grunts	Grunts	2
None	None	None	1

Preparation

- Training
  - Did I mention kids are not just small adults?
  - Resuscitation of kids
  - Other issues already mentioned
- Planning
  - Include info for the public to address kids
  - Include post-disaster planning addressing kids and related kids issues
- Specialist availability for kids
  - Includes sub-specialists

Preparation

- Surge capacity
  - An adult bed is not the same as a pediatric bed
- Kids equipment
  - Types and sizes of equipment may vary
- Medication dosages
  - It is not just the dose, but potentially the concentration may need to change

Surge Capacity for Kids

Special Equipment for Kids

ROUGH EQUIPMENT SIZE GUIDELINES*

Child's age	ET Tube (mm)	Chest Tube	Foley
Premature	2.5 mm uncuffed	10-14 Fr	5 Fr feeding tube
0-6 months	3.0-3.5 mm uncuffed	12-18 Fr	5-8 Fr feeding tube
6-12 months	3.5-4.0 mm uncuffed	14-20 Fr	8 Fr
12-24 months	4.0-4.5 mm uncuffed	14-24 Fr	10 Fr
2-10 years	(16 + age)/4 uncuffed	18-32 Fr	10-12 Fr
> 10	6.0-8.0 mm cuffed	28-38 Fr	12 Fr

*IV should be largest that can be started, usually 22 gauge for preemie up to 18 gauge for adult.

Conclusion

- Kids are not just small adults
- Physiologic and anatomic differences
- Psychiatric and developmental differences
- Applying these to situations
  - Biologic
  - Chemical
  - Radiation
  - Blast
- Preparation is key
  - Planning
    - Training
    - Equipment
    - Recovery

QUESTIONS?