PREPAREDNESS & INFECTION CONTROL IN PEDIATRICS: THE FORGOTTEN PATIENT POPULATION

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Pediatric patients have a unique set of requirements - they simply are not “little adults”

- Physiologically children are different:
  - Higher heart rate and respiratory rates
  - Immature blood brain barrier
  - Higher metabolic rate
  - Larger BSA (body surface area – the smaller the patient, the greater the ratio of surface area to size).
  - Thinner skin

- Require specialized care, especially if medically complex (pediatricians, neonatologists, etc. Consider a patient on ECMO – extracorporeal membrane oxygenation)

- Dietary differences (formula, breast milk, baby cereal, feeding pumps, etc.)
Immature blood/brain barrier

- Higher respiratory rates
- Larger body surface area
- Thinner skin
- Rapidly dividing cells
- Higher metabolic rate
- Immature immune system
Psychosocial and Cognitive Differences

- Children and adolescents are still developing socially and their habits/values/behaviors are not defined.
- They are still developing emotionally and building their ability to recognize and manage their emotions.
- Communication – cognitively, children may not be able to communicate with healthcare providers. Easily one of the biggest challenges, especially if family isn’t present.
- Family component – can be both helpful and disruptive
- Child Life Specialists- unique to pediatrics but also crucial to the care process
- Pet therapy – more common in pediatric settings
Infection Control & Pediatrics

• Precautions – isolation precautions are often modified for pediatric patients due increased risk of transmission based off direct/indirect contact - example: respiratory viruses typically require Droplet precautions in adults, but in pediatrics Contact/Droplet are used.

• Children may not always present with classic symptoms, but are very skilled at spreading germs.

• Isolation difficulty – inability to understand isolation precautions. Some are too young/small to wear PPE or use hand hygiene effectively.

• Visitor Restrictions
Infection Control & The Family Component

Biggest challenge to infection control efforts. Often disagree or refuse to follow isolation precautions. Siblings? Sick family members? Isolation families wandering around the unit or cafeteria? What about the breastfeeding mother?

Child Life – can bring the games to the patients room to avoid making isolation feel so lonely. Skype! Unfortunately, no pet therapy.
Miniature Germ Factories

- Play rooms – patients and visitors alike flock to these, but what if one is infectious? Cleaning is vital!
- Touching – children are more “hands on” than adults, resulting in more high-touch areas.
- Hand hygiene – difficult to reinforce with children (then again, it is with adults!). Alcohol-based hand sanitizer utilization and supervision.
- PPE – may not fit (there are masks that fit children 3-12 years old, but no gowns or gloves). Will they keep them on?
Hospital Preparedness

• Inclusion of events from massive power failure, bioterrorism events, influx of patients, chemical spill, mass casualty, active shooter, nuclear event, etc. Aka- a very *large* range of things to prepare for!

• Assessed by CMS, Joint Commission, and other accreditation organizations – including the review of a facility’s HVA (Hazards Vulnerability Assessment and Analysis).

• Ensures the adequate training of all staff to recognize and appropriately respond to an emergency or disaster.

• Development of plans to respond to, manage, and recover from the most likely or impactful hazard that may occur to the facility or campus.

• Phases of emergency management: Mitigation, Preparedness, Response, and Recovery
Hospital Preparedness – A Pediatric Weak Link?

- Analysis by Gausche-Hill: Pediatric disaster preparedness implies that systems are in place to ensure the rapid triage and emergency management of children as patients in natural or manmade disasters or from acts of terrorism. *Are we really prepared? No, we are not prepared.*
  - Emergency rooms will already be overcrowded and many are unable to handle that kind of surge – even less so with children
  - Lack of experience regarding pediatric emergency and critical care (coupled with lack of pediatric equipment, medications, etc.)
  - Analysis of patients during two hurricanes found that pediatric patients were significantly more likely to have undocumented severity of illness
  - Survey of U.S. EMS agencies found that only 13% had pediatric specific mass-casualty plans.
- “One third of victims of disasters or multi-casualty incidents are children, yet system planning has not included pediatric issues” (Gausche-Hill, 2009).
- Decontamination – children can’t be decontaminated in adult units (consider infants, water pressure, use of cleansers, non-ambulatory children, etc.). Special considerations are necessary for decontamination of pediatric patients.
- Reunification of children with families
- Consider all the unique qualities of children – anatomically, physiologically, and psychosocially.
Challenges When Preparing

- Emergency preparedness can’t approach the care of children by simply modifying current practices.
- Staff to care for complex pediatric patients - (NICU, CVICU, PICU, BMT, ECMO). What about sitters or childlife specialists?
- PPE – do we have enough? N-95 masks? Have staff been fitted? Child-sized PPE?
- Families and security
- Prophylaxis – stockpiles need to include the unique requirement of pediatric dosages.
- PODS – where will they be located and what will they be supplied with?
- Supplies – enough pediatric medical supplies? Dietary?
Bioterrorism
Agents of Bioterrorism

Bioterrorism is the intentional release of biological agents (viruses, bacteria, etc.) to cause illness or death to people, animals or plants (CDC). Surveillance will become key as there can be difficulties in recognizing a bioweapon outbreak.

Category A agents:
- Anthrax
- Botulism
- Plague
- Smallpox
- Tularemia
- Viral hemorrhagic fevers

Category B agents:
- Brucellosis
- Epsilon toxin (clostridium perfringens)
- Food safety threats
- Glanders
- Melioidosis
- Psittacosis
- Q fever
- Ricin toxin
- Staphylococcal enterotoxin B
- Typhus fever
- Viral encephalitis
- Water safety threats (Vibrio cholerae, Cryptosporidium parvum)
Highlighted Focus: Bioterrorism

- BT events aren’t considered “top of the list” for many hospital HVA’s. Several recent studies have highlighted the bioterrorism preparedness of hospitals and pediatricians is often lacking.
- BT pathogens are unique in what they require (decontamination- anthrax, isolation, environmental – negative pressure rooms, care, etc.)
- Increasing concern related to anthrax events, food safety, and even recent Ebola outbreak.
Hospitals Are Unique to BT events

- First wave- hospitals and urgent cares are typically the first to see patients after a mass event or exposure.
- Influx – as illness develops and more people seek care, hospitals may have to activate surge capacity.

  \[\text{Surge} \rightarrow \text{strain on healthcare system}\]

- Walking well – healthy patients that believe they are ill. They amplify the existing burden and can easily become sick (emphasizing the necessity of patient screening and isolation) when mixed with infectious patients.
- Infection control and rapid diagnosis becomes key. Identification can be delayed if symptoms are relatively common, microbiology results become delayed, and providers are overwhelmed. Infection control will become imperative to stop transmission and reduce the risk for secondary cases.
Bioterrorism and Children

• Super Spreaders – between communication barriers, schooling, and hygiene habits, children are often considered super spreaders ("cloud babies" – babies in nurseries were able to spread, after having a URI, *S. aureus* they were colonized with) (Stein, 2011).

• More susceptible – anatomically and physiologically, children are disproportionally more at risk for infection.

• The biggest "hit to home" – increasing terrorist targeting of children.

• Challenges with identification, treatment, and isolation.
Bioterrorism and Children – Susceptibility

- Children have thinner skin (epidermis is thinner and under-keratinized), making them at risk for increased absorption of agents through the skin.
- Higher respiratory rates leading to proportionally higher minute volumes. Smaller airways can increase pulmonary complications (secretions, etc.) when compared to adults.
- Height- children tend to be shorter, meaning their breathing zone is lower to the ground. Some agents are heavier when aerosolized and hover in this proximity. Higher vapor density of bioaerosols places their highest concentration close to the ground.
- Immature blood-brain barriers and enhanced CNS receptivity, meaning that nerve agents may produce more symptoms.
Table 1  Pediatric specific vulnerabilities to terrorist attacks

<table>
<thead>
<tr>
<th>Vulnerability</th>
<th>Blast Injury</th>
<th>Biological agents</th>
<th>Chemical agents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proximity to ground</td>
<td>Either unaware or unable to flee from explosion</td>
<td>Agents settle to the ground</td>
<td>Agents tend to pool in lower areas</td>
</tr>
<tr>
<td>Increased minute ventilation</td>
<td></td>
<td>Increased exposure to inhaled agents</td>
<td>Increased exposure to inhaled agents</td>
</tr>
<tr>
<td>Provider unfamiliarity with pediatric dosing of medications</td>
<td>Potentially curious about ordinances</td>
<td>Dosing of antibiotics different</td>
<td>No prepackaged store of antidotes in pediatric doses</td>
</tr>
<tr>
<td>Lack of knowledge or inability to flee danger</td>
<td></td>
<td>unlikely to recognize signs/symptoms of biologic agents</td>
<td>Would not know to flee from strange odor or seek medical help with symptoms</td>
</tr>
<tr>
<td>Lack of stockpile of pediatric dosed antidotes and vaccines</td>
<td></td>
<td>Prepackaged stockpiles of vaccines and antidotes not dosed for small children</td>
<td>Lack of guidelines for dosing of antidotes in children</td>
</tr>
<tr>
<td>Less blood volume/physiologic reserve</td>
<td>More rapidly develop life threatening blood loss</td>
<td>Prone to dehydration with illness. Lower functional residual capacity</td>
<td>More prone to respiratory distress/failure with nerve agents, vesicants, and pulmonary agents</td>
</tr>
<tr>
<td>Thinner skin</td>
<td>Prone to hypothermia during triage, evacuation and treatment</td>
<td></td>
<td>Faster absorption of agents</td>
</tr>
<tr>
<td>Increased BSA to mass ratio</td>
<td>Unable to follow mental status exam/communicate other injuries early</td>
<td>Present later in the course of biologic agents</td>
<td>Prone to hypothermia with decontamination</td>
</tr>
<tr>
<td>Developmental immaturity</td>
<td></td>
<td></td>
<td>Unable to promptly communicate symptoms</td>
</tr>
<tr>
<td>Increased head size compared to body</td>
<td>Increased head AIS when compared to adults^{[9]}</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

AIS: Abbreviated injury score; BSA: Body surface area.
Triage Challenges for BT Events and Pediatric Hospitals

• Presentation and Diagnosis
  • Evaluations found that surveyed pediatricians consider bioterrorism a significant threat but are “overwhelmingly underprepared to deal with an event” (Stankovic, 2009).
  • Existing guidelines are considered unreliable as screening tools for inhalation anthrax in children (Place, 2007).
  • Children (especially toddlers and infants) present with non-specific symptoms. Many category A agents in their initial stages of infection in children closely resemble more common infections (smallpox – chickenpox, inhalation anthrax- flu, plague – cat-scratch fever)

• Communication – children often have an inability to adequately communicate symptoms. These gaps can pose a larger problem if not accompanied by guardian.
  • Existing medical conditions and medications
  • Timeline of symptoms
  • Locations, events, food consumed, sick contacts, vaccinations, etc.

Keep in mind these all assume the child is at a pediatric hospital. Consider if this was an adult facility with limited resources and staff that were pediatric specific.
Bioterrorism and Children – Treatment Issues

- Most of the recommended antibiotics and antiviral treatments for BT agents have not been approved for use in children (Leissner, 2004)
- IV medications are most common, however vascular access may be difficult in pediatric patients. Smaller child ➔ harder to find vascular access ➔ delay in treatment
- Vaccinia – in the event of smallpox, it is not indicated for use in patients >12 months. Patients under 18 years of age should only be given the vaccine in emergent situations. Children undergoing smallpox vaccination have a higher incidence of complications than adults (Leissner, 2004).
- Dosages - In mass vaccination or prophylaxis situations, are pediatric dosages available? Enough of them?
- Enough staff and equipment to appropriately handle complex pediatric cases (ventilators, ECMO machines, etc.)
Infection Control in Pediatrics During BT Events

- **Hand hygiene and PPE** – existing difficulties with compliance in non-emergent situations, how can we perfect it before these big events?

- **Isolation** – necessity of appropriate isolation for patients.
  - What if we don’t know what we’re dealing with?
  - Enough N-95 masks and other specialized PPE?
  - Have staff been fit-tested within the last year?
  - PPE fatigue and time for donning/doffing
  - Education for family and visitors
  - Double-occupancy

- **Environmental Controls**
  - Negative pressure rooms
    - Do we have enough?
    - What if the patient needs to be taken to the OR emergently?

- **Cleaning and Decontamination**
  - Supplies
  - EVS staff training and use of PPE

*These guidelines are already in place, however, widespread implementation during a period of high census, high acuity, fear, panic, and under-staffing, will undoubtedly make compliance challenging.*

Did I mention hand hygiene and PPE? 😊
Current Methodologies

Current methodologies for preparedness, especially BT plans, generally fail to incorporate or consider the unique needs of pediatric patients

- Available sources include the bioterrorism readiness plans, hospital preparedness plans, other templates from the CDC, DHS, APIC, and FEMA.
- Centers for Bioterrorism Preparedness Planning Pediatric Task Force Initiative
- Pediatric hospital networks incorporate emergency preparedness into their agenda – county-wide exercises and educational workshops.
- On a national-level, do we allot the necessary resources and consideration to the pediatric population during emergent situations? During bioterrorism events?
Room for Improvement?

Always!

- Joint task forces of pediatric hospitals working with adult care facilities to ensure their EP plans include pediatric patients
- Standardization of pediatric screening tools and algorithms for bioterrorism agents
- Education and exercises for healthcare providers regarding infection control during large-scale events
- Inclusion of schools in preparedness plans
- Make this pediatric-specific education available to ancillary staff and encourage their engagement
- Consideration of the unique abilities and cognitive levels of children during preparedness and infection control – disaster and emergency psychological response teams
- Pediatric-specific disaster/CBRNE risk assessments
- Consideration for pediatric isolation precautions and infection control
Sources


“The patient in the next bed is highly infectious. Thank God for these curtains.”

Questions?