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Children in disasters

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Introduction

Given recent disasters, hurricanes, mass shootings, floods and including the COVID-19 pandemic, there is a need for a national discussion about children in disasters. Approximately 25-30% of individuals injured in a disaster are children.[1,2] Care for the pediatric population is unique given differing biological, social, and ethical factors, which requires additional consideration when approaching disaster response and preparedness.[2] Since Hurricane Katrina in 2005, increased attention has been given to the pediatric population in disaster settings. Although we've seen significant improvement across the country in disaster preparedness, many of the recommendations in the 2010 National Commission on Children and Disasters have yet to be fully implemented.[4,5] Recently, with the COVID19 pandemic, we have seen new challenges along with novel advancements for pediatric emergency response.[5] This article serves to provide a brief overview regarding pediatric disaster response and its recent advancements, current issues, recommendations along with brief discussion on future areas of study.

Pediatric Disaster Preparedness

Pediatric Population

The pediatric population is disproportionately affected during disasters and requires special consideration. The Federal Emergency Management Agency (FEMA) categories these into 3 groups: anatomy and physiology, psychological and education vulnerabilities. **Anatomy & Physiology:** Marianne Gausche-Hill outlined the significant differences seen in children in the August 2009 Journal of Trauma. The anatomic differences include the small circulating blood volume, thin skin and lack of body fat which make them more susceptible to fluid and heat loss than adults. For the same force delivered to a body the child's smaller mass receives more energy per square inch than adults. Skeletal immaturity and ligamentous laxity make the patterns of injury seen in children for a similar force applied different from adults. Shorter stature and higher body surface area to mass ratio put children at greater risk of toxin absorption and inhalation of heavy gasses such as sarin and chlorine.[6]

The physiologic differences are primarily in the significantly different metabolic rate of children. The inherent rapid heart and respiratory rate make discrimination of shock more difficult. Medical professionals who don't normally care for children will need quick references for normal vital signs and for appropriate doses of fluids and medications. The rapid metabolic rate makes children more susceptible to hypothermia and the effects of toxins from inhalation agents. Caregivers must keep body temperature in mind and take measures to regulate it earlier than in adults, particularly in the smallest children. Many children treated following hurricanes Katrina and Rita and tropical storm Allison were most significantly affected by gastrointestinal disease than by injury. Susceptibility to gastroenteritis is much more common in the pediatric patient than in adult patients, and dehydration onset is faster. Worldwide, diarrheal diseases remain in the top five causes of death for children under 5 years, along with upper respiratory infections. With the massive disruption of services that can occur in disasters, the mortality of children may quickly follow these global trends.[6]

Development and psychology: The developmental and emotional variability of children is challenging for those healthcare providers who routinely care for injured children. For those who rarely evaluate and treat children, it can be overwhelming. Infants and younger children are completely reliant on parents or guardians for communication, advocacy, and emotional support. The loss of this parent or guardian support that frequently occurs during disaster, due to death, injury, or separation, confounds the ability to care for affected children. Younger children require nearly constant supervision during evaluation and treatment if parents or guardians are unavailable, making staffing needs considerable. While the reality of a disaster situation is daunting for everyone, the reality may be outside of the imagination of a young child. The bewilderment and emotional derangement may significantly affect the ability of healthcare providers to accurately evaluate children. Developmental regression is common during illness or injury. Recent information has come to light that clearly demonstrates the susceptibility of children to acute stress disorder, and subsequent post-traumatic stress disorder. The symptoms are subtle and include withdrawal, emotional labiality, and persistent in-

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vasive bad thoughts. Without identification and appropriate management, acute stress disorder can transition into Post Traumatic Stress Disorder (PTSD) and lead to life-long disability.[7]

Finally, educational vulnerability is often overlooked in disaster response, however, not surprisingly, disasters have a large negative impact on children's academic performance – on average children have to change schools 3 times (up to 11 times) over 3 months following a storm or natural disaster.[10] Additionally, infants and young children are unable to feed, cloth, and care for themselves, safe housing, safety, and age-appropriate equipment and supplies are required in emergency settings.[8] All of these unique considerations need to be taken in to account when approaching disaster response and preparedness on the local, state, and federal level. Failure to address these increases morbidity and mortality following disasters.[1,3,8]

Preparation

Given the varying aspects of pediatric trauma care to consider, more systematic changes to disaster preparedness are often the most beneficial for families and communities, including integration of disaster planning in schools or other institutions as well as pediatric focused drills and trainings. At the state, regional, and local level emergency plans need to be in place for large-scale disasters addressing systems on a legal and operation level. These systems should include pre-disaster planning, management, and assessment, multidisciplinary cooperation and partnerships, and use of existing data to appropriately asses the pediatric population needs of the area and model appropriate disaster response.[8] This is currently lacking as a 2013 analysis of the Pediatric Readiness Assessment showed that less than 50% of hospitals had written disaster policies addressing the pediatric population.[8] Along with the need for written hospital and system policy, there should be additional stipulations regarding triage systems. All trauma systems should be prepared to take care of pediatric patients in a disaster.[3,8] It is also crucial that all emergency medical services have the adequate resources to take care of children, including age-appropriate equipment, trained staff, and resources to provide high-quality pediatric disaster care.[8] Multiple national organizations are helping improve pediatric disaster preparedness including the Emergency Medical Services for Children Program, the Join FEMA's Ready Kids, AAP, Save the Children, and many more. Further discussion on specific aspects of care are highlighted in the sections below.

Reunification

Given the emotional and psychological stressors, addressing the effect that disaster trauma has on children is an important factor to recovery. Children are often more susceptible because of the dependence on adults for protection, stability, transportation, information, and decision-making.[5] Thus an important consideration in the pediatric population is the reunification to legal guardians, which marks the start of many children's recovery process. To start this process, patient identification, registration, tracking, and documentation are crucial during disaster response. Dependent on age, this process may be challenging to complete and can bring up legal implications to providers. Often, these are considered the "systematic choke points" in hospital infrastructure and can impeded on children's access to appropriate care.[5] Given these potential bottlenecks, it is important that supply chain management and hospital infrastructure has a plan in place for when a disaster occurs.[1] Research has indicated that not only having a plan in place, but child-focused training and drills with systems in place for quality improvement are crucial to improve upon areas of systemic weakness.

Mental Health

The canvas of pediatric mental health is continuing to change. Recently, the U.S. Surgeon General, Dr. Vivek Murthy issued an advisory that emphasized the "urgent need to address the nation's youth mental health crisis."[12] Prior to the COVID-19 pandemic, mental health issues were a leading cause of morbidity in children, up to 1 in 5 children (ages 3 to 17) had a mental, developmental, or behavioral disorder, with an increase in suicidal behavior - 57% increase in suicide rates between 2007-2018.[12] By adding to the pre-existing pediatric mental health challenges, the COVID-19 pandemic has disproportionately affected vulnerable populations (disabilities, racial/ethnic minorities, LGBTQ+, low-income, rural, homeless, child welfare or juvenile justice systems) and was declared a national emergency in Fall of 2021. All of this further delineated the need for accessible, affordable, high-quality mental health care. Children and families often experience post event adjustment reactions, including PTSD, anxiety, depression, bereavement, stress, behavioral regression, and psychosomatic disorders. As part of children's recovery process after a disaster, proper psychological first aid and continued mental health care should be provided to all children and families affected. Partnerships between pediatricians, mental health professionals, and other sources of support, including social workers, school counselors, clergy, etc, should be established prior as part of pediatric disaster preparation initiatives.[8] Pediatricians should be able to provide continued support and resources for secondary trauma, physical and demographic changes, ongoing bereavement, etc. for months, years, and even longer after the acute disaster event.[10,13]

Telehealth

Telehealth technology and utilization has boomed since the COVID-19 pandemic especially in aspects of mental health as well as in low resource settings, where children are most affected by disasters. Telehealth has been used as a tool in developing coordinated pediatric disaster response systems. By utilizing technology, low-resources settings may be able to better triage and treat pediatric patients appropriately, especially in locations lacking trained pediatric specialists. Western Regional Alliance for Pediatric Emergency Management (WRAP-EM) is using tele health to encourage multi-disciplinary collaboration in the setting of pediatric emergencies in order to develop a "coordinated, collaborative, and sustainable regional pediatric disaster planning and response capability."[9] A large part in implementation of telehealth systems is the initial start up cost for allocation, testing, and maintain of devices, technology, and broadband, as well as personnel to help with technologic troubleshooting. However, the benefits of telehealth with its wide range of uses outweigh the current costs and risks.

Ready Kids

The Ready Kids program was developed by Federal Emergency Management Agency (FEMA) to help equip people with resources and plans to prepare for disasters that takes into consideration the pediatric population with resources available for children, parents, educators, health professionals, business, etc. These resources help education children on knowing what to do in emergency settings and provides parents and educators of the disaster "planning, preparedness, response, and recovery efforts" when children are affected.[11] On their online website, with multiple language adaptations, people are able to walk through making an emergency plan with family, friends, or household with specific focus on children, and emphasizing the need for practicing the plan in case of emergencies. This often includes making sure all members have copies of the plan and contact information as well as a safe, accessible

place to regroup. As mentioned earlier this can be incredibly helpful for reunification and help accelerate disaster trauma recovery.[5]

Recommendations

Several publications over the last decade have offered recommendations regarding pediatric disaster preparedness, including recommendations for implementation throughout hospital systems at the local, regional, state, and national levels. The American Academy of Pediatrics came out with the following[8]:

"Recommendations and key considerations (main points) in ensuring the health of children in disasters include the following:

1. National, state, tribal, local, and regional disaster planning must address the unique physical, mental, behavioral, developmental, communication, therapeutic, and social needs of all children.
2. Pediatricians should participate in disaster planning, response, and recovery efforts as subject matter experts, agents of public health surveillance, health care providers, and representatives of practices or institutions.
3. Inpatient, outpatient, and emergency services facilities should develop operational preparedness and resiliency planning, both individually and collaboratively, to continue providing care for children during and after disasters.
4. Pediatricians should work collaboratively with local hospitals, public health agencies, emergency management teams, volunteer emergency responders, educators and school personnel, childcare programs, foster care agencies and the juvenile justice system, medical societies, and behavioral health providers, as well as nongovernmental organizations and other agencies that serve children, to effectively meet children's needs in the context of disaster.
5. Equipment, medications, and supplies for children should be available to meet children's needs during a disaster in parity with similar adult needs. Where parity does not exist, research, development, and procurement must be undertaken in a timely manner.
6. Federal, state, academic, and private institutions should conduct more research on identifying gaps in knowledge of treatment of children in disasters and identifying best practices in addressing these deficiencies. Federal grants and funding support for such research need to increase accordingly. The federal government is encouraged to continue developing the infrastructure to facilitate ethical and timely research and data collection in a disaster environment.
7. Disaster exercises and drills need to include children as both victims and responders as appropriate to their age, development, and capability.
8. Mass casualty triage (and related educational efforts) should effectively address children's unique physiology and development.
9. Pediatricians are encouraged to educate children and families in emergency and disaster preparedness and to promote resiliency at individual, family, and community levels.
10. Pediatricians are encouraged to pursue ongoing postgraduate education on disaster issues. Pediatric trainees, nonpediatric health professionals, and first responders should be educated on children's physical and mental health needs in a disaster.
11. Pediatricians are encouraged to sign up for or engage with existing public health disaster response systems, such as Health Alert Network communications, CDC Clinician Outreach and Communication Activity announcements, Emergency System for Advance Registration of Volunteer Health Professionals (ESAR-VHP) registries, MRC teams, SMATs, and DMATs.
12. Pediatricians are encouraged to recognize and attend to their own needs in disasters and take steps to avoid burnout and compassion fatigue. The AAP, AAP chapters, medical societies, and state and federal government should also help pediatricians and pediatric practices survive and be resilient."

Additional recommendations from WHO focus on child-injury prevention to prevent morbidity and mortality in the settings of disasters. These include combined initiatives through education, legislation, law enforcement, and environmental improvements.[5]

Recent Advancements

Since Hurricane Katrina, the Joint Commission has looked at disaster preparedness, but with specific requirements for the pediatric population, including creation of the National Commission on Children and Disasters.[3,9] These include topics regarding disaster management and recovery, mental health, child physical health and trauma, emergency medical services and pediatric transport, disaster case management, childcare and early education, elementary and secondary education, child welfare and juvenile justice, sheltering standards, services, and supplies, housing, and evacuation and reunification.[9]

Many national associations, including the AAP and Ready Kids have distributed pediatric-specific policies, procedures, and guidelines that are widely available and free to access. Finally with feedback received by the Emergency Medical Services for Children Innovation and Improvement Center (EIIC), we are now assessing every state's operational capacity to provide pediatric emergency care. With more of these systemic changes and increase in public awareness regarding pediatric disaster relief, there has been creation of a National Trauma Data Bank that has helped evaluate varying outcomes for pediatric trauma patients along with American College of Surgeons (ACS) initiation of pediatric Trauma Quality Improvement Projects[3] as well as a National Report Card[9] by the National Commission on Children and Disasters. HRSA recently funded the Pediatric Pandemic Network which will further advance the "network of networks" needed to improve pediatric disaster care nationwide.

These systems in place have continued to improve with recent disaster response with the 2020 U.S. Wildfires, 2021 Texas Winter Storm Crisis, COVID-19 Pandemic, and now with the Ukraine Crisis. With these responses, we see a need for increased adaptability to our current response system as each crisis provides in part some novel aspect to caring for the pediatric population.

Future Frontiers

As natural and man-made disasters become more and more prevalent,[5] as we see in the Eastern Kentucky Foods and Ukraine Crisis, it is imperative to continue to establish and expand appropriate disaster preparation within our communities. We are expected to see the number of children affected triple in the future due to factors such as climate change.[5] In addition, the U.S. has seen an increase of child firearm deaths over the last two decades – an 81% increase from 2013 to 2020 (3.1 to 5.6 firearm deaths per 100,000 children)[113] with at least 362 children and teens killed in mass shootings from 2009 to 2020.[11] With this drastic increase in numbers, it is even more important to address the gaps within pediatric disaster care. Currently, it is estimated that 17.4 million children lack access to a pediatric trauma center within an hour of their event. Thus, it is crucial that all adult trauma centers have child are equipped to stabilize and initially manage pediatric trauma care. It is suggested that all level III trauma centers be

able to care for children during disasters. From our 2015 National Report Card,[7] the focus of recommendations for national changes are: supporting The National Child Traumatic Stress Initiative and the Department of Education's school emergency management and School Emergency Response to Violence (Project SERV) state grant initiatives to provide trauma treatment; engaging child care professions and /or school officials by the Department of Homeland Security for State Homeland Security Grants and Urban Areas Security Initiative grants; requiring hospitals receiving state and national funding to have pediatric emergency readiness in their emergency disaster plans; requiring states, counties, and cities to plan provisions for socially vulnerable populations in low resource settings; and finally creating a national task force to ensure implementation of the Joint Commission's recommendations.

In terms of future research, many systems have been established, but more education and training still need to be implemented for continued quality improvement. Increasing the database for child injury prevention and pediatric disaster preparedness can help improve research outcomes regarding pediatric disaster response. On a larger scale, these research efforts can contribute to increased awareness, multilevel systemic implementation, and local, regional, state, and national funding for pediatric disaster preparedness.

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