

# Prehospital Preparedness for Pediatric Mass-Casualty Events

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## ABSTRACT

**OBJECTIVES.** Recent events have reiterated the need for well-coordinated planning for mass-casualty events, including those that involve children. The objective of this study was to document the preparedness of prehospital emergency medical services agencies in the United States for the care of children who are involved in mass-casualty events.

**METHODS.** A national list of all licensed prehospital emergency medical services agencies was prepared through contact with each state's emergency medical services office. A survey was mailed to 3748 emergency medical services agencies that were selected randomly from the national list in November 2004; a second survey was mailed to nonresponders in March 2005. Descriptive statistics were used to describe study variables.

**RESULTS.** Most (72.9%) agencies reported having a written plan for response to a mass-casualty event, but only 248 (13.3%) reported having pediatric-specific mass-casualty event plans. Most (69%) services reported that they did not have a specific plan for response to a mass-casualty event at a school. Most (62.1%) agencies reported that their mass-casualty event plan does not include provisions for people with special health care needs. Only 19.2% of the services reported using a pediatric-specific triage protocol for mass-casualty events, and 12.3% reported having a pediatrician involved in their medical control. Although most (69.3%) agencies reported participation in a local or regional disaster drill in the past year, fewer than half of those that participated in drills (49.0%) included pediatric victims.

**CONCLUSIONS.** Although children are among the most vulnerable in the event of disaster, there are substantial deficiencies in the preparedness plans of prehospital emergency medical services agencies in the United States for the care of children in a mass-casualty event.

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### Key Words

disasters, emergency aid, terrorism

### Abbreviations

MCE—mass-casualty event

EMS—emergency medical services

START—simple triage and rapid treatment

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MANY RECENT MASS-CASUALTY events (MCEs) that involved multiple pediatric victims demonstrated the need for pediatric disaster preparedness. The Oklahoma City bombing in 1995 included several child victims because a child care center was located in the Murrah Federal Building.<sup>1-3</sup> A number of school shootings, including those at Columbine High School in Colorado and at Westside Middle School in Arkansas, caused multiple casualties.<sup>4-7</sup> The occupation of the school at Beslan, Russia, resulted in the death of >300 children.<sup>5,8,9</sup> Although the events of September 11, 2001, resulted in few pediatric deaths, the pediatric psychosocial and long-term health effects are likely significant and are still being measured.<sup>10-16</sup> Most recently, Hurricane Katrina had a very dramatic impact on children's health.<sup>17-19</sup>

The capability of the prehospital care system to care adequately for seriously ill or injured children has been questioned.<sup>20-25</sup> Children who are younger than 5 years receive fewer prehospital interventions than older patients.<sup>23</sup> Pediatric emergencies occur less commonly than those for adults; therefore, skills retention is an important issue for paramedics. Studies have demonstrated deficiencies in the equipment that ambulances carry to care for children.<sup>21,25</sup>

Prehospital care system personnel will likely be the first to provide health care at the scene of an MCE. Little is known about the capacity of the prehospital care system to care for multiple pediatric victims at the scene of an MCE. The purpose of this study was to document the preparedness of prehospital emergency medical services (EMS) systems in the United States for the care of children at an MCE.

## METHODS

An address list of all licensed prehospital EMS (ambulance) providers in each state was obtained in October and November 2004 via contact with each state EMS licensing office or agency. Compilation of each state list demonstrated that there were ~14 000 EMS systems in the United States. Services that were identified as transfer-only services, air ambulance services, or services that do not respond to 911 calls were excluded, although this could not always be determined from the list obtained from the state agency. A sample accounting for 25% of the agencies in each state was randomly selected (using a random-number generator) to compile a list of 3748 ambulance services to be surveyed.

A pilot survey that focused on prehospital EMS system preparedness for the care of children in an MCE was developed and sent to a random sample of services in Arkansas. The national survey was revised on the basis of the pilot survey. The revised survey was mailed to the national sample of 3748 randomly selected ambulance services in November 2004. Responders were identified by the return address label placed on the return envelope, but the survey instrument was anonymous. A sec-

TABLE 1 Which of the Following Best Describes Your EMS Agency?

Agency Description	n (%)
We are a private company.	197 (10.9)
We are operated by a local or county government.	858 (47.5)
We are a nonprofit organization not affiliated with a government agency.	355 (19.6)
We are a volunteer-only service.	463 (25.6)
We have both volunteer and paid staff.	498 (27.5)
We have only paid staff.	425 (23.5)
Our service is a part of a volunteer fire department.	342 (18.9)
Our service is a part of a fire department with a paid staff.	361 (20.0)
We provide only paramedic-level services.	276 (15.2)
We provide only intermediate-level services.	107 (5.9)
We provide only basic-level services.	493 (27.3)
We provide a combination of paramedic, intermediate, and basic services.	903 (50.2)

Agencies were asked to mark all that apply.

ond mailing was sent to nonresponders in March 2005. The cover letter with the survey assured the ambulance service manager that individual answers would be kept confidential and only aggregate results would be reported. The study protocol was reviewed and approved as exempt by the institutional review board of the University of Arkansas for Medical Sciences.

Survey responses were entered into an Excel (Microsoft, Redmond, WA) spreadsheet and analyzed by using descriptive statistics. Responses from partially completed surveys were included in the analysis.

## RESULTS

A total of 1932 surveys were returned (51.5% response rate). Forty-two services reported that they do not respond to 911 emergency calls, 8 services responded that they were no longer in business, and 74 surveys were returned by the postal service as undeliverable. These surveys were excluded, leaving 1808 services in the analysis. Tabular data that do not add to 1808 reflect partially completed surveys. Table 1 describes the characteristics of the responding agencies. Table 2 describes the responding agencies' annual run volume, and Table 3 describes the population of the headquarters city of the responding ambulance services.

TABLE 2 How Many Emergency Runs Are Made by Your Service Each Year?

No. of Annual Runs	No. of Services
1-50	94
51-250	333
251-500	264
501-1000	256
1001-2500	333
2501-5000	235
5001-10 000	140
>10 000	145

**TABLE 3** What Is the Population of the Headquarters City for Your Service?

Population, Headquarters City	Services
1–300	69
301–1000	212
1001–10 000	704
10 001–50 000	520
50 001–100 000	137
100 001–500 000	107
>500 000	51

### MCE Plans

A total of 1318 (72.9%) services reported that their agency has a written plan for response to an MCE; 489 (27.1%) services reported that they do not have a written plan for MCE response. Of those that have a written MCE plan, 248 services (18.8% of those with a written plan) reported that their written MCE plan included any specific provisions for the care of children.

### Coordination With Local Schools and Child Care Centers

A total of 576 (31.8%) services reported that their MCE plan included specific provisions for response to an MCE at a school. Table 4 reflects responses regarding whether EMS personnel knew whether the school districts in their service area have an evacuation plan in the event of a terrorism incident. Table 5 summarizes the response to the survey question on whether EMS personnel had met with local school officials in the past year to discuss emergency plans. When asked whether their service has a written disaster response agreement or plan with any local school districts, 455 (25.7%) services reported that they had such agreements and 1313 (74.3%) services reported that they did not. Table 6 summarizes the survey question regarding whether the service has copies of floor plans of the schools in their service area. Table 7 documents responses to the survey question regarding whether EMS officials had met with local child care center officials to discuss emergency plans.

### Pediatric-Specific Planning

Only a minority of services (341 [19.2%]) reported that they plan to use a pediatric-specific triage protocol in an

**TABLE 4** Do You Know Whether the School Districts in Your Service Area Have an Evacuation Plan That Would Be Used in the Event of a Terrorism Incident?

Knowledge of Evacuation Plan	n (%)
Yes, all of the districts have an evacuation plan, and we have copies of all of them.	479 (26.9)
Yes, some districts have evacuation plans, and we have copies of them.	84 (4.7)
Yes, all or some districts have evacuation plans, but we do not know the details.	764 (42.9)
To the best of our knowledge, school districts in our area do not have specific evacuation plans.	149 (8.4)
We do not know whether they do.	303 (17.0)

**TABLE 5** Has Anyone From Your Agency Met With Any School Official in Your Service Area in the Past Year to Discuss Emergency Preparedness Plans?

Met With School Officials	n (%)
Yes, we have regularly scheduled meetings with area school officials.	303 (16.9)
Yes, we have met once or twice.	583 (32.5)
No, we have not met with school officials.	908 (50.6)

**TABLE 6** Does Your Agency Have Copies of the Floor Plans of the Schools in Your Service Area?

Copies of Floor Plans	n (%)
We have floor plans for all of the public schools in our service area.	663 (37.4)
We have floor plans for some of the public schools in our service area.	203 (11.5)
No.	906 (51.1)

**TABLE 7** Has Anyone From Your Agency Met With Any Child Care Center Official in Your Service Area in the Past Year to Discuss Emergency Preparedness Plans?

Met With Child Care Centers	n (%)
Yes, we have regularly scheduled meetings.	89 (5.1)
Yes, we have met once or twice.	270 (15.3)
No, we have not met with child care center officials.	1402 (80.0)

MCE. Few agencies (219 [12.3%]) reported that they have a pediatrician who works with the agency in medical control. When asked whether the local disaster response plan included provisions for reunification of children with their parents or guardians, 465 (26.5%) services answered yes, 654 (37.2%) services answered no, and 638 (36.3%) services reported that they did not know. When asked whether their written MCE plan included any provisions for the care of people with special health care needs (eg, those in wheelchairs, on ventilators, or with mobility problems), 1045 (62.1%) services reported that they did not have plans for people with special health care needs.

### Disaster Drills

Most services (1242 [69.3%]) reported that they had participated in a local or regional disaster drill in the past year. Of those that had participated in a disaster drill, only approximately half (603 agencies; 49.0% of those who had participated in a drill) reported that the drill included pediatric victims, whereas 628 services (51% of those who had participated in a drill) reported that their drill in the past year included only adult victims.

### DISCUSSION

Children are among the most vulnerable in the population in the event of disaster.<sup>26–31</sup> They may not have the cognitive or physical ability to protect themselves or move away from a threat during disaster. In addition, they have increased risk for adverse effects of transder-

mal chemical exposure because of increased permeability of the skin and a larger surface-to-mass ratio. Children are at increased risk for inhaled toxicity with an airborne agent as a result of increased respiratory rate. They live closer to the ground and would therefore be at greater risk with any airborne agent that would settle close to the ground.<sup>32</sup> Infants are vulnerable to heat loss, particularly when decontamination is necessary. There is also evidence that children may have a greater psychological vulnerability in the event of disaster.<sup>3,10-13,33</sup> Finally, concern has been expressed that the health care system may not be prepared for a mass influx of child victims.<sup>34</sup> Both resources within community hospitals and the pediatric tertiary care referral network could be seriously strained or overwhelmed in any MCE with many child victims.

Well-coordinated, multiagency, community-based planning has been shown to be important in an effective response to a disaster or an MCE.<sup>35-39</sup> Ambulance service personnel are most likely to provide on-scene care to MCE victims. Because of their important first-responder role at the scene of a disaster, knowledge of the current state of preparedness of prehospital care providers is important in improving disaster planning and care.

In this survey, most agencies reported that they have a written plan for response to an MCE; however, very few reported that their plans included specific provisions for the care of children. Such plans might include provision of adequate pediatric equipment and supplies, consideration of the special decontamination needs of infants and children (particularly warmth), the use of a pediatric-specific mass-casualty triage protocol, regionalization of transport to distribute the load of pediatric patients to facilities that can accommodate them, consideration of parental reunification plans, and consideration of the mental health needs of both the child victims and the care providers.

Because schools and child care centers are places of mass gathering, they are of particular importance when considering pediatric disaster planning. For example, after the Columbine school shooting, the governor of Colorado appointed a study commission that concluded in its final report that the emergency response agencies had not considered a school-based scenario before the shooting.<sup>39</sup> This study focused on several aspects of multiagency prehospital EMS and school planning. Only a minority of services reported that their MCE response plan included provisions for response at a school. In this study, a minority of the services reported that they had copies of some or all of the evacuation plans for schools in their service area. More than half of the services reported that they had never met with school officials to discuss emergency planning, and very few reported having regularly scheduled meetings. Most services reported that they had never met with child care center officials to discuss emergency planning.

Most services reported that they did not have plans to use a pediatric-specific triage protocol at an MCE. Rapid triage and sorting of patients at the scene of an MCE is critical to optimize the care of those with a chance of recovery while not wasting time and resources on those who do not have a reasonable chance of recovery. Several disaster scene triage protocols have been developed, but most are designed for use with adult patients, including the simple triage and rapid treatment (START) protocol, the secondary assessment of victim end point (SAVE) protocol, the British sieve protocol, the Australian CareFlight triage system, and the Sacco triage method.<sup>40-43</sup> It is interesting that the START protocol was developed by the Newport Beach Fire and Marine Department and Hoag Hospital in Newport Beach, California, in 1983 on the basis of their experience at a school bus crash with multiple casualties. However, because this protocol uses the ability to follow simple commands as one of the major decision points, it may be inappropriate for young victims.<sup>44</sup> Because of the physiologic differences between adult and pediatric patients, adult MCE triage protocols may not be appropriate for use with infants and children. Triage protocols that are specific to pediatric patients have been suggested. A pediatric MCE triage protocol called JumpSTART, based on the original START method, was suggested by Romig.<sup>45</sup> This method focuses on pediatric-specific parameters, including early airway intervention because respiratory failure often precedes circulatory failure in infants and children. The American Academy of Pediatrics developed the Pediatric Assessment Triangle in 2000 as a rapid assessment tool for prehospital use. Although it was not necessarily designed as an MCE triage instrument, use of the Pediatric Assessment Triangle has been suggested as a disaster triage tool.<sup>46</sup> A Pediatric Triage Tape protocol has been suggested as a revision of the Triage Sieve.<sup>47</sup> In this survey, most EMS administrators reported that they do not have plans to use a pediatric-specific disaster triage protocol. Inappropriate triage, specifically overtriage, was found to be associated with increased mortality in a review of 10 terrorist bombing incidents.<sup>48</sup> Because of the substantial physiologic differences between adults and children, this is an important deficiency in preparedness because children may be misclassified in an adult triage protocol.

A lack of pediatric-specific preparedness was found in other measures in the survey. Few services have a pediatrician involved in their medical control. In a recent policy statement, the American Academy of Pediatrics recommends that pediatricians be involved in community-level disaster planning.<sup>28</sup> Most services reported that they did not have specific plans for the care of people with special health care needs. These people are among the most vulnerable in a disaster situation. Because of the more limited availability of pediatric resources in any given area to care for children with spe-

cial health care needs, the need for transfer capability of children with special needs out of a disaster area was demonstrated during Hurricane Katrina. The need to perform interstate, large-scale transfer of children with special health care needs was demonstrated to be necessary in the aftermath of Hurricane Katrina.<sup>18</sup> Reunification of children with their families is an important task in the aftermath of a disaster. Local emergency management, hospitals, or social service agencies would more likely be involved in the task of parental reunification than ambulance services, but all emergency responding agencies would have need to know the plans for care of unaccompanied children until parental reunification. The survey asked whether the EMS agency administrator was aware of whether there were local reunification plans, and almost half reported that they were not aware of whether reunification was a part of the local disaster plan.

Disaster response drills are frequently used as a means to practice MCE skills and to identify and address preparedness deficiencies. For example, disaster drills have been shown to have effectiveness in preparing hospital staff for an MCE.<sup>49,50</sup> Although most services in this survey reported that they had participated in a community disaster drill in the past year, fewer than half of those who had participated included any pediatric victims.

This study was limited by factors that are associated with survey research. Although the sample was chosen randomly, the sampled population might not represent the situation present in all areas. Choosing agencies randomly from each state list helped to ensure that all states and regions were represented in the survey sample given the large variability in the number of agencies in each state. The response rate to the survey is only moderate, and there is no information on services that did not respond to the survey. Agencies that are better prepared could be more likely to respond to such a survey; therefore, this study may overestimate the preparedness of the EMS agencies. The survey was not formally validated, but a pilot survey was performed and the survey instrument was revised on the basis of the pilot.

Community disaster plans should include consideration of the needs of children, including the plans of prehospital EMS agencies. EMS licensing agencies should consider regulations to require ambulance services to prepare formal written disaster plans, including pediatric disaster planning. Community-wide, well-coordinated planning has been shown to be important in disaster response.<sup>35–39</sup> Schools and child care centers require particular attention in such planning because of the large number of congregated children in those settings. More EMS agencies should consider the use of a pediatric-specific triage protocol, and more research should be done to validate such protocols. Community and regional disaster drills should routinely include pe-

diatric victims so that responding emergency agencies can practice pediatric-specific skills and important deficiencies are identified and addressed.

## CONCLUSIONS

This national survey demonstrates important deficiencies in the preparedness plans of prehospital EMS agencies for the care of infants and children in an MCE or disaster event. Children are among the most vulnerable in a disaster situation; planning for their care should be a major priority of the emergency care system.

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