

Impact of an Educational Intervention on Residents' Knowledge of Pediatric Disaster Medicine

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Background: Globally, natural and created events have underscored the vulnerability of children in disasters. There is an unmet need for a standardized pediatric disaster medicine (PDM) curriculum.

Objective: To create and implement a PDM course, measure course efficacy, and assess residents' attitudes toward and experience in disaster medicine.

Design/Methods: An educational intervention was conducted for pediatric and emergency medicine residents at a tertiary care teaching hospital. Participants completed a precourse survey of PDM attitudes and experience. Paired *t* tests were used to compare pretest, immediate posttest, and delayed posttest scores. Test performance was assessed by resident type and postgraduate year. A postcourse survey gauged reaction to the course and interest in further PDM training.

Results: Among the participants, 11 residents (9.4%) had treated disaster victims, and 5 (4.3%) had formal disaster medicine education. Most (83%) felt PDM is an important part of their training. Seventy-five eligible residents (64.6%) completed the intervention. Pairwise comparison of scores showed a mean improvement in scores of 24.5% immediately after taking the course (95% confidence interval, 22.9%–30.1%; $P < 0.001$). Two months later, residents scored a mean of 69.0% for the delayed posttest, with a retained improvement in scores (18.3%; 95% confidence interval, 14.3%–22.3%; $P < 0.001$). Residents preferred future PDM exercises to additional didactic training (72.0% vs. 32.7%; $P < 0.001$ %).

Conclusions: Residents who complete this curriculum increase their knowledge of PDM with moderate retention of information. Most residents lack PDM training, believe it is important, and request disaster-training exercises.

Key Words: disasters, educational intervention, residency education/training, triage

(*Pediatr Emer Care* 2009;25: 447–451)

BACKGROUND

Pediatricians and other health care professionals have long recognized the special needs of children in disasters.^{1,2} When medical resources are overwhelmed, pediatric disaster victims are particularly vulnerable. In the aftermath of Hurricane Katrina alone, there were nearly 5000 reports of children who were missing or displaced.³ In the United States and internationally, created and natural events of the last decade have underscored the need for disaster preparation, response, and recovery.

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Conflicts of interest: There are no relevant conflicts to disclose.
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ISSN: 0749-5161

Disaster medicine is not a traditional component of residency training, but there is a growing call for standardized, validated curricula in disaster medicine.^{4–6} Ideally, pediatric disaster medicine (PDM) coursework should include didactic and experiential learning.^{5,7,8} In addition, the Accreditation Council for Graduate Medical Education (ACGME) has mandated that disaster training must be a component of all pediatrics and emergency medicine (EM) residency programs.^{9,10}

The most widely used disaster-training program, offered by the National Disaster Life Support Foundation (Augusta, Ga) and comprising basic and advanced disaster life supports, is not pediatrics specific. The pediatric disaster life support (PDLIS) curriculum developed by the University of Massachusetts together with emergency medical services for children has not been widely adopted by residency training programs. Residency programs face the educational challenge of delivering meaningful PDM training within the time constraints of a busy training schedule; practitioners also seek easily accessible PDM training via self-study programs or single-day conferences.^{5,11}

The 5 components of PDM training are preparedness, triage, treatment, mental health needs of victims, and implementation of local training programs. Child-appropriate resuscitation equipment, family-based disaster plans, and planning for surge capacity are components of disaster preparedness.^{4,12–14} A child-specific triage system allows rapid sorting of child disaster victims. Dr. Lou Romig developed the JumpSTART triage algorithm. JumpSTART has emerged as the prominent PDM triage tool.^{5,11,15–20} When treating children, clinicians may face a wide range of disease processes in disasters, including chemical, biological, radiological, and nuclear agents, and conventional trauma, burns, and dehydration.^{21–25} Pediatric mental health needs in disasters vary by demographics, history, and personal loss. Victims may manifest anger, depression, and posttraumatic stress disorder.^{26–28}

Our primary goal was to create a half-day PDM curriculum to meet the learning needs of residents and practitioners who will potentially care for children in disasters. Additional goals included measuring the efficacy of this course in conveying knowledge of PDM, measuring learners' lasting retention of knowledge gained, and assessing residents' attitudes toward and previous experience in PDM.

METHODS

Course Design

A 2-hour PDM course entitled “Small Victims, Big Challenges: Pediatric Triage, Treatment, and Recovery in Disasters” covering preparedness, triage, treatment, mental health, and training was created. The course was a joint project of the Yale New Haven Center for Emergency Preparedness and Disaster Response and the Area Health Education Center of Southern Nevada; one of the authors of this manuscript served as the primary author of the course. Final course content was edited and approved by a panel of regional subject matter experts

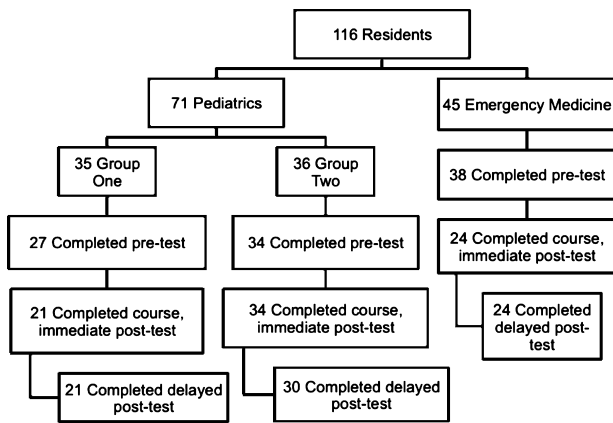


FIGURE 1. Residents completing disaster course and tests.

appointed by Yale New Haven Center for Emergency Preparedness and Disaster Response.

Study Setting and Participants

An educational intervention was conducted at a large, university-based teaching hospital. The course was a scheduled component of the pediatrics and EM residency curricula. Internal medicine–pediatrics and pediatrics–psychiatry residents were included with categorical pediatrics residents in the pediatrics cohort. Course dates for pediatrics residents were in October and December 2006. Emergency medicine residents completed the course in February 2007. Residents rotating on all inpatient and outpatient rotations were included. Residents were excused from clinical responsibilities during the course; the course was conducted in the evening. The course author served as the presenter and facilitator for all course dates. The study was reviewed by the human investigations committee and, because the study is an educational intervention, exempted from review.

Study Methods

Pediatrics residents were randomized to either the October or December dates for the course and testing. The randomization was intended to accomplish 2 goals: accounting for postgraduate year (PGY) and controlling for ambient learning that may have contributed to improved delayed postcourse test scores. Ambient learning is the knowledge and skills gained experientially, outside a formal educational environment. For example, a local or national disaster in the interval between PDM course dates might contribute to ambient learning. Participation in randomized course dates was an expected part of the residency curriculum. Randomization was performed via even-odd group assignment from an alphabetical list of resident names. The EM residents were offered the course on a single date owing to residency scheduling constraints.

Incentives for course participation included a catered meal; residents who completed all components of the study received a \$15 gift certificate to Amazon.com and were entered in a raffle for an iPod nano (Apple, Cupertino, Calif).

Evaluation Tools/Primary Outcomes

To measure residents’ knowledge of PDM, a pretest was administered 2 weeks before each participant’s course date; the pretest was given individually in proctored paper-and-pencil format at convenient clinical settings. The examination included 14 multiple-choice questions and was validated by an education evaluation specialist (E.B.), who mapped the question contents back to the course. The validation ensured proportional representation of course content in the examination. The same examination items were used, unaltered, for the immediate posttest and delayed posttest. The immediate posttest was given via paper-and-pencil format the same day as the course was undertaken. The delayed posttest was administered via a web-based survey tool (surveymonkey.com) 2 months after the participant’s course date.

Surveys of PDM Experience and Attitudes

Two surveys were included in the study. The first survey was administered with the pretest. This precourse survey assessed previous disaster training and experience and attitudes about the importance of PDM education. On a 5-point Likert scale, residents were asked to rate the importance of PDM training to them as learners. The scale was anchored with 1 as unimportant and 5 as very important. Because disaster education is integral to military medical practice, military service was also recorded. The postcourse survey was given with the delayed posttest; participants critiqued the course, provided suggestions for future PDM education, and rated their comfort performing JumpSTART triage and providing care during disasters. Residents could provide an unlimited number of suggestions for further PDM training.

Statistical Analysis

The paired *t* test was used to assess differences in pretest, immediate posttest, and delayed posttest scores for each participant. Only participants who completed the pretest and both posttests were included in data analysis. Differences in scores were assessed by specialty and PGY via the 1-way analysis of variance (ANOVA). The χ^2 test was used to compare proportions of participants completing the study. Statistical analysis was performed using SPSS version 11 (Chicago, Ill).

RESULTS

Study Population

The study commenced with 116 eligible residents, of which 75 (64.7%) completed the course, the pretest and the

TABLE 1. Number of Residents Completing All Components of the Study

PGY	EM (%)	Medicine-Pediatrics (%)	Categorical Pediatrics (%)	Psychiatry-Pediatrics (%)
1	6 (55)	0 (0)	15 (83)	1 (50)
2	5 (50)	3 (75)	14 (78)	—
3	6 (60)	3 (75)	12 (67)	—
4	7 (70)	3 (75)	—	—
Total	24 (51)	9 (56)	41 (76)	1 (50)

2 posttests (Fig. 1). The eligible pediatrics group comprised 54 categorical residents, 15 internal medicine–pediatrics, and 2 pediatrics–psychiatry residents. Table 1 shows the participants who completed the course and all evaluations, by discipline and PGY. The χ^2 test showed a similar proportion of residents from each PGY who completed the study, with 22 (62.9%) of 35 of first years, 21(65.6%) of 32 of second years, 19 (57.5%) of 33 of third years, and 9 (56.3%) of 16 of fourth years ($P = 0.95$). Among the pediatrics group, significantly fewer participants who were randomized to the October group (21/35, 60%) completed the course than those randomized to the December group (30/36, 83.3%), with $P = 0.28$.

Precourse Survey

The precourse survey, administered in September 2006, had 103 respondents (88.8%). Of the 5 residents (4.9%) with prior disaster medicine training, all 5 were EM residents. The highest level of training achieved was advanced disaster life support instructor for 2 and basic disaster life support certification for the other 3 respondents. Of note, among the same 5 EM residents, 1 had paramedic-level disaster training, 1 had federal emergency management agency online training, and 1 had navy disaster training. Figure 2 shows the disasters in which residents had rendered medical care. Most respondents (93.2%) received their medical training in the United States. The proportion of respondents rating PDM training as important was 65%, and 18.4% rated PDM training as very important.

Pretest Scores

Pediatrics residents had a mean score of 49.7% (n = 51; SD, 11.8%), and EM residents had a mean of 54.4% (n = 24; SD, 16.7%). The pooled mean of all pretest scores was 50.1%. There was no significant difference in pretest scores based on learners’ PGY ($P = 0.38$) or trainee type ($P = 0.41$).

Immediate Posttest Scores

Pediatrics residents had a mean score of 79.3% (n = 51; SD, 11.3%), and EM residents scored a mean of 74.8% (n = 24; SD, 11.2%). The pooled mean of immediate posttest scores was 77.6%. Again, the scores did not vary significantly by trainee type ($P = 0.62$) or PGY ($P = 0.687$).

Delayed Posttest Scores

Pediatrics residents had a mean score of 70.1% (n = 51; SD, 14.5%), and EM residents scored a mean of 66.7% (n = 24; SD, 14.8%). The pooled mean of delayed posttest scores was

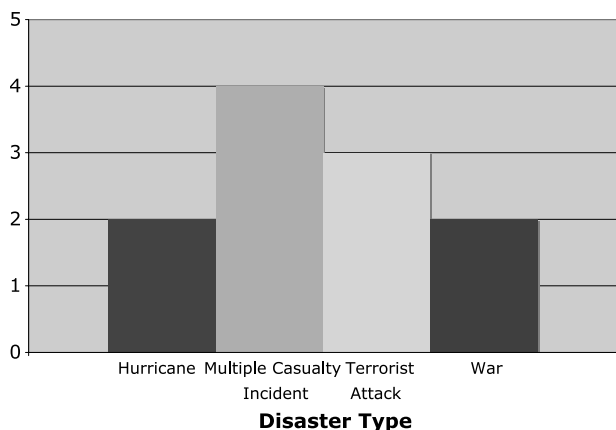


FIGURE 2. Residents with prior disaster medicine experience.

TABLE 2. Scores of 3 Evaluations by Resident Type

Resident Type	Pretest Score (%)	Immediate Posttest Score (%)	Delayed Posttest Score (%)
EM (n = 24)			
Mean	52.7	74.1	66.7
SD	16.7	10.9	14.9
Pediatrics (n = 51)			
Mean	49.7	79.4	70.1
SD	11.8	11.3	14.6
ANOVA	$P = 0.38$	$P = 0.062$	$P = 0.34$

69.0%. Trainee type ($P = 0.344$) and PGY ($P = 0.588$) did not influence delayed posttest scores. Tables 2 and 3 show the results of the ANOVA of scores by trainee type and PGY.

Pairwise t Test Comparison of Pretests to Immediate and Delayed Posttests

Pairwise comparison of scores shows a mean improvement in scores of 24.5% immediately after taking the course (95% confidence interval, 22.9%–30.1%; $P < 0.001$). Two months after taking the course, there was a retained, significant improvement in scores (18.3%; 95% confidence interval, 14.3%–22.3%; $P < 0.001$).

Randomization of Pediatrics Residents (October and December Groups)

Between the 2 pediatrics groups, no comparison could be made regarding ambient learning. No drills or actual disasters occurred in our community between the dates the course was offered, making conclusions about ambient learning is difficult. As noted previously, significantly fewer participants randomized to group 1 completed the study than those randomized to group 2.

Postcourse Survey

The postcourse survey had 82 respondents, of whom all had taken the course. Seven residents did not complete the delayed posttest, hence the discrepancy with the number completing the pretest and posttests. In the 2 months between course

TABLE 3. Scores of 3 Evaluations by Resident PGY

PGY	Pretest Score (%)	Immediate Posttest Score (%)	Delayed Posttest Score (%)
1 (n = 24)			
Mean	51.7	75.7	65.7
SD	15.4	13.6	14.6
2 (n = 22)			
Mean	48.1	78.9	71.7
SD	10.4	11.9	14.7
3 (n = 19)			
Mean	56.4	77.5	69.2
SD	18.1	9.5	16.9
4 (n = 10)			
Mean	50.7	80.2	70.7
SD	13.6	6.7	9.5
ANOVA	$P = 0.410$	$P = 0.687$	$P = 0.558$

completion and the survey, no respondents had cared for pediatric disaster victims.

Respondents were asked to rate their comfort performing PDM triage and treatment. Most respondents (63.4%) were comfortable performing triage, and 4 (4.9%) were very comfortable. Only 5 (6.1%) were uncomfortable with triage. In contrast, 37 respondents (45.1%) were comfortable treating pediatric disaster victims, with 31 (37.8%) being neither comfortable nor uncomfortable and the remainder either uncomfortable or very uncomfortable performing this task.

Further training in PDM was rated desirable (64.6%) or very desirable (15.9%) by the survey respondents. Fifty-nine (72.0%) requested further training with disaster drills tailored to the residents' specific health care venue, such as the emergency department. Two options, full-scale exercises involving the entire health care system and further didactic training, were requested by the same proportion of respondents, 27 (32.9%) each. Only 21 (25.6%) would choose to take the National Disaster Life Support Foundation curriculum to advance their PDM knowledge.

Respondents were asked to critique how well participating in this course improved their knowledge of PDM. A 10-point rating scale anchored at 1 (not at all) and 10 (vastly) was used. The mean score given to the course was 6.7, and the median score was 7.

DISCUSSION

In disasters, children have unique vulnerabilities when compared to adults. Due to greater surface area–mass ratio, still-developing cognitive skills, and limited mobility, children are more likely to experience dehydration, infection, and trauma. Training in PDM is often overlooked in residency training, despite the potential dangers to children from natural and created events. Our study revealed that few residents had prior disaster training or experience and those who did tended to be EM residents. A lasting, moderate improvement in residents' knowledge can be accomplished using our novel, didactic PDM curriculum. Acquisition and retention of knowledge were not significantly influenced by PGY or residency training program type.

Recently published work by Schobitz et al²⁹ describes a course that addresses some important facets of PDM, including bioterrorism and chemical terrorism. The primary objective of the previous study of Schobitz et al was to assess residents' baseline fund of knowledge, whereas this current work focuses on developing a succinct yet comprehensive PDM course. Other strengths of the work presented here include (1) greater numbers of resident participants, (2) the ability to convey practical, awareness-level PDM knowledge in less than a half day with few instructors, and (3) a scope that includes often overlooked components of PDM, such as mental health issues and children with special health care needs.

This study adds to the literature in another significant way. The survey of resident experiences and attitudes in PDM revealed that residents prefer experiential learning, such as drills and other operations-based exercises, to further classroom learning in PDM. Although drills consume more time and other resources than didactic teaching, adult learning theory⁶ and the results of the posttest survey suggests standardized, experiential education such as exercises should be used to augment and reinforce courses such as ours. Further work should focus on reproducible, standardized PDM exercises.

The precourse and postcourse surveys suggest that residents feel PDM is an important topic about which they would like to learn more. Few residents had previous disaster training,

despite the ACGME requirement for PDM inclusion in residency curricula. The course, "Small Victims, Big Challenges: Pediatric Triage, Treatment, and Recovery in Disasters," is a good option to begin to fulfill this requirement. At this time, one may not draw conclusions regarding the relative efficacy of our course to PDLs or any other course. However, the addition of standardized drills, such as those provided in PDLs, may enhance residents' knowledge in this crucial area.

This study has several significant limitations. One instructor taught all sessions, which may limit the generalizability of the study. Of note, this course, entitled "Small Victims, Big Challenges: Pediatric Triage, Treatment, and Recovery in Disasters" was recorded by a public television station in Las Vegas, Nev. The video course was narrated by the course author and is used in Nevada as a continuing medical education activity. A web-based version of the course is also available. Future instructors of this course will need strong teaching skills and working knowledge of PDM. Subjects were from one institution and included pediatrics, internal medicine–pediatrics, pediatrics–psychiatry and EM residents only. The generalizability of future versions of the course will be strengthened by the inclusion of other residents who will care for children in disasters, such as family practice physicians and psychiatrists, and subjects from multiple institutions. The delayed posttest occurred 2 months after the course; a longer delay in posttesting might have revealed greater attrition of knowledge. Finally, although most eligible residents completed all components of the study, 35.4% of residents did not participate in all components of the study.

Future work should focus on enhancing the efficacy of the course in conveying PDM knowledge and skills. In addition, the course should be provided to additional learners, from a variety of specialties, to further validate the generalizability of this course. A standardized curriculum with a train-the-trainers component and experiential education, such as health care venue-specific drills, will likely yield a product that fulfills the ACGME requirement for PDM training, empowers residents to respond to pediatric disasters, and is sensitive to the time pressures of modern residency training.

CONCLUSIONS

Residents who complete the PDM curriculum "Small Victims, Big Challenges: Pediatric Triage, Treatment, and Recovery in Disasters" increase their knowledge of PDM with moderate retention of information. Most residents have not had PDM training and believe it is important. Residents prefer the addition of drills and exercises to this curriculum rather than further didactic training. The current iteration of the course is an important step toward a reproducible PDM curriculum. Future versions will incorporate experiential learning and be offered to a wider range of pediatric care providers.

ACKNOWLEDGMENT

The authors would like to thank Linda Brown, MD, for her help in conceiving this study.

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