ORIGINAL RESEARCH

Are Tertiary Care Paediatricians Prepared for Disaster Situations?

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IC: intensive care
PPE: personal protective equipment

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Abstract

Introduction: Children, with their specific vulnerabilities and needs, make up to more than 20% of society, so they are at risk of getting involved in disasters. Are the specialists treating them for medical problems in daily life also capable to deal with them in disaster situations?

Hypothesis/Problem: The goals of this study were to evaluate perceived knowledge and capability of tertiary pediatricians to deal with disasters, to identify promoting factors, and to evaluate education need and willingness to work.

Methods: A survey looking for demographics, hospital disaster planning, estimated risk and capability for disasters, training, and willingness to work, and a set of six content assessment questions to evaluate knowledge, were presented to emergency pediatricians and pediatric emergency physicians in specialized tertiary centers.

Results: The response rate was 51%. Thirty-five percent had disaster training and 53% felt that disaster education should be obligatory in their curriculum. Risk for disasters was estimated from 2.4/10 for nuclear incidents to 7.6/10 for major trauma. Self-estimated capability for these situations ranged from 1.8/10 in nuclear incidents to 7.6/10 in major trauma. Unconditional willingness to work ranged from 37% in nuclear situations to 68% in pandemics. Mean score on the questions was 2.06/6. Training, knowledge of antidote and personal protective equipment (PPE) use, self-estimated capability, and exposure were significant predictors for higher scores. Willingness to work correlated significantly with age, self-estimated capability, and risk estimation. In case of chemical and nuclear incidents, there was correlation with knowledge on the use of decontamination, PPE, and radio-detection devices.

Conclusion: Despite a clear perception of the risks and a high willingness to work, preparedness is limited. The major conclusion is that basics of disaster management should be included in pediatric training.

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Introduction

Events in the last few years, like The Fukushima incident in Japan in 2011, terrorist attacks, and the Ebola outbreak, have raised awareness about the need for disaster preparedness. Classical emergency preparedness planning and training tends to focus on adult victims. Children, however, make up at least 20% of society, and in any disaster, potential victims include children, at least in proportion to their number in the population.[1-3] Moreover, in some recent examples of terrorist attacks, children were not only secondary victims but also primary targets.[4,5]

This pediatric population needs special attention. Age-related cognitive and physical limitations may hamper appropriate reactions to hazardous situations. Furthermore, anatomic and physiologic characteristics make children more susceptible to harmful effects of environmental, biological/chemical, and nuclear/radiological exposure.[6-8] The psychosocial impact of a disaster, both in the acute phase as well as on a longer term, demand particular attention and specialized counseling.[9-11]

Given this, the goal of this study was to evaluate the perceived disaster medical-related knowledge and self-estimated capability of tertiary pediatricians to deal with children

Type of Incident	Mean Self-estimated Risk for Incident to Occur with a Maximum of 10 (95% CI)	Mean Self-estimated Capability to Deal with Incident with a Maximum of 10 (95% CI)
Chemical Incident	3.87/10 (3.42-4.32)	3.19/10 (2.76-3.61)
Nuclear Incident	2.42/10 (1.93-2.91)	1.85/10 (1.46-2.23)
Biological Incident (eg, anthrax)	2.81/10 (2.36-3.26)	3.11/10 (2.65-3.56)
Major trauma mass casualty	7.62/10 (7.22-8.01)	7.56/10 (7.15-7.97)
Highly Contagious Infectious Outbreak with High Mortality	5.46/10 (4.94-5.98)	5.79/10 (5.30-6.27)
Natural Disaster	4.83/10 (4.31-5.35)	5.54/10 (5.10-5.99)

Table 1. Mean Scores on a Maximum of 10 and 95% Confidence Interval for Self-estimated Risk that Different Disaster Scenarios could Occur and Self-estimated Capability to Deal with these Scenarios

during disaster, and the perceived need of education on this matter. Furthermore, the willingness to perform in potential high-risk situations was measured.

Materials and Methods

To evaluate pediatric preparedness, an online survey based on a cross-sectional descriptive study was performed. The population was limited to pediatricians or pediatric emergency physicians from tertiary care centers recruited amongst members and worldwide contacts of the European Society of Emergency Medicine pediatric section (EUSEM-PEM) and/or selected participants to the first Pediatric Resuscitation and Emergency Medicine Congress (PREM 2013; Ghent, Belgium);[12] all of them were key role players in specialized pediatric emergency care all over the world. Those not active (full or part time) in emergency care were excluded.

An online survey (Survey Monkey; Palo Alto, California USA) was sent to the network with an email reminder to non-responders. Validated structural questionnaires covering this subject aren't readily available; therefore, a questionnaire based upon available literature, previous studies, and work in recent pilot projects[13-26] was used. The questionnaire was validated by several disaster management specialists.

This survey evaluated demographic data, data on perceived risk for and knowledge of disasters, and capability to act in different disaster situations. Furthermore, willingness to respond in certain situations and eventual factors convincing to respond were evaluated. Questions were multiple choice and scores were measured on a 0 to 10 visual analogue scale. Data were collected and processed in an anonymous way. Local ethical committee approval was obtained from ZiekenhuisNetwerk Antwerpen (Antwerp, Belgium). Data were evaluated statistically by the use of Stata SE 10.1 (StataCorp LP; College Station, Texas USA). The Pearson chi square test was used for comparison of proportions/percentages and the two-sample (two-sided) t-test for comparing means. For comparing medians, the Wilcoxon-Mann-Whitney test was used; for comparing normal numerical with normal numerical variables, the Pearson correlation coefficient was used and the Spearman correlation coefficient as the non-parametric version of this for not normal numerical variables. To provide an estimation on the margin of error for results, 95% confidence intervals (CI) are given. A P value smaller than.05 was considered to be significant.

Results

One hundred eighteen fully completed surveys were available for evaluation, being a response rate of 51%; 87% were from Europe, seven percent from Oceania, four percent from Asia, and two percent from America. Mean age of respondents was 43.9 years; 56% were male. Of these, 86% worked in a university hospital and 19% were active in prehospital care. Up to 46% worked in an exclusive pediatric hospital; 40% worked in a (minus) 350 beds hospital and 21% worked in a hospital of over 1,000 beds. Only 35% ever had some disaster management training, while 53% stated that basic disaster management training should be obligatory included in training of all pediatric residents. Only one percent evaluated such training as useless.

Hospital Disaster Planning

Importantly, 95% of the respondents reported that their hospitals would receive pediatric patients of incidents in the larger region (direct catchment area and referral zones), but only 44% of these hospitals had any specific emphasis on children in their hospital disaster plan. Only one-half of them had arrangements for family reunion, and the same amount offered child specific post-traumatic psychological relief.

Of all hospitals, 29% had a known risk for natural disasters in the catchment area, 25% had a chemical high-risk plant (Seveso-type) in their neighborhood, and 15% had a nuclear installation in the vicinity. Up to 64% of the hospitals could mobilize specialized pediatric personnel in case of a disaster. Extra pediatric beds were available in 58% of hospitals, extra pediatric intensive care (IC) beds in 54%, and specific pediatric IC supplies (eg, ventilators) in 46%. Facilities for medical isolation of pediatric patients were available in 75% of the hospitals and 43% had decontamination facilities. There was a 24/7 availability of advice from an infectious disease specialist in 69% of hospitals, a nuclear medicine specialist in 33% of the hospitals, and disaster medicine specialists in 34% of hospitals.

Personal Preparedness

The mean scores on self-estimated risk for occurrence, and self-estimated capability to deal with several hypothetic incidents, are presented in Table 1. From all participants, 14% stated they had been confronted with a chemical incident and three percent had ever dealt with a nuclear incident. Only 25% stated they knew how to use radio-detection material. Further, only 32% had

Antidotes	Mean Self-estimated Knowledge/Capability of Antidote Use with a Maximum of 10 (95% CI)
Atropin	6.38/10 (5.83-6.94)
Pralidoxim/Obidoxim	3.58/10 (2.97-4.18)
Hydroxycobolamin	3.70/10 (3.11-4.30)
Thiosulphate	2.45/10 (1.91-2.98)
Dicobalt Edetate	1.85/10 (1.41-2.29)
Nitrites	2.45/10 (1.91-2.98)
Methylene Blue	5.00/10 (4.37-5.63)
Prussian Blue	1.86/10 (1.42-2.31)
DTPA	1.98/10 (1.49-2.47)
Iodine Tablets	2.63/10 (2.10-3.15)

Table 2. Mean Scores on a Maximum of 10 and 95% Confidence Interval on the Self-estimated Knowledge and Capability on the use of Several Antidotes
Abbreviation: DTPA: diethylenetriaminepentaacetic acid.

Type of Incident	Percentage that Works Unconditionally	Percentage that Doesn't Come to Work	Percentage that Works Under Conditions
Flooding and Mass Evacuation	63%	3%	34%
Nuclear Incident	37%	10%	53%
Chemical Incident	51%	4%	45%
Highly Contagious Pandemic	68%	3%	29%
Highly Contagious Infection with High Morbidity/Mortality	61%	3%	36%

Table 3. Figures on the Willingness to Respond to Work in Several Hypothetical Disaster Situations

practical training in decontamination. The mean estimated knowledge on decontamination of all respondents was scored at 2.39/10. In addition, only 25% had had some practical training in use of personal protective equipment (PPE), and the mean score on estimated knowledge of PPE use in all participants was 1.8/10. The self-estimated capability on the use of several antidotes is presented in Table 2.

Finally, Table 3 shows the willingness to work in several hypothetical disaster scenarios. The unconditional response to work varied from 37% in nuclear incidents to 68% in highly contagious pandemics like swine flu. Conditions that convinced pediatricians to go to work were mainly sufficient personal protection (up to 92%), guaranteed security of own family (up to 83%), and specific training (up to 70%).

Content Assessment

The mean score on the set of six theoretical questions was 2.06/6 (minimum of zero, maximum of five) with the best score on the PPE use in a contagious pandemic. Knowledge on protective capacity of PPEs in general, however, had the weakest score. All answers are provided in Table 4.

Male sex; prior disaster management training; knowledge of antidote, PPE, and decontamination use; risk estimation; self-estimated capability; and prior exposure were significant ($P < .05$) positive predictors for higher scores on the theoretical questions. Willingness to work correlated significantly with age, self-estimated capability, and risk estimation. In the case of chemical and nuclear incidents, willingness to work correlated with knowledge about the use of decontamination, PPE, and radio-detection devices.

Discussion

Literature on this subject is scarce, especially in the pediatric field. Preparedness studies are very fragmented, studying limited populations in very specific situations, and mainly highlighting the absence of pediatric disaster preparedness.[5,27-29] Surge capacity in pediatric hospitals mainly is discussed in a theoretical way and mainly focused on IC settings.[19,30,31] Data on factors promoting willingness to work are more widely available, but always in a context of pandemic situations.[26,32,33] Once again, an evaluation of pediatricians/pediatric emergency medicine physicians as a separate group is not available.

Iodine Tablets Protect Against:	external radiation	13%
	internal radiation	29%
	both internal and external radiation	18%
	no radiation protection at all	13%
	don't know	27%
Standard PPE Protects You Against:	internal contamination	2%
	external contamination	58%
	both internal and external contamination	15%
	external contamination and radiation	8%
	don't know	17%
What to do with Life-threatening Injuries in Seriously Contaminated Patients:	decontaminate first, than ABC life support	62%
	first ABC life support than decontamination	28%
	no decontamination nor ABC life support	1%
	don't know	10%
Most Likely Symptoms after Anthrax Incident:	necrotic skin ulcers	8%
	dyspnoe, fever, cough and widened mediastinum on chest X-ray	51%
	nausea and diarrhea	5%
	lymph node swelling	3%
	don't know	33%
PPE to Use in Flu Pandemic:	surgical mask for patient	5%
	gown, gloves and surgical mask	12%
	gown, gloves & N95 respiratory mask	54%
	gown, gloves & air purifier respirator	4%
	gown, gloves and SCBA respirator	3%
	don't know	22%
First Step in Decontamination of a Patient from a Nuclear Incident:	washing	36%
	iodine tablets	7%
	wearing a lead apron	2%
	taking off shoes and clothes	30%
	antidote total body spray	25%
	don't know.	0%

Table 4. Distribution of Different Answers on the Six Content Assessment Questions. Correct answers are given in bold. Abbreviations: ABC, airway, breathing, circulation; SCBA, self-contained breathing apparatus.

Although every pediatrician can be confronted with pediatric disaster victims, most often this study population, working in referral centers, will be solicited in case of such a disaster. People and hospitals tend to plan for those risks that already happened and are far less aware of the likelihood of future events to come. Less than one out of two hospitals has specific emphasis on children, being their target population, in their hospital disaster plan. Specific needs in pediatric populations as family reunion and post-traumatic stress relief are dealt with in only 50% of hospitals, and only one out of three hospitals can rely on a disaster medicine

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specialist. The limited availability of decontamination facilities and nuclear specialists probably correlates with a limited risk perception as chemical and nuclear plants are not as common in the catchment area. However, incidents can occur everywhere, be it from traffic/transportation accidents or from malicious attacks. Data on surge capacity are somewhat better but might still prove insufficient in large parts of Europe when there would really be a mass-casualty incident. Severe Acute Respiratory Syndrome and flu pandemic threats made people aware of the risks of a high inflow of patients, and children are extremely vulnerable in these circumstances. These findings are in the line with data from studies in general hospitals, but one might expect that tertiary care centers, being centers for pediatric referral, are equipped sufficiently to cope with a disaster in their region that involves children.[25,29,34]

Focusing on the personal preparedness of this study population, data are daunting. Although one-half of the respondents feel that some disaster training should be obligatory in their training, only one out of three has had some education on this topic. Comparing this with Belgian and Dutch emergency physicians, were the ratio is one out of two,[26] this is even less. This discrepancy between perceived needs and effective training supports the necessity of a curriculum adaptation.

The study population felt slightly more confident in cases of trauma or infectious diseases as these are most closely linked with their normal practice, but they clearly were uncomfortable in other incidents.

The set of content assessment questions confirmed this. The only question with a reasonable score is on personal protection in influenza pandemic, a situation highlighted in the last years. When it comes to decontamination, real PPE use and use of iodine tablets scores are clearly low. More than one out of five tertiary care pediatricians/pediatric emergency physicians believes that iodine tablets protect against external radiation. The good correlation between prior training and exposure, risk estimation, knowledge, self-estimated capability, and higher scores on the test supports the validity of the survey.

Antidote use follows the same trend. Only atropine, which is commonly used in daily practice, scores well in the evaluation. Specific chemical, biological, radio nuclear antidotes commonly are unknown with a surprisingly low score for iodine tablets.

Despite the limited preparedness, there is a high willingness to work in the population, even in nuclear incidents and infections with a high mortality rate. Sufficient personal protection is rated the most important condition "sine qua non," although the knowledge to use it is extremely limited. Specific training indeed is stated to be the second most important promoting factor to convince respondents to go to work but, in the majority of the population, training is lacking. Safety and training are important factors to respond to work in other studies, but most of them are limited to influenza pandemics. One study evaluated willingness to work in physicians of a large metropolitan hospital group for similar disaster situations as in this group[35] and found this to be lower than in the study population for all situations. Effective protective equipment, good and timely information, and possibility to contact family were the main factors to convince these colleagues to respond.

Limitations

The limited number of respondents, as well as the use of a self-response survey, are limitations of this study. However, the good correlation with the results of the theoretical question set supports these data. One could have the impression that the survey is a European evaluation as the majority of the contacts are from Europe; however, international faculty from other continents was included on purpose to have some comparison in view of fundamental differences. There were no significant differences between the continents. Although the total numbers of participants is low, key role players in pediatric emergency medicine from all over the world were included, so the sample is relevant. Tertiary care specialists are not representative for the average pediatrician, but most likely are involved in any disaster that involves children – thus, probably every disaster in their region.

Conclusion

Despite a clear perception of the risks, disaster preparedness is limited in the study population. Training is an important factor, as is acknowledged by the participants. The basics of disaster management should be a mandatory part of pediatric training.

References

1. Markenson D. Have we forgotten about the needs of children? *Disaster Med Publ Health Prep*. 2014;8(3):188-190.
2. Gausche-Hill M. Pediatric disaster preparedness: are we really prepared? *J Trauma*. 2009;67(2 Suppl):S73-S76.
3. Mace SE, Doyle C, Fuchs S, et al. Pediatric patients in a disaster: part of the all-hazard, comprehensive approach to disaster management. *Am J Disaster Med*. 2012;7(2):111-125.
4. Stamell EF, Foltin GL, Nadler EP. Lessons learned for pediatric disaster preparedness from September 11, 2001: New York City trauma centers. *JTrauma*. 2009;67(2 Suppl): S84-S87.
5. Chokshi NK, Behar S, Nager AL, et al. Disaster management among pediatric surgeons: preparedness, training, and involvement. *Am J Disaster Med*. 2008; 3(1):5-14.
6. Barthel ER, Pierce JR, Goodhue CJ. Can a pediatric trauma center improve the response to a mass casualty incident? *J Trauma Acute Care Surg*. 2012;73(4): 885-889.
7. Burke RV, Iverson E, Goodhue CJ, et al. Disaster and mass-casualty events in the pediatric population. *Semin Pediatr Surg*. 2010;19(4):265-270.
8. Markenson D, Reynolds S. American Academy of Pediatrics Committee on Pediatric Emergency Medicine, Task Force on Terrorism. The pediatrician and disaster preparedness. *Pediatrics*. 2006;117:e340-e362.
9. Gold JI, Montano Z, Shields S, et al. Pediatric disaster preparedness in the medical setting: integrating mental health. *Am J Disaster Med*. 2009;4(3):137-146.
10. Brandenburg MA, Arneson WL. Pediatric disaster response in developed countries: ten guiding principles. *Am J Disaster Med*. 2007;2(3):151-162.
11. Mace SE, Sharieff G, Bern A, et al. Pediatric issues in disaster management, part 2: evacuation centers and family separation/reunification. *Am J Disaster Med*. 2010; 5(3):149-161.
12. Van de Voorde P, Graham CA. Top ten abstracts from the first European Paediatric Resuscitation & Emergency Medicine Congress; Ghent, Belgium; May 2013. *Eur J Emerg Med*. 2013;20:224-228.
13. Barelli A, Biondi I, Soave M, et al. The comprehensive medical preparedness in chemical emergencies: 'the chain of chemical survival'. *Eur J Emerg Med*. 2008;15 (2):110-118.
14. Considine J, Mitchell B. Chemical, biological, and radiological incidents: preparedness and perceptions of emergency nurses. *Disasters*. 2009;33(3):482-497.
15. Cone DC, Davidson SJ. Hazardous materials preparedness in the emergency department. *Prehosp Emerg Care*. 1997;1(2):85-90.
16. Edwards NA, Caldicott DG, Aitken P, et al. Terror Australia 2004: preparedness of Australian hospitals for disasters and incidents involving chemical, biological, and radiological agents. *Crit Care Resusc*. 2008;10(2):125-136.
17. Domress BD, Rashid A, Grundgeiger J, et al. European survey on decontamination in mass-casualty incidents. *Am J Disaster Med*. 2009;4(3):147-152.
18. Koenig KL. Preparedness for terrorism: managing nuclear, biological, and chemical threats. *Ann Acad MedSingapore*. 2009;38(12):1026-1030.

19. Mace SE, Sharieff G, Bern A, et al. Pediatric issues in disaster management, part 1: the emergency medical system and surge capacity. *Am J Disaster Med*. 2010;5(2):83-93.
20. Mitchell CJ, Kernohan WG, Higginson R. Are emergency care nurses prepared for chemical, biological, radiological, nuclear, or explosive incidents? *Int Emerg Nurs*. 2012;20(3):151-161.
21. O'Sullivan TL, Dow D, Turner MC, et al. Disaster and emergency management: Canadian nurses' perceptions of preparedness on hospital front lines. *Prehosp Disaster Med*. 2008;23(3):s11-s18.
22. Phelps S. Mission failure: Emergency Medical Services response to chemical, biological, radiological, nuclear, and explosive events. *Prehosp Disaster Med*. 2007;22(4):293-296.
23. Sansom GW. Emergency department personal protective equipment requirements following out-of-hospital chemical, biological, or radiological events in Australasia. *Emerg Med Australas*. 2007;19(2):86-95.
24. Summerhill EM, Mathew MC, Stipho S, et al. A simulation-based biodefense and disaster preparedness curriculum for internal medicine residents. *Med Teach*. 2008;30(6):e145-e151.
25. Mortelmans LJ, Van Boxstael S, De Cauwer HG, et al. Belgian Society of Emergency and Disaster Medicine (BeSEDiM) study. Preparedness of Belgian civil hospitals for chemical, biological, radiation, and nuclear incidents: are we there yet? *Eur J Emerg Med*. 2014;21(4):296-300.
26. Mortelmans LJ, Bakker AM, Jacobs C, et al. Nuclear and chemical incidents in Belgium and the Netherlands: are we there yet? *Act Clin Belg*. 2013;68(6):483.
27. Balasuriya D, Iverson E, Burke RV, et al. Community engagement and pediatric disaster readiness in a large urban disaster resource hospital network: the case of "The Great California ShakeOut." *Disaster Med Public Health Prep*. 2012;6(2):182-186.
28. Ferrer RR, Balasuriya D, Iverson E, et al. Pediatric disaster preparedness of a hospital network in a large metropolitan region. *Am J Disaster Med*. 2010;5(1):27-34.
29. Thompson T, Lyle K, Mullins SH, et al. A state survey of emergency department preparedness for the care of children in a mass casualty event. *Am J Disaster Med*. 2009;4(4):227-232.
30. Scarphone RJ, Coffin S, Fieldston ES, et al. Hospital-based pandemic influenza preparedness and response: strategies to increase surge capacity. *Pediatr Emerg Care*. 2011;27(6):565-572.
31. Campbell C. The benefits of designing a stratification system for New York City pediatric intensive care units for use in regional surge capacity planning and management. *J Community Health*. 2010;35(4):337-347.
32. Devnani M. Factors associated with the willingness of health care personnel to work during an influenza public health emergency: an integrative review. *Prehosp Disaster Med*. 2012;27(6):551-566.
33. Draper H, Wilson S, Ives J, et al. Health care workers' attitudes towards working during pandemic influenza: a multi method study. *BMC Public Health*. 2008;8:192-198.
34. De Cauwer HG, Mortelmans LJ, d'Orio V. Are Belgian hospitals prepared for an H5N1-pandemic? *Eur J Emerg Med*. 2007;14(4):204-206.
35. Mortelmans LJ, Dieltiens G, Anseeuw K. Fight or flight, will our colleagues come to work when disaster strikes? Presented at the 6th Mediterranean Emergency Medicine Congress; Kos, Greece: 2011.