Recurrent Medical Response Problems during Five Recent Disasters in the Netherlands

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Abbreviations:
ADC = ambulance dispatch center
GHOR = Accident and Disaster Medical Response Organization
RMO = Regional Medical Officer

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Abstract

Objectives: The aim of this qualitative, retrospective review is to identify and analyze the occurrence of recurrent problems in 20 processes that cover all relevant aspects of disaster health during the response phase. Consequently, an attempt is made to determine if there are generic themes of coherences in these problems.

Methods: Eight after-action reports of five consecutive disasters in the Netherlands between 1996 and 2005, were integrally analyzed in a structured manner. The analysis was confined to processes from the start of the event up to and including the initial stages of hospital admission.

Results: Problems during all five disasters arose with eight processes: (1) submission of information to the ambulance dispatch center (ADC); (2) provision of information by the ADC to disaster response personnel; (3) scaling-up of prehospital response; (4) communication; (5) logistics; (6) registration; (7) multidisciplinary cooperation; and (8) preparation. Three generic themes of coherence were identified: (1) processes in which exchange of information among medical personal plays a major role are more likely to be affected by problems than processes in which this is less relevant; (2) processes in which disaster circumstances differ from day-to-day health care, or do not figure in day-to-day health care, are more likely to give rise to problems than processes that remain essentially similar; and (3) the existence of a protocol or disaster plan governing a process does not prevent problems.

Conclusions: The method used enables a systematic analysis of the problems in health-related processes following five consecutive disasters. The analysis confirms that the majority of problems are repeated. The identified themes of coherences are in agreement with case reports and expert opinions. They are now supported with a higher level of evidence.

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Introduction

Most publications on medical disaster response describe, in different manners, what has happened during a single disaster. Therefore, aggregation of the data is not possible.[1–11] A uniform methodology to analyze several disasters has, as far as the authors are aware, never been applied. Sweden's KAMEDO group has come the closest to adopting such an approach by *post-hoc* investigation visits to the sites of the events. This method has helped improve the national disaster response.[12–16] A systematic study of several disasters, based on the separation of fact from myth in medical disaster response, has provided relevant new insights.[17,18] In the future, indicators may become a powerful tool for more systematic evaluation of a series of disasters; however, indicators have not yet been applied in real events.[19–21]

The aim of this study is to systematically identify problems in medical response following five consecutive major disaster-causing events that occurred in the Netherlands between 1996 and 2005, to investigate the existence of persisting problems, and to find generic themes of coherence that may

Date of Event	Nature of Disaster	Number of Victims	Title of Report	Reporting Body
15 July 1996	Crash-landing of aircraft leading to fire and explosion, with 41 passengers trapped	34 dead 7 wounded	*Hercules Ramp Eindhoven (Eindhoven Hercules Disaster)*[22]	Raad voor de Transportveiligheid (Transport Safety Council)
			Vliegramp Eindhoven (Eindhoven Air Disaster)[23]	Werkgroep Herculesramp (Hercules Disaster Working Party)
25 September 1996	Crash of aircraft with 32 passengers into Wadden Sea	32 dead	*Dakota-incident (Wadden Sea Dakota Incident 1996)*[24]	Inspectie Brandweerzorg en Rampenbestrijding (Fire Service and Disaster Management Inspectorate)
13 May 2000	Explosion at fireworks factory, devastating nearby residential district	22 dead 944 wounded 3 missing	*Onderzoek vuurwerkramp Enschede (Investigation of the Enschede Fireworks Disaster)*[25]	Inspectie voor de Gezondheidszorg (Health Care Inspectorate)
01 January 2001	Fire in a bar on New Year's Eve	14 dead 231 wounded	*Medische Evaluatie Ramp Volendam (Medical Evaluation of the Volendam Disaster)*[26]	VU University Medical Center, Amsterdam Medical Centre, Beverwijk Burns Victim Centre
			Evaluatie cafébrand Volendam (Evaluation of the Volendam Bar Fire)[27]	Inspectie voor de Gezondheidszorg (Health Care Inspectorate)
27 October 2005	Major fire at a detention center	11 dead 15 wounded	*Brand cellencomplex Schiphol-Oost (Schiphol-East Detention Centre Fire)*[28]	Onderzoeksraad voor Veiligheid (The Dutch Safety Board)
			Evaluatie operationele geneeskundige hulpverlening brand detentiecentrum Schiphol-Oost (Evaluation of the Operational Medical Response to the Fire at the Schiphol-East Detention Centre[29]	Geneeskundige Hulpverlening bij Ongevallen en Rampen Amsterdam (Accident and Disaster Medical Response Organization Amsterdam)

Table 1—The five consecutive disasters in the Netherlands between 1996 and 2005 and the official governmental reports that were analysis to identify problems and generic themes

be related to the persistence of the problems. To achieve this, eight after-action reports have been studied, analyzed, and disentangled using a uniform methodology and definitions, and, consequently, integrally compared.

Study Setting

The research took place in the Netherlands, a small country (41,528 km^2) in Western Europe, bordered by Germany, Belgium, and the North Sea, with a high population density (400 residents/km^2, total population 16.4 million), and a relatively high gross national product ($529.6 billion in 2007). The Netherlands has a compact and complex infrastructure with a great deal of industry and transport by road, water, and air.

Overall responsibility for the medical disaster response lies with the Accident and Disaster Medical Response Organization (GHOR). The GHOR is the link between the government and ordinary healthcare organizations. Day-to-day health care is provided by various public and private groups and organizations such as family physicians (the formal single point of access to health care in the Netherlands), ambulance dispatch centers (ADC), ambulance services, and hospitals. The Netherlands is divided into 25 safety regions, which are geographically the same for the GHOR, police, and fire brigade regions. Each safety region has a GHOR office with a small staff led by a Regional Medical Officer (RMO). In the event of a disaster, the RMO has the ultimate responsibility for coordina-

Submission of information to the ADC	The ADC had no essential data (who, what, where, when, how, and how many) when scaling up the response.
Start of scaling up procedure	Scaling up was delayed.
Provision of information by ADC to medical disaster response personnel	Unclear, non-specific, incorrect, or insufficient information was provided. There were technical, procedural, and practical shortcomings.
Safety	Medical disaster response personnel gave little thought to safety and were provided with insufficient information to make an accurate assessment of the safety.
Scaling up of prehospital response	The scaling up was absent, late, incomplete, or excessive. Professional disaster response personnel were not readily identifiable and insufficiently familiar with the organization's command structure.
Self-help	Nearby hospitals and nursing homes, which are not equipped to provide acute medical care, were overloaded by people who independently sought help. Triage, setting up holding points, ambulance assistance, wounded dispersal, and registration did not go according to plan. Self-help made it more difficult to build a picture of the situation.
Independent action by medical disaster response personnel	Independently acting medical disaster response personnel were not sufficiently familiar with the protocols or the GHOR command structure and did not register themselves. This made it more difficult to build a picture of the situation.
Communication	There were technical, procedural, and information problems that resulted in inadequate information transfer among the various care providers. This made triage, treatment, and dispersal of the wounded more difficult, and resulted in insufficient structural coordination and insufficient leadership.
Logistics	Medical disaster response personnel had difficulties accessing the disaster site. There were capacity problems with ambulance service and suitable medical equipment.
Triage	Different parties used different or inadequate triage methods.
Scaling up of hospital response	There were problems with the dispersal of the wounded to the hospitals, the scaling up procedures of the hospitals, and interhospital transfer when hospitals became overloaded.
Start of downscaling	Hospitals did not wait for instructions from the GHOR to scale down, or were not informed that scaling down was indicated.
Continuation of day-to-day care	The ability of the ambulance services, the ADC and the hospitals to meet day-to-day care requirements was impaired.
Identification of the dead	Identification was laborious, because of flaws in the registration arrangements and because the fire brigade moved victims without noting or communicating where they were found.
Registration	Registration was insufficient or incomplete due to insufficient personnel of GHOR, ambulance, and emergency department and because disaster response personnel were not familiar with the registration. As a result, the lists of the wounded were available with delays.
Medical treatment	There was disagreement about treatment at the disaster site, even in situations in which national protocols could be applied.
Multidisciplinary cooperation	Multidisciplinary consultation at the disaster site was compromised by lack of clear definitions of tasks and responsibilities.
International cooperation	The communication systems and equipment used abroad for patient transportation proved incompatible with the Dutch systems and equipment. Dutch MRSA policy complicated the return of wounded to hospitals in the Netherlands.[31]
Evaluation	Evaluation did not take place until long after the disaster, by which time the local gathering of first-hand information was no longer possible and matters identified as requiring improvement did not receive any more attention.
Preparation	The contingency plans did not provide adequately for the situations encountered on the ground, were out of date, were mutually contradictory, were not available, or were not familiar to the people expected to implement them. This included not clearly defined responsibilities. There had been insufficient planning or drilling.

Table 2—A summary of the problems in 20 processes which were described in the reports of five consecutive disasters in the Netherlands (1996–2005) (ADC = ambulance dispatch center; GHOR = Accident and Disaster Medical Response Organization; MRSA = Methicillin-resistant Staphylococcus aureus)

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Processes that were identified as problematic in all five disasters				
Submission of information to ADC				
Provision of information by ADC to medical disaster response personnel				
Scaling-up of prehospital response				
Communication				
Logistics				
Registration				
Multidisciplinary cooperation				
Preparation				
Processes that were identified as problematic in the majority of the disasters in which they were relevant	n = number of disasters			
	Relevant	Problematic	Not Problematic	Not Addressed
Start of scaling-up procedure	5	3	2	
Identification of the dead	5	3		2
Evaluation	5	3		2
Safety	5	3		2
Start of downscaling	4	3		1
Continuation of day-to-day care	4	3		1
Independent action by medical disaster response personnel	3	2	1	
Processes that were identified as problematic in half or the minority of the disasters in which they were relevant	n = number of disasters			
	Relevant	Problematic	Not Problematic	Not Addressed
Medical treatment	5	2	2	1
Scaling-up of hospital response	5	2	1	2
Self-help	4	2	1	1
Triage	4	2		2
International cooperation	2	1	1	

Table 3—Processes categorized according to the number of disasters in which they were relevant, addressed as problematic or not problematic, and not addressed (ADC = ambulance dispatch center)
The fact that a process was not addressed does not imply that the process went without problems. However considering the critical objective of the after action reports, this is unlikely. When a process was addressed without any reference to problems, the process is described as "not identified as problematic".

tion of the medical response, but has no statutory powers. With the exception of the GHOR office staff, all the people involved in the provision of medical disaster response normally provide day-to-day healthcare services.

Methods

Methodology

This is a retrospective, qualitative review of a series of five consecutive disasters in the Netherlands with a sudden onset and sudden ending. These "flash-disasters" occurred between 1996 and 2005. No other flash-disasters occurred during this period. Several official governmental reports, in the Dutch language, have been published regarding these disasters. The reports describe the work of independent commissions, which were installed on the initiatives of governing bodies, such as the Ministry of Interior and Kingdom Relations and the Health Care Inspectorate. Although several scientists participated in these commissions, the reports have no scientific objective. All reports have been presented, discussed, and approved during formal and public meetings of the Dutch House of Representatives and received extensive media attention. The reports have focused mainly on administrative issues, on the legislation and regulations governing disaster response, and on the compliance with these regulations. Based on the extensive knowledge of all existing reports of the authors, eight reports relevantly regarding the medical responses were selected for analysis, containing a total of 1,307 pages (Table 1). Analysis of the other reports would not add new information.

The analysis is confined to processes from the start of the disaster up to, and including, the initial stages of hospital care immediately following admission. It was decided, *a priori*, that these processes had to harmonize with the emergency medicine system in the Netherlands. By formal regulations, the emergency medical system in the Netherlands is described in 10 steps: (1) bystander assistance and alert; (2) moving to incident; (3) triage/judgment;

Identified	Provision	Communication less relevant
Processes that were identifed as problematic in all the disasters in which they were relevant	- Submision of information to ADC - Provision of information by ADC to medical disaster response personnel - Scaling-up of prehospital response - Communication - Logistics - Registration - Multidisciplinary cooperation - Preparation	
Processes that were identified as problematic in the majority of disasters in which they were relevant	- Start of scaling-up procedure - Identification of the dead - Evaluation - Safety - Independent action by medical disaster response personnel - Start of downscaling	- Continuation of day-to-day care
Processes that were identified as problematic in the minority of disasters in which they were relevant	- Scaling up of hospital response - International cooperation	- Medical treatment - Self-help - Triage

Table 4—The role of communication as a generic coherent theme for the problems that occurred in 20 processes during five consecutive disasters in the Netherlands (1996–2005). (ADC = ambulance dispatch center)

(4) individual medical aid; (5) transport; (6) hospital emergency department; (7) surgery; (8) intensive care; (9) nursing and discharge; and (10) rehabilitation. During a meeting one year before the study, experts in disaster medicine had agreed that these steps were inaccurate to describe the processes during disasters and, instead, 22 processes were proposed. This proposal was still in a conceptual phase when the current study began. In a pilot analysis of one report, the initial application of these 22 processes showed that certain processes were inter-related, while other processes would be missed. Therefore, before the final analysis started, the 22 processes had been rearranged into 23 processes that harmonized to the national system. The selection and definition of the processes worked out well. At the end of the analysis all identified problems appeared to fit unambiguously into one of the 23 processes.

Each of the eight reports was analyzed to identify the problems with each of the 23 processes. Verbatim sentences related to problems in the 23 processes were extracted from the eight reports and included in 23 tables ("copy and paste"). During this laborious process, feedback and control were performed. In this manner, all problems with each separate process were composed in one table, 23 tables in total. The 23 tables are available on request from the authors. Insufficient data for further analysis and aggregation were found in the tables with regard to "scientific research", "implementation", and "governmental coordination". The 20 processes that remained for analysis were tabulated according to the number of disasters in which they were identified as problematic. The 20 verbatim tables for each process were then summarized by both authors. This was a straightforward procedure for most of the processes. The number of problems in "communication" and "scaling-up of hospital response" was so large that it was necessary to group the problems and to use these problem groups as the basis for further summary. The problems are presented as a synopsis (Table 2). The complete tables with summary of the problems are available from the authors. The pattern of problems in the 20 processes then were examined and aggregated by both authors during an open discussion using expert opinion to identify generic themes of coherences.

The retrospective, observational design and the manner of analysis of qualitative data have a serious risk of bias and subjectivity. All measures were taken to avoid this during each step of the study. There was no subjective interpretation of the information provided in the reports. The *a priori* selection of the reports, the *a priori* identification and definition of the 23 processes, the *a priori* research method, the tables with the summary of the problems, and the identified generic themes were discussed independently at two meetings of the GHOR Academy's Scientific Committee, presented for comment to 10 peer reviewers, presented at a national invitational conference with 60 participants, and made available on the Internet for comments.[22] Approval of an Institutional Review Committee was not considered to be applicable because the study is based on publicly available reports.

Results

An analysis of the 20 process-specific tables revealed significant differences in the extent to which the various processes were affected by problems: eight processes were identified as problematic in each of the disasters examined, seven in a majority, and five in a minority (Table 3). Analysis, examination, aggregation, and interpretation of the process-specific problem patterns led by a process of open communication using expert opinion resulted in the identification of three consistent and generic themes:

1. Processes in which communication plays a major role are more likely to be affected by problems than processes in which communication is less relevant (Table 4);
2. Processes that, in a disaster situation, are very differently organized from day-to-day health care, or do

Identified	Process is organized very differently in a disaster situation or does not figure in day-to-day care	Process does figure in day-to-day care and is organized in a similar way in a disaster situation
Processes that were identified as problematic in all the disasters in which they were relevant	- Provision of information by ADC to medical disaster response personnel - Scaling up of prehospital response - Communication - Logistics - Registration - Multidisciplinary cooperation - Preparation	- Submission of information to ADC
Processes that were identified as problematic in the majority of disasters in which they were relevant	- Start of scaling up procedure - Start of downscaling - Identification of the dead - Evaluation	- Safety - Independent action by medical disaster response personnel - Continuation of day-to-day care
Processes that were identified as problematic in the minority of disasters in which they were relevant	- Triage - Scaling up of hospital response	- Self-help - Medical treatment - International cooperation

Table 5—The role of similarity and dissimilarity with day-to-day care as a generic coherent theme for the problems which occurred in 20 processes during five consecutive disasters in the Netherlands (1996–2005). (ADC = ambulance dispatch center)

not figure in day-to-day health care, are more likely to give rise to problems than processes that remain essentially similar (Table 5); and

3. The existence of a protocol or disaster plan governing a process does not prevent problems to occur in this process (Table 6).

Communication

Communication was relevant in 16 of the 20 processes that were identified for this study. Communication as a process, *per se*, was problematic in each disaster, but communication was also a collective theme in 11 other processes that were found to be problematic in each (or most) disaster. Communication during the disaster was important in problematic processes in which the ADC played a central role, during scaling-up, multidisciplinary cooperation, independent actions by medical disaster response personnel, logistics, safety, scaling-down and identifications of the dead. Communication about the disaster was an essential part of recurrent problems during registration, preparation, and evaluation (Table 3).

Similarity between Process in Disaster Situations and in Day-to-day Care

Of the 20 processes, 13 either do not feature in day-to-day care or are organized on a different basis, while seven are very similar in disaster situations to those used in day-to-day situations (Table 4). Of the 13 processes that are different from the common situation, seven were problematic in all five disasters. Of the seven processes similar to day-to-day processes, only one is problematic in all five disasters. In other words, of the eight processes that proved to be problematic in all five disasters, only one is very similar to the corresponding day-to-day care process. By contrast, three out of the five processes that gave rise to problems in a minority of the disasters are similar to the day-to-day care processes.

Discussion

This study was successful to identify and aggregate, in a structured manner, the problems in health issues during five consecutive disasters in the Netherlands between 1996 and 2005. The relevancy of the study has several practical and strategic aspects. The analysis shows that a structured summary of 23 processes retrieved from eight after-action reports can be used to systematically describe the health-care-related problems in any given disaster situation. The results of the analysis provide a coherent and complete overview of many problems in medical disaster response. The study shows that many problems recur each time again, despite that in the 10 years of the study period, changes have been made in the funding arrangements, protocols, legislation, functions, and organizations. As such, the results are a baseline reference to evaluate disaster management during future disasters in the Netherlands.

In addition, it was possible to identify three generic themes of coherence in the problems that have been identified in the processes. The results of the analysis provides qualitative and quantitative pointers that communication is the common factor linking many of the problems that typically affect the medical responses to accidents and disasters. The analysis also suggests that the likelihood of problems increases as the similarity of a medical disaster response activity to the corresponding day-to-day care activity decreases. The existence of protocols and disaster plans is no guarantee against the occurrence of problems. These three themes are not new and the same concerns have been raised in case reports and as expert opinions.[10,33–39] As a result of this study, the conclusion now is based on a sys-

	Process covered by protocols in day-to-day care or disaster plans	Process not covered by protocols in day-to-day care or disaster plans
Processes that were identifed as problematic in all the disasters in which they were relevant	- Submission of information to ADC - Provision of information by ADC to medical disaster response personnel - *Scaling up of prehospital response* - Communication - Registration - Logistics - Mulidisciplinary cooperation - Preparation	
Processes that were identified as problematic in the majority of disasters in which they were relevant	- Start of scaling up procedure	- Independent action by medical disaster response personnel - Continuation of day-to-day care - Evaluation
Processes that were identified as problematic in the minority of disasters in which they were relevant	- Triage - Scaling up of hospital response - Medical treatment	- Self-help - International cooperation

Table 6—The role of presence of protocols as a generic coherent theme for the problems which occurred in 20 processes have occurred during 5 consecutive disasters in the Netherlands (1996-2005; ADC = ambulance dispatch center)

tematic analysis and aggregation of data of five disasters in one country during a period of 10 years. The recurrence of problems advocates serious considerations to innovate disaster preparedness in such a manner that the recurrence of problems is better avoided and that focus more on generic themes to improve disaster preparedness. At the same time, it can be questioned what the relevancy of after-action reports is when no consequences are linked to the findings of the reports.

Communication

Many problems during the five disasters can be traced back to poor compliance with the basic principles of communication, such as: Is the right provider sending information?; What information is sent?; Is the information received correctly?; Does the information reach the right recipient?; Is the information received in time?; Is the information complete?; Does the sender receive confirmation that all the relevant information has been received by the intended recipient?; Does the recipient receive information from the right sender?; Are the sender and recipient identifiable and traceable?[40] These basic communication principles played a role in most of the recurrent problems during all five disasters. Also, technical problems have been mentioned as a cause for communication problems; however, technical problems appear to be less critical than the exchange of information between participants.

The vital role of communication in disaster situations has been emphasized previously.[29–31,33] This analysis showed that communication causes direct or indirect problems and in many ways. For the ADC, problems with communication resulted in problems with accurate estimations of the need for scaling-up. Once scaling-up has started, problems with communication were caused because people were not aware of one another's identities, roles, or tasks. Similar problems arose in the multidisciplinary cooperation between the police, the fire brigade, and health personnel. The problems were greater where communication was needed with parties that are not ordinarily involved, such as port authorities or coast guards. Independent action by professional care providers, although very useful in itself, caused other communication-related problems mainly because the coordinating health authority (GHOR) was not aware of their initiatives. It appears that many logistical problems are communication-related but quickly become apparent during a disaster and often are resolved by *ad hoc* measures. It is worrisome that if communication is not adequate, medical disaster response personnel are not given full information about the risks to which they are exposed, and may remain in unnecessary danger for prolonged periods of time. These safety issues often become only clear after the disaster. Response personnel tend to be focused on primary tasks, such as fire-fighting, extricating people and providing medical assistance.[41] They overlook that through their work, important information is lost for the identification of the dead by the Disaster Victim Identification Team, such as where a victim was found. Finally, the decision to scale down to the normal level was not communicated, notably not to the hospitals.

Communication *about* the disaster relates to preparation, registration, and evaluation. The basic communication principles identified above also impact preparations. Response personnel tend not to attach a high priority to registration. There were registration problems at the disaster site, at the ADC, in the ambulance service, and at the hospitals. Problems occur because complete and reliable information cannot be communicated.[17,18,32,42] Registration shortcomings also affected the accuracy of subsequent evaluations and scientific research.[10] Many new registration equipment currently is being developed and tested.[42–49]

Whether such equipment can resolve all registration-related problems remains to be seen.

In the minority of the disasters, there were problems identified in regard to "scaling-up of hospital response" and "international cooperation". These were processes in which communication also is relevant. The scaling up of hospitals proved to be problematic in the two disasters with the largest numbers of victims (245 and 966) and was most related to the communication of quantitative and qualitative data pertaining to the wounded victims.[50] These were the same two disasters in which victims were transported to hospitals outside of the Netherlands.

Communication was less relevant in the context of four processes characterized by individual, independent, or professional actions. None of these processes were problematic in the analyzed disasters.

Similarity between Process in Disaster Situations and in Day-to-day Care

The second generic theme of coherence that was identified, relates to the fact that a disaster situation differs from a day-to-day healthcare situation both in quantitative terms and in qualitative terms.[51] According to regulations, medical disaster response personnel are required to perform unusual roles and procedures or to receive directions from unusual channels.

This observation is consistent with the generally accepted belief that good disaster management is facilitated by improving the day-to-day quality of care and providing a response through the familiar channels. Registration serves as a good example in this regard: if registration is not well-organized and executed in daily circumstances, it certainly will not be effective in a disaster situation.

There are three possible explanations for the above revelation. During a disaster, people are less inclined to act according to an agreed, but unfamiliar manner. This can result from ignorance, misunderstanding, or the inability to act in an unfamiliar manner in an unfamiliar situation. Furthermore, a disaster situation places great psychological stress on response personnel, which makes it difficult to put what one has been taught into practice. In a chaotic situation and under pressure of time, people tend to fall back onto knowledge they are sure of or based on previous, day-to-day experiences.[52,53] Finally, it is impossible to exclude the possibility of individual failures having a critical effect on the outcome of a process.[54,55] Such failures can be made less likely by selection of people, education, training, and practice.

Protocols

The third generic theme of coherence relates to the value of protocols and disaster plans. As in many other countries, there are many protocols and disaster plans in place in the Netherlands. During the 10 years of the study, several new protocols and plans have been added. Of the 20 processes studied, 16 processes had protocols or disaster plans related to them at the moment of the disaster. There have been protocols or disaster plans available for eight processes that were problematic in each disaster.

There are several explanations for why the availability of protocols and disaster plans do not assure good disaster medical assistance. The problems that confront medical disaster response personnel may be too complex or too specific to the situation to be regulated by protocols. Protocols may be impractical, i.e., too long, inaccessible, too complicated, or appropriate only in the context of one disaster, like the one in response to which they were devised. Protocols are most useful for relatively uniform, simple activities that are performed on a day-to-day basis, but are less suitable for the coordination and control of occasional events.[34] Every disaster is different and unpredictable, while protocols and disaster plans assume consistent or foreseeable situations. When following a protocol or disaster plan, the likelihood of problems increases as the relevant procedures become less similar to day-to-day procedures or become even more complex.[55,56] It probably is better to work on the basis of practical principles: rules of thumb, mnemonics, checklists, and mission intent statements. Such tools allow more scope for improvised and adaptable solutions than protocols do.[35,36,39] This consideration is supported by observations in this study that five processes are not covered by protocols: (1) independent action by medical disaster response personnel; (2) the continuation of day-to-day care; (3) evaluation; (4) self-help; and (5) international cooperation. These processes proved not to be problematic in most cases (Table 5). It is unclear whether protocols for these processes are considered unnecessary, or have not yet been developed because the processes have only recently begun to attract attention, or whether the processes concerned are less likely to give rise to problems precisely because they are not regulated by protocols.

The authors do not mean to suggest that the development of plans or protocols is pointless: such tools are very useful for shedding light on the problems that one may encounter in various disaster scenarios. Protocols and disaster plans facilitate the definition of themes for inclusion in education, training, and drill activities.

Limitations

Although this analysis confirms certain established views, its shortcomings also should be addressed. First, qualitative data that include the risk of bias and subjective interpretation have been analyzed. This problem had been identified before the study started and the methodology, analysis, and conclusions were repeatedly and independently reviewed by the members of the GHOR Academy's Scientific Committee and by outside experts. The generic themes of coherence were defined by the same painstaking procedure.

Although all five of the analyzed disasters were sudden-onset events, there were considerable differences between them and not all the defined processes were equally relevant in relation to all the disasters. Furthermore, the reports on the disasters that were used as the basis for the analysis differed in their structure and their quality, making comparison difficult. Only one of the reports focused primarily on the medical disaster response.[17] Where the other reports were concerned, information about the medical disaster response had to be extracted from material produced primarily with the review of legislation and regulations in mind. It is quite possible that some of the healthcare-related problems that occurred were not addressed. For example, triage, medical treatment, and international cooperation

were not referred to in relation to all the disasters in which they were relevant. The expectation is that, if the analyzed reports had been more systematic and placed more emphasis on medical response, these three processes would have been more often mentioned.[57,58] The reports, by their destination, mention little or nothing about processes that operated smoothly, and there is a bias towards negativity. Therefore, it is unlikely that problems with these processes have not been mentioned.

Certain important measurable data, such as times, disaster response personnel numbers, dispersal of patients, hospital admissions, and early and late fatalities were absent from the reports. The quality of the analysis would have benefited from the availability of such measurable data. The definition and inclusion of indicators in after-action reports would have helped in defining outcome measurements.

Finally, the analysis is confined to five sudden-onset disasters with a short period of impact. Therefore, the conclusions are not necessarily applicable to non-sudden-onset disasters, such as an influenza pandemic or flooding.

The authors are aware of these limitations in their study, but are convinced that no better research material is available to study whether some problems are recurrent after each disaster. With the existing material, no better quality of research is possible.

Conclusions

This analysis of five recent disasters in the Netherlands shows that several disaster health-related problems occurred over and over again during 10 years of disaster response. Three generic themes of coherence have been identified that may explain the recurrence. The findings of the analysis confirms observations from case reports of single disasters and from expert opinion.[1–21] Disaster medicine scientists have a moral duty to bring this unacceptable observation to the attention of policy-makers, dedicated organizations, and research institutions until it is understood why the same problems continue to persist.

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Use of Structured Observational Methods in Disaster Research: "Recurrent Medical Response Problems in Five Recent Disasters in the Netherlands"

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Doctors Juffermans and Bierens are to be commended for their paper published in this issue of *Prehospital and Disaster Medicine* entitled "Recurrent Medical Response Problems in Five Recent Disasters in the Netherlands." In the study, it is noted that health disaster response problems are repeated disaster after disaster. This finding seems to be consistent with the recurrent problems of communications, logistics, and access that have occurred in major events such as the Indian Ocean tsunami, Hurricane Katrina in New Orleans, and earthquake in Haiti. Interestingly, the authors found no improved performance in medical disaster response related to disaster plans and protocols.

While disaster experts will find the findings reported important for discussion and further evaluation, this editorial is written to discuss the research methodology demonstrated by the study. In their paper, Doctors Juffermans and Bierens have used research methods that are important for performing valid observational "meta-analysis" of archived disaster reports.[1] The authors have provided a template for structured disaster medical research of archived data. Further, the research supports the use of field and after-action reports to further develop disaster medical research. As shown with this study, structured field reports, after-action reports, KAMEDO reports, and disaster case reports contribute to disaster research and form a foundation for standardized reviews and analysis of multiple events.[2]

In an effort to promote future research based on the methods used by Juffermans and Bierens, it is useful to dissect the methodology of the paper into the steps the authors used in doing their research. These steps are identified and discussed in the following paragraphs.

Pre-study actions included the following steps:

1. The authors refined their study objective, so that they were able to concisely state what they were seeking to study.
2. The existing medical literature was searched to determine what specific information already existed regarding the study objective. After reviewing the literature, the authors were able to state that their study would add to the medical science knowledge base.
3. The study population was identified and defined. The study population definition included location, infrastructure, population density, economic status, and timeframe. Timeframe for study of a population is important because extended time periods may allow for population shift and change. A vaguely defined or changing study population may result in undetected bias of study results.
4. The study data source was defined. For this study, the authors selected data that was homogeneous (lacked a tendency for variability in collection and vague definition of data elements) and internally consistent (reported similar situations and conditions). In this way the authors used a meta-analytical approach to their research which allowed for pooling of the data to make study evaluations.
5. The study data sources were validated. The reports used for the study were generated from data sources presented to independent commissions which were scrutinized by government and the public media. One

method to validate data when the source may not be as reliable as that used for this paper is the use of the observational research method of triangulation.[3]

6. The authors defined the type of event to study as that which occurs with an initial sudden impact. In disaster research it is important to define the type of event to be studied to decrease classification bias that would occur by including unrelated types of disasters, such as earthquake and pandemic, into one study variable.
7. Prior to initiating the study, the researchers defined the phase of disaster response to be studied. Disaster medical research is unique in that there are distinct phases in response and recovery. As with defining the time frame for including a population in the study, defining the phase of a disaster for research helps focus the study and decrease classification and situational bias.
8. For the study, the researchers defined the study data elements (processes) prior to initiation of the study. This important step decreased the risk of bias caused by a tendency to change data interpretation during the data collection phase of the study, a form of data-dredging.
9. The researchers were aware of the potential need for human subjects or ethics review of the research prior to initiation of data collection. While this study was based on publicly available reports and therefore not submitted for human subjects review, any research involving humans or identifiable institutions must be considered for Institutional Review Committee approval.
10. To limit subjective internal bias within the study, the authors submitted the study plan and data collection tables to an expert focus group (peer reviewers) for independent review.
11. Finally, prior to beginning study data collection, the authors performed a pilot test to determine if their definitions and methods were workable. This was done by applying the study methods and definitions to one of the after-action reports selected for the study.

During the data collection phase of the study, a structured approach was used to limit the potential for undetected bias. The steps the researchers used during this phase of the study included the following actions.

1. Only after establishing the study elements (processes) did the authors initiate the study. The data analysis was limited to that information which fit into the study processes that were identified prior to initiation of analysis. This approach limited the risk that data dredging could lead to bias.
2. For the study, data was extracted from the after-action reports by one author. A recommendation to improve the study would have been for both authors to extract after-action report data and compare findings for consistency and to calculate a Kappa statistic for inter-rater reliability.[4]
3. Data was tabulated and ranked in a structured method that had been determined prior to initiation of the study.

As can be seen by examination of the study elements above, much of the work in performing a valid observational study comes before the data is collected.

In addition to good research methodology, the authors were careful to report the results of the study without over interpretation. They freely discuss the limits of the study and present conclusions that are supported by the data presented in the paper.

In closing, both Doctors Juffermans and Bierens are to be commended for their excellent paper and additions to the disaster medical knowledge base. It is suggested that those interested in research based on archived reports and studies use this paper as a methods template.