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# Disaster medicine- performance indicators, information support and documentation

A study of an evaluation tool

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'It takes a totally new way of thinking to solve problems created with the old way of hinking"
Albert Einstein
To: Marie

## **Abbreviations**

ICS: Incident Command System

KAMEDO: Katastrofmedicinska organisationskommittén. Swedish Organisation for Studies

and Reports from International Disasters

KMC: Katastrofmedicinskt centrum. Centre for Teaching and Research in Disaster

Medicine and Traumatology

MIMMS: Major Incident Medical Management and Support

WADEM: World Association for Disaster and Emergency Medicine

# **Glossary**

Aim: purpose or intent

Allvarlig händelse: major incident or incident that requires activation of disaster plan

Ambulance file system: a system in which patient and logistic data from ambulance

missions are filled-in after the completion of each mission

Command and control: the exercise of authority and direction by a properly designated

commander over assigned and attached forces in the

accomplishment of the mission

Disaster (Swedish definition): situation where normal medical standards cannot be attained

Doctrine: a rule or principle that forms the basis of a belief, theory, or policy

First responder: staff from first unit to arrive on scene of accident/incident

Goal: what you overall want to achieve

Information system: a system, usually computer based, where information can be sent

or received

Major incident: any occurrence that presents a serious threat to the health of the

community and where there are, or are likely to be, so many casualties that special arrangements are necessary to deal with

them.

Management the act of handling or controlling something successfully

Modelling: processes where functions or concepts are described and defined

Objective: a goal that can be measured.

On-line system: a technical system that presents information using a technique

where information can be seen simultaneously by several

observers

Performance indicator: the level of standard that you aim to achieve. The performance

indicator is measurable using quantitative methods.

PS-prehospital sjukvårdsledning: a training concept for command and control by prehospital

staff

Staff procedure skills: skills in important procedures of medical personnel in command

and control during a major incident

Time stamp Clocking of procedures where the time stamp is considered as the

standard

#### Abstract

The science of disaster medicine is more a descriptive than analytical type. Research, in most instances, has not employed quantitative methods and there is very sparse knowledge based on analytical statistics. One consequence of this is that similar mistakes are repeated over and over. Lessons that should be learned are merely observed.

Moreover, there are almost no practical or ethical ways in which randomised controlled studies can be performed.

The management, command and control of situations with different levels of hierarchy, has seldom been evaluated and there have been no standards against which performance can be evaluated. Furthermore, the documentation of decisions and staff work is rarely sufficient enough to evaluate command and control functions.

Setting standards that may be used as templates for evaluation and research is an issue that is constantly being addressed by leading experts in the field of disaster medicine and this is also an important issue that is expressed in the Utstein Template.

Using results from the process modelling of command and control that was performed by the Swedish National Board of Health and Welfare, templates of performance indicators were developed. These were tested on reports available from incidents, and our conclusion was that documentation in this form was not adequate enough for use in this method of evaluation. Documentation must be improved and data probably need to be captured and stored with the help of information systems.

A template developed for the evaluation of medical command and control at the scene was tested in standardised examinations. When using this template in this setting it was possible to obtain specific information on those aspects of command and control that need to be improved.

An information system using on-line Internet technique was studied twice. The first study concluded that in spite of technical disturbances the system was acceptable to the organisation but could not yet be recommended for use during major incidents. The second study concluded that the retrieval of information was, in all respects not as good as the control system, a conventional ambulance file system.

In a study of staff procedure skills during training of management staffs in command and control it was concluded that documentation during training sessions was not adequate and this lack of staff procedure skills could possibly be a contributing factor to the fact that lessons in command and control are not learned from incidents.

Conclusions in thesis are that measurable performance indicators can be used in the training of command and control. If performance indicators are to be used in real incidents and disasters, functioning information systems have to be developed. This may lead to a better knowledge of command and control and could possibly contribute to a process where lessons are learned and mistakes are not repeated.

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# 1. List of papers

This thesis is based on the following papers, which are referred to in the text by their roman numerals.

- I. **Rüter A**, Örtenwall P, Wikström T. A new system for transmission of on-line information from scene of accident and ambulances to hospitals. *International Journal of Disaster Medicine* 2003;2:127-31.
- II. **Rüter A**, Örtenwall P, Wikström T. Performance indicators for major incident medical management a possible tool for quality control? *International Journal of Disaster Medicine*. 2004:2:52-55
- III. **Rüter A,** Örtenwall P, Wikström T. Performance indicators for prehospital command and control in training of medical first responders. *International Journal of Disaster Medicine*.2004;2:89-92
- IV. **Rüter A,** Örtenwall P, Vikström T. Comparison of an on-line information system with a conventional ambulance file system regarding the retrieval of information after missions. *International Journal of Disaster Medicine* 2005;3:37-40.
- V. **Rüter A**, Örtenwall P, Vikström T. Staff procedure skills in management groups during exercise in disaster medicine. Submitted Prehospital and Disaster Medicine

#### 2. Introduction

#### Science of disaster medicine

Disaster medicine is a discipline that is generally regarded as being developed from military medicine (1,2,3,4). Although today there is no internationally accepted definition of disaster medicine, it is a general conception that disaster medicine deals with various aspects of managing situations suddenly arising where there is a lack of resources in relation to the imminent need. These situations can be classified according to type, cause and sometimes also in relation response (5,6). The term disaster is often used to describe situations where there is a great inadequacy of resources and medical treatment must deviate from the normal. It must, however, be understood that disaster medicine includes an element of human injury and/or fatality or situations where there is a threat to human life (7,8,9,10). Sometimes the term major incident is used to describe situations where resources are available but the key issue is to mobilise them to the correct place and at the right time (11).

Response to disaster situations as well as major incidents always must aim at minimising human fatalities as well as reducing the risk for both long and short-term complications. This should of course apply both for physical and psychological consequences. This basic humanitarian view makes it somewhat more difficult when evaluating effects of response using quantitative research methods (7,12). Even in disaster medicine, a scientific approach is one of the important factors when testing hypotheses, analysing results and gaining new knowledge. This has had, and will have consequences for research in a discipline where it is impossible to perform randomised trials. One consequence is that the science of disaster medicine has traditionally had more of a descriptive than analytical character (7,13). Any organisation that does not analyse results adequately runs the risk that the same mistakes will be repeated time after time. This is one of the key issues that the science of disaster medicine has tried to address and suggestions have been made how this should be dealt with (6,7,14,15,16). Furthermore, there is an increasing awareness that reports from disaster response often describe the same problem areas again and again (17). There is also a growing knowledge of shortcomings in documentation during disaster response, which makes evaluation even more difficult (7,12,18,19,20,21). When the same problems are described repeatedly, it seems that what is often regarded as lessons learned is more a question of lessons observed.

#### Theories on how to evaluate

In any medical discipline knowledge is increased by a scientific approach. The prospective randomised trial is a commonly used quantitative method. Results are expressed in numbers and differences are determined using statistical techniques. The expression of results numerically has so far been difficult in disaster medicine. There is no possibility to conduct randomised studies on the response or the management of a situation. Various aspects of performance during major incidents or disasters have therefore not been considered possible to evaluate or assess using quantitative methods (7,22).

Different methods for performance evaluation in disasters and major incidents have been addressed. The World Association for Disaster and Emergency Medicine (WADEM) has published a policy document on evaluation and research where the question of bringing a more scientific approach to disaster medicine is presented (7). Although addressing the key issues of research, there are no easy and practical guidelines in this document on how this should be done. Several other institutions and experts have developed protocols for the evaluation of disasters but so far results are sparse (14,23,24,25,26). One explanation for this could be that protocols developed may be too complicated or that they can be subject to different interpretations. Even reputable researchers have so far not shown indications on compiling with developed protocols

(27). An alternative way of evaluating performance is to set standards and develop indicators that are easily measured quantitatively. These indicators, performance indicators, must be developed so that results can be recorded, measured and assessed (7,8,28,29,30,31,32)

#### **Information support systems**

A major incident or disaster is a complex situation to manage and sometimes even difficult to identify as such at an early stage. Information as to what has happened may initially be very vague and almost always sparse (9,10,11,18,33,34,35,36,37) It is, however, in the early phase that the chance of influencing the outcome is best. Early decisions are therefore necessary even if the information available is, normally considered to be inadequate. Moreover, one must be prepared to take decisions and act upon sparse and at first seemingly insufficient information. Examples of such decisions are declaration of a major incident, and the decision to activate strategic command and control. At the same time there must be an awareness of the fact that an organisation might have to stand down, should the situation not be as severe as initially estimated. It can thus be regarded that one of the cornerstones of disaster medicine is to be able to take decisions and act on sparse information. At a later stage, when all information is at hand, it may be too late to take the decisions that could have a major impact on the outcome.

#### **On-line information systems**

Systems for transmitting data and information on-line are now being developed and tested (2,9,16,39,40,41). An on-line system is a system that uses a technique where the receiver obtains information at the same time (almost) as it is being sent. On-line information systems may use Internet, sometimes in conjunction with other systems for transmitting data. The systems being developed can be for different purposes:

- 1) transmitting patient data
- 2) sending information about the overall picture at the scene
- 3) both 1 and 2.

From a command and control perspective the last two types are more interesting. Reports from tests have shown promising results, but there is so far little evidence of their usefulness in incidents and disasters (23). One explanation for this may be that when systems do not live up to expectations, no report is published (42). One important issue that is not debated enough is to use digital techniques that allow the storage of data not only for information support, but also for evaluation purposes (9,43,44,45)

#### Management doctrine

A management doctrine may be described as a set of rules for how the management of a situation should be carried out. Sometimes a doctrine is referred to as an Incident Command System ICS, and may or may not imply legal obligations (2,9,46,47). It should describe the authority and responsibility of different organisations, persons or functions. Furthermore the doctrine should also state who is responsible for sending and receiving information and at what time this should be done. There should be only one doctrine for each emergency service and the doctrine for the different services involved must harmonise. A doctrine must also define a common terminology for all agencies involved.

For a management system to be successful there must be a doctrine that all involved functions agree on and are familiar with. The basis for a doctrine used in a major incident and disaster is that it is easy to apply and based on daily procedures and routines (49,50). Without a doctrine it is difficult to evaluate command and control during major incidents or disasters using quantitative methods. When studying reports from incidents there are often shortcomings described in the field of communication (4,10,36,50). However, a closer look reveals that these shortcomings often are doctrine issues (9).

As one consequence from a disaster that occurred, the Swedish National Board of Health and Welfare became aware that there was a lack of a national doctrine for medical services during major incidents and disasters (51). A process to develop a national doctrine was started in February 2000 using a technique of process- and concept modelling (52). The results from this were later implemented as national rules and regulations in 2005 (47). The very existence of a management doctrine, as previously mentioned, may well be a prerequisite for both using on-line information systems and using performance indicators for evaluation.

#### Daily activities must be the basis

The number of major incidents and disasters in Sweden is fairly low. Over the last decade there have been 2-3 incidents annually where the fatalities have been five or more (53). However there are no statistics regarding how often a hospital or a county council activate their disaster plan. Hopefully the newly introduced term "Allvarlig händelse" (major incident or incident that requires activation of the disaster plan) will help in forming a nationwide database for evaluation and studies. Unpublished data from one county council suggest that there could be as many as 400-500 occasions each year when a disaster plan has or should have been activated in Sweden (54).

The same terminology, management levels and functions should be applicable in minor accidents even if only a single casualty is involved (55). In other words, the same doctrine should apply in order to minimise the chance that misunderstanding occurs if a small situation proves to be more extensive than anticipated or if an alarm is underestimated. The command structure should expand if the incident expands (2,49,56). Besides this, the definition of disaster or major incident being a situation with "lack of immediate resources" could imply that there may well be a different threshold when this is applied in the future.

#### The structure in a management group

Effective command and control requires good leadership as well as skills (57). During the first 30-60 minutes the persons in medical command and control are often doctors (or nurses) who is being on call at that particular time. These individuals have to establish immediate command and control and have to make early, often, crucial decisions. It is therefore important that all persons involved in command and control at disasters both have good and updated knowledge in disaster medicine and management as well as having a good understanding of how work in an incident command room should be performed (17,50,57,58,59,60,61,62).

In a management group, be it medical command during a disaster situation or in other situations with sudden onset, work must be structured in such a way so that it benefits the key process, which is to save lives and avoid physical as well as psychological complications. (20,63). This importance of having good knowledge of how to work in an incident command room has been acknowledged by other agencies such as the rescue service and the police. This fact is also well known the armed forces (64,65,66). However, in the health care system, to my knowledge, there is no documentation about the importance of this. This may reflect lack of interest, lack of time or even a belief that there is no need for this kind of training. Regardless of the reason, a systematic approach to the evaluation of these skills could possibly lead to better understanding of what links in the medical chain of command during major incidents and disasters need to be improved.

# 3. Aims of study

The aims of this study were:

- 1) To demonstrate the possibility to use measurable performance indicators in the evaluation of management of major incidents and disasters during training.
- To demonstrate the possibility to design templates of performance indicators and use them prospectively as a quality control tool in the evaluation of major incidents and disasters.
- To demonstrate the importance of functional information systems for the retrieval of information after incidents.

The following questions were addressed:

- \* Does the information system, developed by the Swedish National Board of Health and Welfare function well enough to be used in major incidents and disasters?
- \* Does the same information system function well enough for the purpose of retrieving data stored for evaluation purposes?
- \* Can performance indicators be applied retrospectively to reports from disaster and major incidents?
- \* Can measurable performance indicators for command and control be a future quality assessment tool in disaster management?
- \* Can performance indicators be used as a standard for the evaluation of command and control in training?
- \* What are the weak and strong points of "staff work" of medical personnel groups in training?

# 4. Study design

#### Paper I

The first development phase of an on-line information system developed for disaster management was studied. The functions that had so far been developed were for the use in daily routine ambulance missions and comprised priority of mission and medical data of patients.

The system was studied regarding patient priorities and medical information. The study also focused on how much of the time the system was operational, how much it was used, how it was used and technical- as well as user related problems. The study period was two months and the timing was one year after introduction of the system.

#### Paper II

This study was designed to see if standards against which performance can be measured could be applied retrospectively to reports from major incidents. A set of standards, performance indicators, for different levels of command and control of major incidents was developed. These indicators were categorised into different templates. The indicators were time stamped and put in the order that was considered a good standard, see section on templates, I and II. The reports tested against these templates were the KAMEDO reports (Swedish Organisation for Studies and Reports from International Disasters) from incidents that had occurred in Sweden (n=13) between 1977 and 1998 (27,67). These reports, which were commissioned by the Swedish National Board of Health and Welfare, all had a scientific purpose. The study was also designed to see if there were problem areas in management of the incidents that were reported more frequently than others and if there were any improvements in later reports.

#### Paper III

A template of performance indicators previously developed for evaluation of on-scene command and control, was tested in examination of students trained as medical first responders, see section on templates, II. All examinations were performed in a standardised way in a training concept called "PS-Prehospital sjukvårdsledning", a training concept for command and control by prehospital staff (68). This concept was been developed at the Centre for Teaching and Research in Disaster Medicine and Traumatology in Linköping. The training concept comprised two days of both theoretical and practical training as well as examinations.

Results from 46 examinations were studied, involving more than 200 students from nine different medical and ambulance providers in Sweden.

#### Paper IV

The purpose of on-line information systems is twofold. First, and most obvious, is to provide timely and adequate information to different managers. The second is to store data that later can be retrieved for evaluation purposes. From a scientific perspective it is very important to evaluate and analyse what information is provided to whom and at what time. Decisions should be documented dated and stored. In Paper IV we compared retrieval of information from a conventional ambulance file-system that not is on-line, compared with an on-line information system. This study analysed the content of data stored as well as the possibility to retrieve the data. We also compared time consumption between the two systems regarding the retrieval part.

#### Paper V

This study was designed to evaluate the staff procedure skill of medical management groups during training in simulation exercise. The aim was to see if an evaluation template could serve as a quality tool for this purpose. The template was designed to indicate which skills were good and which skills needed improvement, see section on templates, III. The purpose of this test was also to evaluate the relevance of weak points in a scientific perspective of disaster medicine.

#### 5. Results and comments

Detailed descriptions of the results are given in the respective paper.

#### Paper I

# A new system for transmission of on-line information from scene of accident and ambulances to hospitals

The on-line system was primarily used for transmitting data to and from ambulances during daily routine missions. The studied version was the first that was primarily was developed for the use in daily routine. The final version, which was intended to be used as an on-line information system during major incidents and disasters, was still in the development phase. The system was a combination of an already existing technique (Mobitex®) and new (LAN and Internet).

The system was used in 75% of all missions during the study period of two months. The help desk was notified of system problems 11 times. Six of the problems were technical and five were user-related. The system was in operation during 95% of the period of study.

This study indicates that the on-line system evaluated was accepted by the organisation to a degree that could be expected one year after introduction. The system was not operational to the extent that back-up systems could be considered unnecessary.

The on-line information system studied needed more development and to be more robust before it could be tested during major incidents and disasters. However a system such as this could serve as an evaluation tool since all data were stored for later retrieval.

#### Paper II

# Performance indicators for major incident medical management – a possible tool for quality control?

By setting standards based on what could be considered good management (both regarding content and time) performance indicators were developed. The various key processes that had been translated to performance indicators were initially identified in the concept- and process modelling of major incident management commissioned by the Swedish National Board of Health and Welfare in 2000 (52).

Different sets of performance indicators to be used at different levels of command and control were designed, see section on templates I and II. These templates were tested on previously published reports from major incidents. In order to use reports that were reasonably standardised we chose the KAMEDO reports (27,67). These are issued by the Swedish National Board of Health and Welfare and have a scientific purpose. In only 25% of the indicators applied was it possible to draw conclusions as to whether performance was according to indicators or not. In these cases the objectives were met in 67%. The best result was time from first ambulance arriving to scene and first patient leaving scene. This is an important indicator since it gives an estimate of the time frame in which a functioning command and control must be established at the scene of incident as well as at the strategic level of management

Conclusions from the study were that only in 25% the templates of performance indicators could be applied retrospectively in this series of reports.

#### Paper III

# Performance indicators for prehospital command and control in training of medical first responders.

A template of performance indicators for medical first responders was used during examinations in a standardised training course. Results from this study indicates what needs to be improved in order to meet the standard set by the performance indicators for command and control by first responders on scene. The poorest results were 1) to formulate general guidelines for response, 2) to decide on the level of medical ambition, 3) the content of second report from the scene and 4) to formulate a statement for the media (Table I).

Table I.

Proposed performance indicators and average score of 46 examinations in Prehospital Management. Score could be 0=not acceptable, 1= not completely or 2=completely correct

Activity	Objective/goal to be achieved	Average
	all times are from when arriving on scene	Score
1. Putting on tabard indicating medical	Immediately	1.91
and ambulance incident officer.		
2. First report to dispatch centre	Within 2 minutes	1.96
3. Correct content of first report	METHANE*	1.57
4. Formulate guidelines for response	Within 3 minutes	1.20
5. Establishing contact with strategic	Within 5 minutes	
level of command and control		1.52
6. Liaison with fire and police	Within 5 minutes	
incident officers on scene		1.93
7. Second report from scene	Within 10 minutes	1.70
(to strategic management)		
8. Correct content of report	Verifying first report and indicating	
	when first patient transport can take place	1.15
9. Establishing level of medical	Within 10 minutes	
ambition.		1.24
10. First patient evacuated	Within 15 minutes	1.52
11. Information to media on scene	Within 30 minutes	1.33

<sup>\*</sup> Major Incident Medical Management and Support (11).

The first two results were no surprise, but rather demonstrated the difficulty to make and communicate general decisions in an unfamiliar situation. More training emphasising the importance of these two decisions is needed. The third result, the content of the second report indicates that there is a discrepancy between what the medical management on the scene believes is important to report, and the information required by the strategic management. Future implementation of these performance indicators will probably demonstrate their validity.

#### Paper IV

# Comparison of an on-line information system with a conventional ambulance file system regarding the retrieval of information after missions

As a prospective study, two different systems for storing data from routine ambulance missions were compared. One system was a conventional ambulance file system developed regionally from an Oracle base. The other was an on-line system previously tested regarding reliability and acceptance in the organisation. Both organisations employing these systems were notified in advance about the time, purpose and design of the study. The major difference between two systems studied was that the ambulance file system could not be used for sending messages to ambulances and that all data were recorded at the end of the mission. Sending messages to ambulances was instead done via telephone but the content of this communication was not recorded or logged, only the time at which the call was made. In all aspects studied the ambulance file system was better for the registration and well as for retrieval of information (Table II). The time required for retrieval of information was 25.5 and 3 hours respectively.

Table II.

Comparison of retrievable information regarding of number, priority of ambulance missions and registration of main symptom in two different systems of registration during a 4-week period.

Type of registration		On-line system	Ambulance file system	
Number of mission	IS-	2862	2018	
registered by dispa	tch			
Registration of priority				
	out	2778 (97%)	2018 (100%)	p<0.005
	in	2608 (93%)	1992 (99%)	p<0.005
Main symptom		967 (37%)	1285 (64%)	p<0.005

Our conclusion was that the on-line system was not technically developed enough to serve as a tool for evaluation if had it been used during major incidents and disasters.

#### Paper V

#### Staff procedure skills in management groups during exercise in disaster medicine

Forty-four different management groups were tested during simulation exercises in their ability to work in a structural way. A template defining what was considered good standard was used, see section on templates, III. All groups prior to the test had received information on both performance indicators as well as the staff procedure skills.

Results show the introduction of a new member as he/she arrives to be the weak point followed by writer summary of actions (Table III).

Table III.

Scoring of results according to template in staff procedure skills in 44 different training sessions in disaster management. Achieved results on each indicator given 0,1 or 2 points. Average score for each indicator is presented.

Performance indicator	Average score
Assigning functions to all staff-	
members directly upon arrival	1.66
Placement in room according to function	1.73
Designated telephone numbers	1.32
Introduction of newly arrived staff member	
maximum 1 minute	0.94
Utilisation of available equipment*	1.69
Max. 8 minutes for "staff briefing"	1.50
Content of "staff briefing"¤	1.42
Telephone discipline during staff briefing	1.34
Drawing and content of "staff schedule"	1.22
Summary after session, verbally	1.20
Summary after session, written	1.07
Average total score (out of maximum 22)	15.1

<sup>\*</sup> Equipment available: Whiteboard, flipchart, fax, computer

Although this was a training situation, the results indicate that poor documentation could be one reason why there are difficulties in evaluating performance of command and control at different levels during major incidents. Furthermore, it is not likely that performance is better during a real situation compared to an exercise. More training of staff procedure skills is needed. Information support systems that are easy to handle could possibly contribute to a better outcome in this respect.

<sup>¤</sup> Reports from all functions, summarising, assigning new tasks, time for next briefing

## 6. Statistical methods

#### Papers I and II.

Descriptive statistics.

#### Paper III

The statistical method used was a two-way variance analysis, Tukey comparison in pairs. The program used for calculation was Minitab version 13, Minitab Inc®, <a href="www.minitab.com">www.minitab.com</a> Adjusted p<0.05 was considered significant.

#### Paper IV

The statistical method used was Fisher's exact test. P < 0.05 was considered as significant.

#### Paper V

The statistical method used was three-way analysis of variance with performance indicator and training session (first, second and third) as fixed factors and simulation exercise as a random factor nested within training session. Training sessions were compared pair-wise with the Bonferroni procedure and indicators were compared pair-wise with the Tukey procedure. Significance in the pair-wise tests was considered when adjusted p<0.05.

#### 7. General discussion

#### **Setting standards**

Disaster medicine as a science is more descriptive than analytical (7,13). One reason for this is that not enough quantitative analysis is performed. If this were done, it would be easier to set standards and compare results (7,22). This has so far been difficult to do in disaster medicine while in all other fields of medicine this is well established.

A disaster or major incident is a situation where initially not all activity is under control. This, however, must not be an excuse not to develop standards for use when evaluating performance during incidents and disasters including also the initial phase, during which many of crucial decisions have to be made. Analysis and comparison of results in the search for improvement may come to be a factor that establishes disaster medicine as a science on the same level as other fields of medical science.

#### **Development of performance indicators**

The development of performance indicators for setting standards is one way of approaching the issue of expressing results numerically. Different methods can be used when developing these. The method presented in this thesis is the identification of the key processes as a foundation on which to develop standards. In this thesis I have shown that standard may be extracted from results of process- and concept modelling. In this case this was done on a national basis by the Swedish National Board of Health and Welfare (52). One result of this modelling was a functional description of all processes involved in the medical management of major incidents and disasters. Furthermore, all involved processes were linked and their sequential relations to each other were established and described. By extracting the key processes it was possible to build up the different performance indicators that were put into templates. The importance of the time factor in a situation of command and control was approached by the use of clocking (time stamps) (69). The different clocking times were derived from the results of studying incidents that had occurred and from focusing on the patient perspective.

In all incidents involving injured people it is a recognised fact that the patient should be transported to the correct facility as quickly (and adequately stabilised) as possible (70,71). This is a fact based on the physiological response to trauma and is well accepted. In most trauma literature this is described as the "Golden hour". Subsequently the performance indicator that serves as a base for all other indicators in the process of time clocking was the time of evacuation of the first patient from the scene of incident. The rest of the indicators that were time clocked following on from this.

It must be understood that it may not always be possible to meet the standards set by the performance indicators. This also applies as well for all other issues in the medical field and as long as it is understood that the indicators are not used to find scapegoats but rather ways to create improvement, this must not refrain us from implementation. The templates of performance indicators used in thesis are presented in chapter 8.

#### The application of performance indicators retrospectively

After studying a series of well-reputed reports from 13 different major incidents we found that the result of applying performance indicators to retrospective material will not serve as a base for quantitative research. Paper II. The information in reports from major incidents is sometimes collected and presented for purposes other than evaluation. Performance indicators are therefore best used as prospective templates were evaluators or persons studying management are trained in how and when to use them. Moreover, there must be an acceptance both for the method as well as the proposed standards set in the performance indicators.

#### Start with training of staff

If performance indicators are to be used in the future one way of testing this is to start in training situations. In <u>Paper III</u> we demonstrated that the developed template could not only be used at the centre where it was developed, but also at other institutions and by several other instructors. None of these had previously come into contact with this way of evaluating results, but even so were able to use the indicators after brief training. The implications of this may be that possible future evaluations of real incidents where performance indicators are used may not be difficult.

The results in <u>Paper III</u> also show what aspects of prehospital command and control need to be improved. These areas are well defined and the process of improving training can commence. Using this method it is possible to be more specific than just describing shortcomings such as "problems in command and control".

All training in disaster medicine should include this technique where possible. One important factor is to ensure that indicators from different training programmes are compatible. If not, this may lead to the concept as a whole being rejected.

#### Implementation of performance indicators in real incidents

The aim of introducing performance indicators is to improve patient management during major incidents and disasters not just in training situations. However, use in the training and examination situation should be considered the first step in the process of implementation in real incidents. But, there are certain criteria that must be met before this can be done. The first is that this technique is wanted as a quality tool. By this we mean that organisations want to be evaluated in a way that can be expressed in figures and compared from time to time and between different organisations. The process of establishing acceptance of performance indicators as a quality tool has not been addressed in this thesis.

#### Documentation

A great challenge is to ensure that in stressful situations there is adequate documentation regarding, decisions made, reports and other important issues. This documentation must be retrievable for evaluation purposes. No medical management or command and control persons will probably ever consider this aspect so important that it takes resources from command and control per se. The rationale for this is disputed and we believe that other solutions to this issue must be found. Documentation for evaluation purposes is, however, crucial. And must include all decisions made, when they were made as well as by whom. When evaluating management performance in a major incident data must be available and preferably recorded in a way that evaluation can be performed without delay. Trying to reconstruct information afterwards is not considered to be reliable enough.

The process of documentation should be structural, templates should be used and action cards where measures performed are easy to record must be developed and tested in simulation exercises. In order to facilitate this process there should also be a structure that management can follow. This may be called staff procedure skills and is something that is usually not taught during training in the medical professions.

By using a template of performance indicators for staff procedure skills we were in <u>Paper V</u> able to demonstrate strong and weak points of these skills during simulations exercises. The weak points deserve consideration since one of them was the documentation process, previously described as being of crucial importance. In spite of emphasis on the importance of this, and in spite of showing the indicators beforehand, this was a significant weak point. One of the key elements in making proper evaluation can be missed if there is no understanding of the importance of documentation. We also demonstrated that the staff procedure skills could be improved by repeated training. More education in this field is

needed as well as testing in real incidents. Perhaps better technical solutions such as information systems could increase the results.

#### **Information systems**

The development of information systems has started and there are several products available (2,9,16,39,40,41). Some of them use digital radio transmission while others use on-line Internet with or without local area nets. However, if anyone is expected to work during a major incident or disaster using technical systems he/she must be familiar with them from daily work. Systems must be designed to be functional in routine work but can to be escalated in the case of major incidents. The process of introducing such a new information system is described in <a href="Paper I">Paper I</a>, where we also conclude that the system tested was not reliable enough and needed more development. Although it had only been in operation for approximately one year, the system looked, however promising.

#### Retrieval of information for evaluation purposes

Even if it is sophisticated, functional and easy to handle, a system that is solely used on-line has its limitations. It cannot be used for evaluation purposes unless data is stored in a way that retrieval of information is possible and easy. If standards such as performance indicators have been implemented, it is easy to have these incorporated into the information systems. Not only retrieval of data would be possible, but it could also indicate where standards are met or not. This would be no different to when laboratory results are presented to the referring physician where unexpected or abnormal results are indicated.

In <u>Paper IV</u> we compared a conventional ambulance file system that had been operative for several years with a newly developed Internet-based on-line system. The results showed that the conventional system was better in all aspects studied as well as that of the retrieval of data. This is not acceptable if a system like the one tested is to be used during major incidents. More development in this field is needed and more concern should be paid to the fact that the evaluation of performances could very well be the most important aspect of disaster management.

#### **Future studies**

Validation of performance indicators must be started. This could be done by implementing indicators and relate the results to patient outcome.

Further development of information systems with respect to on-line information as well as evaluation must continue.

Performance indicators should be built into these systems in order to facilitate evaluation processes so that performance during major incidents and disaster directly can be compared to set standards.

#### **Conclusions**

In this thesis it is concluded that:

- Measurable performance indicators can be used in the training of management, command and control at different levels of major incidents and disaster.
- Performance indicators could provide an important tool for creating standards and comparing results.
- Functional and easy to handle on-line information systems may well play an important part in the evaluation of management in major incidents and disasters.

# 8. Templates of performance indicators

Template I. Strategic management

Activity Objective, goal to be achieved
All times indicate time when alarm was received

1. Declaring major incident Within 1 minute 2. Deciding level of preparedness for Within 3 minutes

strategic management

3. Deciding what additional\* resources Within 3 minutes

need to be sent to scene

4. Deciding which hospitals should Within 5 minutes

receive patients from incident

5. Establishing contact with incident Within 5 minutes

officers on scene

6. Decide on guidelines for referring Within 10 minutes

patients to hospitals

7. Notify above guidelines to hospitals Within 30 minutes

designated to receive patients

8. Formulate general guidelines, in Within 15 minutes

in accordance with guidelines from scene,

for the medical response.

9. Inform the media Within 15 minutes

<sup>\*</sup> For this particular incident resources that are additional to what is specified in plans.

#### Template II.

#### Prehospital command and control

Performance indicator

#### **Activity**

Objective, goal to be achieved
All time stamps indicate time from first
ambulance arriving on-scene

- 1. Putting on tabard indicating medical and ambulance incident officer.
- 2. First report to dispatch centre3. Correct content of first report
- 4. Formulate guidelines for response
- 5. Establishing contact with strategic level of command and control
- 6. Liaison with fire and police incident officers on scene
- 7. Second report from scene (to level of command and control)
- 8. Correct content of report
- 9. Establishing level of medical ambition.
- 10. First patient evacuated
- 11. Information to media on scene

Immediately

Within 2 minute METHANE\* Within 3 minutes Within 5 minutes

Within 5 minutes

Within 10 minutes

Verifying first report and indicating when first patient transport can take place
Within 10 minutes

Within 15 minutes Within 30 minutes

#### Template III.

#### Staff procedure skills

Performance indicator

- 1) Assigning functions to all staff members directly upon arrival
- 2) Placement in room according to function in staff
- 3) Designated telephone numbers
- 4) Introduction of newly arrived staff member, maximum 1 minute
- 5) Utilisation of available equipment\*
- 6) Max. 8 minutes for "staff briefing"
- 7) Content of "staff briefing"¤
- 8) Telephone discipline during staff briefing
- 9) Drawing and content of "staff schedule"
- 10) Summary after session, orally
- 11) Summary after session, written

<sup>\*</sup> Major Incident Medical Management and Support (11).

<sup>\*</sup> Equipment available: Whiteboard, flipchart, fax, and/or computer.

<sup>¤</sup> Reports from all functions, summarising, assigning new tasks, time for next briefing

# 9. Summary in Swedish

#### Populärvetenskaplig sammanfattning på svenska.

Avhandlingen handlar översiktligt om att förbättra möjligheterna till att leda sjukvården vid olyckor och katastrofer. Hypotesen är att påvisa en anledning att samma ledningsrelaterade problem upprepas vid stora olyckor och katastrofer samt att ge ett förslag på hur denna situation kan förbättras. Genom att visa att det går att mäta resultat av ledningsarbete med jämförbara siffror, kan det skapas möjligheter att på ett mera exakt sätt kvalitetssäkra katastrofmedicinsk ledning. Detta synsätt har huvudsakligen hämtats från ett dokument utgivet av den katastrofmedicinska världsorganisationen (WADEM). Detta dokument heter "the Utstein template" och undertecknades av en stor del av världens katastrofmedicinska expertis. En förutsättning är att det sannolikt behöver utvecklas informations system, dels som beslutsstöd under händelser men även syftande till att göra information tillgänglig i efterhand för att kunna utvärdera insatser. Dessa system måste bygga på on-line teknik, dvs. inmatade uppgifter måste vara direkt tillgängliga och det måste gå att uthämta inmatad data i utvärderingssyfte.

I <u>arbete I</u> diskuteras användandet av ett informationssystem som tagits fram för att kunna stödja ledningen vid olyckor och katastrofer. Denna första version av detta system var huvudsakligen avsett för att användas i dagligt arbete av ambulanspersonal. Studien gjordes ett år efter introduktionen och avsåg att belysa användandet och driftsäkerheten. Dessa var uppbyggda kring mobitex® -och Internet teknik. Resultaten visade att systemet behöver utvecklas innan det kan anses tillräckligt driftsäkert för att användas vid katastrofer.

I <u>arbete II</u> studerades möjligheten att använda framtagna kvalitetsindikatorer för att utvärdera genomförda insatser. De indikatorer som testades var utvecklade vid Katastrofmedicinskt Centrum och angav både vad som skulle mätas samt vilken standard som kan anses vara bra. Underlaget hämtades från resultaten av de ledningsmodelleringar som Socialstyrelsen låtit utföra med hjälp av en nationell expertgrupp. De rapporter som testades var utförda på uppdrag av Socialstyrelsen, alla utförda med ett vetenskapligt syfte. Resultaten visade att det inte gick att använda de framtagna mallarna i någon större utsträckning utan att det bästa sättet är att tillämpa dessa prospektivt, dvs. kvalitetsindikatorerna ska finnas i mallar som ska utgöra ledstjärnan vid utvärdering av ledningen vid olika insatser.

I <u>arbete III</u> studerades de indikatorer som var framtagna för att ange standard av sjukvårdens skadeområdesledning vid såväl dagligt förekommande olyckor som vid katastrofer. Indikatorerna testades i samband med examination av befattningshavare som genomgått en standardiserad utbildning. Resultaten visade att under dessa förutsättningar gick det bra att använda de framtagna mallarna av kvalitetsindikatorer och att det dessutom gick att peka ut de specificerade ledningsfrågorna som behövde förbättras.

I <u>arbete IV</u> studerade möjligheten att på ett enkelt sätt få fram data ur ett informationssystem att användas i utvärderingssyfte. Samma system som studerats i arbete I valdes eftersom det var det enda tillgängliga on-line systemet. Som kontroll valdes ett ambulansjournal system, vilket idag är det vanligaste sättet att registrera uppgifter från ambulanser i Sverige. Resultaten visade att ambulansjournal systemet på alla punkter var bättre än det andra systemet och slutsatserna blev att om ett on-line system ska användas så måste detta utvecklas ytterligare.

<u>Arbete V</u> syftade till att testa framtagna kvalitetsindikatorer för hur en stab bör arbeta under övningssituation. Hypotesen var att en förutsättning för ett bra ledningsarbete är att själva stabsarbetet utförs systematisk och välorganiserat i en sjukvårdsledning. Resultaten visade att de områden där förbättringar behövs gäller introduktion av nya stabsmedlemmar samt dokumentationen efter genomförd insats. Användbara informationssystem kan vara en avlösningen till att ovan ska förbättras, vilket är en förutsättning för en kvalitetssäkrad utvärdering av ledningsarbetet.

#### I avhandlingen konkluderas:

- Mätbara kvalitetsindikatorer kan användas i samband med katastrofmedicinsk lednings utbildning.
- Kvalitetsindikatorer kan komma att utgöra en viktig komponent för att skapa standarder och därmed möjlighet att jämföra resultat av katastrofmedicinsk ledning.
- Funktionella och användarvänliga on-line informationssystem kommer att spela en viktig roll för fortsatt utveckling av katastrofmedicinsk ledningsmetodik.

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